Singapore Renal Registry
Annual Report 2020

National Registry of Diseases Office

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Acknowledgement

This report was produced with joint effort from the following staff of Health Promotion Board.

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1. GLOSSARY

ASIR	Age-standardised incidence rate
ASPR	Age-standardised prevalence rate
Ca	Calcium
CKD5	Chronic kidney disease stage 5
CIR	Crude incidence rate
CPR	Crude prevalence rate
CVD	Cerebrovascular disease
DN	Diabetic nephropathy
eGFR	Estimated glomerular filtration rate
ESA	Erythropoietin stimulating agent
IHD	Ischemic heart disease
Kt/V	Fractional clearance of urea
GN	Glomerulonephritis
HD	Haemodialysis
hb	Haemoglobin
iPTH	Intact parathyroid hormone
PD	Peritoneal dialysis
pmp	Per million population
PO_4	Phosphate
PVD	Peripheral vascular disease
SRR	Singapore Renal Registry
URR	Urea reduction ratio
VWO	Voluntary Welfare Organisation

2. EXECUTIVE SUMMARY

The crude incidence rate (CIR) of chronic kidney disease stage 5 (CKD5) increased significantly from 418.6 per million population (pmp) in 2011 to 516.4 pmp in 2019. While the age-standardised incidence rate (ASIR) of CKD5 remained relatively stable at between 266.7 pmp and 295.3 pmp in 2011 to 2019, the ASIR of definitive dialysis increased significantly from 169.6 pmp in 2011 to 187.3 pmp in 2020. The age-standardised prevalence rate (ASPR) of definitive dialysis also increased significantly from 919.2 pmp in 2011 to 1132.0 pmp in 2020.

Males outnumbered females in both the incidence and prevalence rates of dialysis. In 2020, the ASIR was 229.9 pmp for males and 148.2 pmp for females, while the ASPR was 1333.3 pmp for males and 947.2 pmp for females. The incidence and prevalence rates of dialysis were higher among Malays than Chinese and Indians. In 2020, the ASIR was 148.5 pmp for Chinese, 455.2 pmp for Malays and 192.3 pmp for Indians, while the ASPR was 887.8 pmp for Chinese, 2894.7 pmp for Malays and 1133.8 pmp for Indians. Most of the dialysis patients were on haemodialysis (HD). 81.6% of the new patients and 86.8% of the prevalent patients were on HD in 2020. Diabetic nephropathy (DN) was the main cause of CKD5 among dialysis patients. 67.8% of the new patients and 56.0% of the prevalent patients had DN in 2020.

Cardiac event and infection were the two most common causes of death among prevalent dialysis patients. 39.6% of the deaths in 2020 were due to cardiac event, while 25.7% were due to infection. After adjusting for demographics, etiology and co-morbidities, the risk of death was 1.5 times higher for patients on peritoneal dialysis (PD) compared to those on HD. This is mainly because patients who were older and/or with medical conditions (besides the co-morbidities captured by the Singapore Renal Registry) were preferentially placed on PD, a gentler therapy than HD. However, the disparity in survival between HD and PD narrowed over the years as the survival among HD patients remained stable while it significantly improved among PD patients.

The management of prevalent dialysis patients was assessed based on several criteria: frequency of dialysis, management of urea, management of anaemia, and management of mineral and bone disease. 97.0% of the HD patients had thrice weekly dialysis in 2020. Urea was well managed in 97.1% of the HD patients and 41.4% of the PD patients based on their urea reduction ratio or fractional clearance of urea in 2020. Anaemia was well managed in 77.0% of the HD patients and 61.9% of the PD patients based on their haemoglobin level in 2020. Bone metabolism was well managed in 74.4%, 58.5% and 29.8% of the HD patients and 62.4%, 51.9% and 28.1% of the PD patients based on their calcium level, phosphate level and intact parathyroid hormone level respectively in 2020.

Prior to 2014, the ASIR of kidney transplants fluctuated year-on-year. Subsequently, there was an upward trend from 2014 to 2017, followed by a downward trend from 2017 to 2020, with the sharpest drop from 18.3 pmp in 2019 to 10.4 pmp in 2020. However, the ASPR of kidney transplants remained relatively stable at between 258.9 pmp and 271.1 pmp in the past decade, with a slight dip in 2020.

Males outnumbered females in both the incidence and prevalence rates of kidney transplant. In 2020, the ASIR was 11.3 pmp for males and 9.6 pmp for females, while the ASPR was 281.6 pmp for males and 238.0 pmp for females. There was no consistent ethnic difference in the incidence rate of transplant, but Chinese had the highest prevalence rate of transplant. In 2020, the ASIR was 9.8 pmp for Chinese, 13.8 pmp for Malays and 8.5 pmp for Indians, while the ASPR was 261.5 pmp for Chinese, 244.2 pmp for Malays and 215.7 pmp for Indians. Most of the transplants were performed locally. 92.0% of the transplants done in 2020 were performed in Singapore. Glomerulonephritis (GN) was the main cause of CKD5 among transplant patients. 46.0% of the new patients and 66.7% of the prevalent transplant patients had GN in 2020.

Patients with kidney transplants from living donors had better survival (5-year graft survival = 93.8%, 5-year patient survival = 96.2%) than those with kidney transplants from deceased donors (5-year graft survival = 86.2%, 5-year patient survival = 91.8%). After adjusting for demographics, etiology and co-morbidities, the risk of death was lower for patients who had undergone transplant, be it from living or deceased donor, than those who were on dialysis.

3. INTRODUCTION

Chronic kidney disease (CKD) is a worldwide epidemic[1], with diabetes as its leading cause. Based on the National Population Health Survey 2020, about 1 in 10 Singapore residents have diabetes[2]. Our ageing population further compounds the situation in Singapore as decline in kidney function tends to rise with age[3].

Estimated glomerular filtration rate (eGFR; glomerular filtration rate corrected to body surface area of 1.73m^2) is one of the markers of kidney damage. Internationally, CKD is defined as eGFR <60 mL/min/1.73m^2. There are five stages of CKD. This report focuses on CKD5, the most severe stage of kidney failure, whereby the eGFR is <15 ml/min/1.73m^2 on at least two occasions >90 days apart. CKD5 patients may undergo dialysis, kidney transplant or conservative management after discussion with their doctor. This report focuses on CKD5 patients who were on renal replacement therapy (i.e. dialysis or kidney transplant). There are two main modalities of dialysis: HD and PD. Older patients and/or those with medical conditions (besides the co-morbidities captured by the Singapore Renal Registry) were preferentially placed on PD, which is a gentler therapy compared to HD.

[1] Mallamaci F. Highlights of the 2015 ERA-EDTA congress: chronic kidney disease, hypertension. Nephrology Dialysis Transplant. 2016; 31(7): 1044-1046.
[2] National Population Health Survey 2020. Ministry of Health, Singapore.
[3] Ayodele OE and Alebiosu CO. Burden of chronic kidney disease: an international perspective. Advanced Chronic Kidney Disease. 2010; 17(3): 215-224.

4. METHODOLOGY

The National Registry of Diseases Office collects and analyses epidemiological data to support policy planning and programme evaluation.

In most renal registries, only patients who initiated dialysis are captured[4]. There are also others, such as the United States Renal Data System[5], which capture only patients who survived >90 days after initiation on dialysis. However, these registries may underestimate the burden of kidney failure in the country and the workload of healthcare professionals. As such, the Singapore Renal Registry (SRR) captures patients with CKD5, regardless whether they have initiated dialysis or survived >90 days after initiation of dialysis.

In 2007, the Singapore General Hospital started to provide the SRR their list of patients with eGFR <15 ml/min/1.73m^2. This practice was followed by the National University Hospital in 2009 and the remaining healthcare institutions in 2010, after legislation mandating notification of CKD5 from all healthcare institutions was put in place by the Ministry of Health.

<u>Data sources</u>

The SRR receives CKD5 case notifications from the public hospitals, dialysis centres, private nephrology clinics, kidney transplant centres and the National Organ Transplant Unit.

From 1999 to 2009, case finding for CKD5 was guided by serum creatinine ≥10 mg/dl or ≥880 μmol/L, or initiation of renal replacement therapy. Since 2010, to ensure that case coverage is as comprehensive as possible, the guiding principle was subsequently changed to serum creatinine ≥500 μmol/L, eGFR <15 ml/min/1.73m^2, or initiation of renal replacement therapy. Once a potential CKD5 case is identified, the SRR monitors the patient's eGFR readings for at least six months before accepting the case as CKD5. The monitoring period is to let the eGFR readings stabilise over a period for accurate case ascertainment and to rule out the possibility of acute kidney impairment. This is in accordance with the Kidney Disease Outcomes Quality Initiative guidelines[6].

The registry coordinators confirm the diagnosis of CKD5 by viewing the patients' medical records, before extracting relevant detailed clinical information from there.

For this report, the death status of all patients registered in the SRR were updated till 31 March 2021 by matching the patients' unique National Registration Identity Card number with information from the Death Registry.

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[4] Liu FX, Rutherford P, Smoyer-Tomic K, Prichard S, Laplante S. A global overview of renal registries: a systematic review. BMC Nephrology. 2015; 16: 31.
[5] United States Renal Data System (USRDS). www.usrds.org Accessed on 1 Mar 2021.
[6] Chronic Kidney Disease: Evaluation, Classification, and Stratification 2002. National Kidney Foundation, New York.

Population estimates

The Singapore population estimates used to calculate the incidence rates and prevalence rates in this report were obtained from the Singapore Department of Statistics, which releases mid-year population estimates of Singapore residents (i.e. Singapore citizens and permanent residents) annually[7]. The Segi World population estimates used for age standardisation are available on the World Health Organisation website[8].

This report focuses on Singapore residents with CKD5 and underwent dialysis or kidney transplant in 2011 to 2020, as they stood on 14 July 2021. Statistics on prevalence and survival included patients since the start of the SRR in 1999. Detailed definition of each indicator is elaborated at the start of each section of this report.

[7] SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore. www.tablebuilder.singstat.gov.sg Accessed on 1 Mar 2021.
[8] Omar BA et al. Age standardization of rates: a new WHO standard. GPE discussion paper series: no. 31. EIP.GPE/EBD World Health Organization 2001.

5. FINDINGS

5.1 Overview of dialysis and transplant

Table 5.1.1 shows the stock and flow of patients in the past five years - 2016 to 2020. The number of new dialysis patients, deaths among dialysis patients, and prevalent dialysis patients generally increased over the years. However, the number of new kidney transplant patients, deaths among transplant patients, and prevalent transplant patients decreased in 2020, compared to the numbers in 2019.

Table 5.1.1: Stock and flow in 2016 – 2020

	2016	2017	2018	2019	2020
Incidence					
Definitive dialysis	1170	1174	1255	1207	1328
Transplant	97	115	114	105	50
Death					
Definitive dialysis	800	879	915	907	957
Transplant	26	20	39	33	30
Prevalence					
Definitive dialysis	6672	7006	7406	7763	8211
Transplant	1503	1568	1602	1618	1609

All dialysis and transplant patients are tracked by the SRR at the end of every year as part of the year-end follow-up monitoring. Patients can be followed up for dialysis or consultation with nephrologist, and the prevalence numbers in Table 5.1.2 were based on the last follow-up visit for each patient.

Not only are HD patients followed up by their nephrologists in the restructured hospital (RH)[9], they also have routine follow-up at the dialysis centre, where they go for their regular dialysis. In 2020, the majority of the prevalent HD patients were last followed up at dialysis centres run by the Voluntary Welfare Organisations (VWO, 61.2%), followed by the private clinics and dialysis centres (37.2%), then the public hospitals and affiliated dialysis centres (1.6%).

On the other hand, as PD is done at home, follow-up among PD patients is typically for consultation with their nephrologists, where PD was initiated. Almost all the prevalent PD patients (99.4%) were last followed up at the public hospitals and affiliated dialysis centres in 2020.

Similarly, follow-up among transplant patients is typically for consultation with their nephrologists, where transplant was done. Almost all the prevalent transplant patients (90.9%) were followed up at the public hospitals and affiliated dialysis centres in 2020.

Detailed breakdown of the prevalent patients by service providers is shown in the Annex.

[9] Patients on HD routinely follow up with a primary nephrologist at the Specialist Outpatient Clinics (SOC) in the RH once every 4-6 months.

Table 5.1.2: Prevalent patients as at 31 December 2020

	HD		PD		Transplant	
	Number	%	Number	%	Number	%
Public hospitals and affiliated dialysis centres	116	1.6	1080	99.4	1462	90.9
Dialysis centres under Voluntary Welfare Organisations	4362	61.2	0	0.0	0	0.0
Private clinics and dialysis centres	2647	37.2	6	0.6	147	9.1
Overseas	0	0.0	0	0.0	0	0.0
Total	7125	100.0	1086	100.0	1609	100.0

5.2 Incidence of CKD5

The incidence rate in each year was calculated by taking the number of new CKD5 patients in a year, divided by the number of Singapore residents in the same year. The count was based on the diagnosis date of CKD5. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

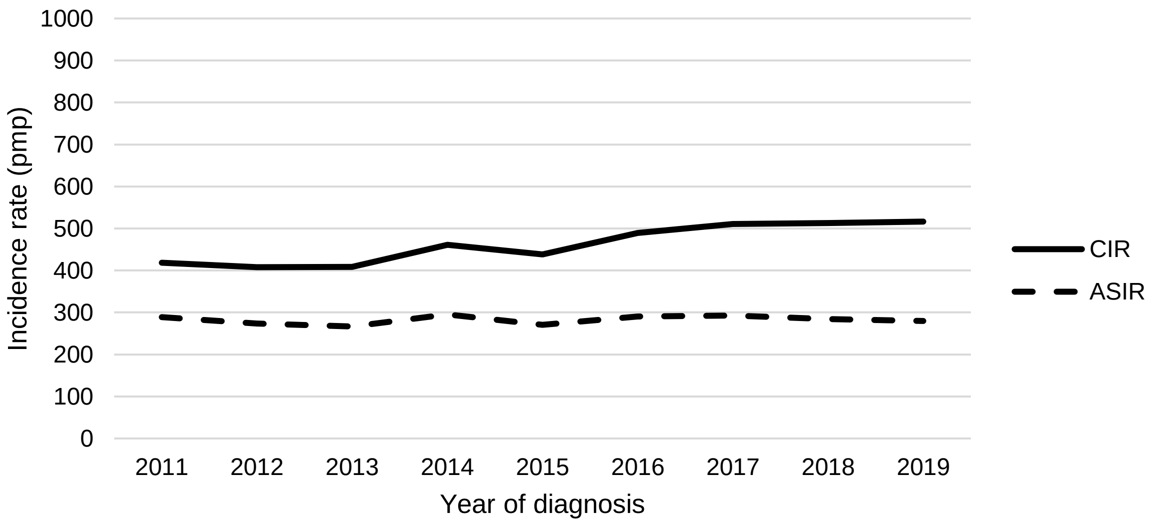
As the registry monitors the patient's eGFR readings for at least six months before accepting a case as CKD5 to allow for accurate case ascertainment, all statistics related to new CKD5 patients for 2020 are not shown in this section.

The number of new patients diagnosed with CKD5 increased from 1,586 in 2011 to 2,079 in 2019 (Table 5.2.1 and Figure 5.2.1). Correspondingly, the CIR increased significantly from 418.6 pmp in 2011 to 516.4 pmp in 2019 ($p<0.001$). However, the ASIR remained relatively stable at between 266.7 pmp and 295.3 pmp during the same period. The stable ASIR trend in relation to the significant rise in CIR suggests that the rise in CIR was driven mainly by Singapore's ageing population.

Table 5.2.1: Incidence number and rate (pmp) of CKD5

Year of diagnosis	Number	CIR	ASIR
2011	1586	418.6	288.7
2012	1557	407.8	274.0
2013	1570	408.4	266.7
2014	1786	461.4	295.3
2015	1711	438.4	270.3
2016	1924	489.1	290.8
2017	2026	510.9	292.8
2018	2050	513.2	284.5
2019	2079	516.4	280.1
P for trend	-	<0.001	0.602

Figure 5.2.1: Incidence rate (pmp) of CKD5



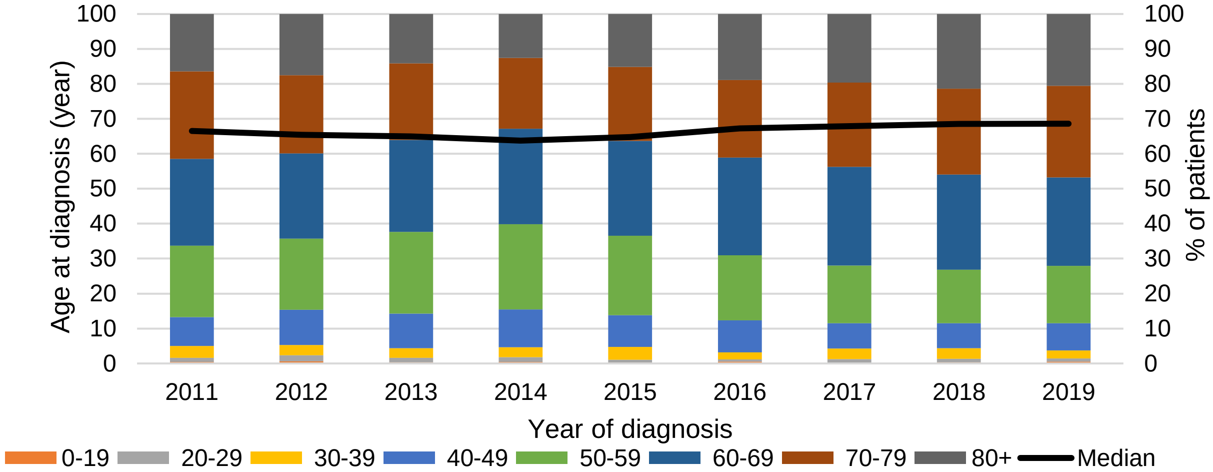
The majority of the new CKD5 patients were aged 60 years or older, with about 7 in 10 of the patients in this age group in 2019 (Table 5.2.2).

Table 5.2.2: Age distribution (%) and age-specific incidence rate (pmp) of CKD5

Year of diagnosis	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	7	0.4	7.8	19	1.2	36.7	54	3.4	88.0	131	8.3	207.7
2012	10	0.6	11.3	26	1.7	50.1	46	3.0	75.5	157	10.1	249.3
2013	5	0.3	5.7	21	1.3	40.2	43	2.7	71.4	155	9.9	246.5
2014	8	0.4	9.4	24	1.3	45.3	51	2.9	85.8	193	10.8	309.0
2015	5	0.3	5.9	14	0.8	26.2	62	3.6	104.8	156	9.1	251.5
2016	10	0.5	12.0	12	0.6	22.2	39	2.0	66.4	176	9.1	286.4
2017	4	0.2	4.8	22	1.1	40.1	61	3.0	105.1	146	7.2	237.4
2018	6	0.3	7.3	21	1.0	38.4	63	3.1	107.7	146	7.1	238.8
2019	11	0.5	13.5	18	0.9	33.5	48	2.3	80.8	162	7.8	264.5
P for trend	-	-	0.801	-	-	0.380	-	-	0.403	-	-	0.475
Year of diagnosis	**Age 50-59**			**Age 60-69**			**Age 70-79**			**Age 80+**		
	Number	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**
2011	323	20.4	568.1	394	24.8	1229.3	398	25.1	2384.7	260	16.4	3551.9
2012	317	20.4	544.5	380	24.4	1108.5	348	22.4	2023.3	273	17.5	3518.0
2013	367	23.4	617.9	413	26.3	1122.0	344	21.9	1953.4	222	14.1	2704.0
2014	436	24.4	722.0	487	27.3	1240.1	363	20.3	1982.4	224	12.5	2566.0
2015	389	22.7	637.5	464	27.1	1097.1	362	21.2	1969.1	259	15.1	2771.6
2016	359	18.7	583.6	537	27.9	1193.7	427	22.2	2226.8	364	18.9	3721.9
2017	335	16.5	545.2	571	28.2	1223.7	489	24.1	2312.6	398	19.6	3929.9
2018	314	15.3	511.9	559	27.3	1155.5	503	24.5	2197.7	438	21.4	4098.1
2019	341	16.4	560.4	526	25.3	1051.7	546	26.3	2231.1	427	20.5	3692.0
P for trend	-	-	0.416	-	-	0.458	-	-	0.495	-	-	0.223

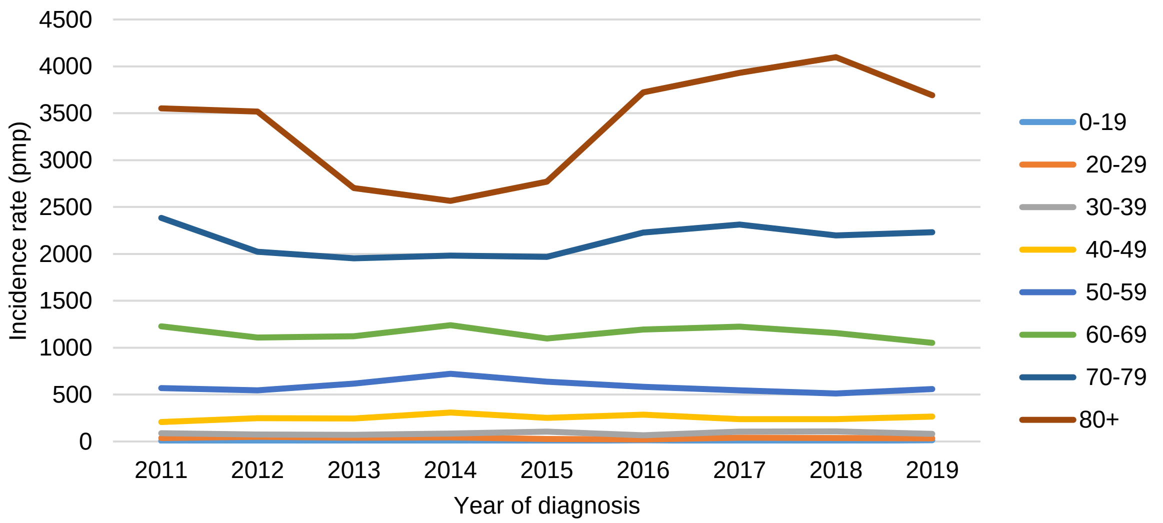
The median age at diagnosis of CKD5 increased slightly from 66.5 years in 2011 to 68.6 years in 2019 (Figure 5.2.2a).

Figure 5.2.2a: Median age (year) and age distribution (%) of CKD5 patients



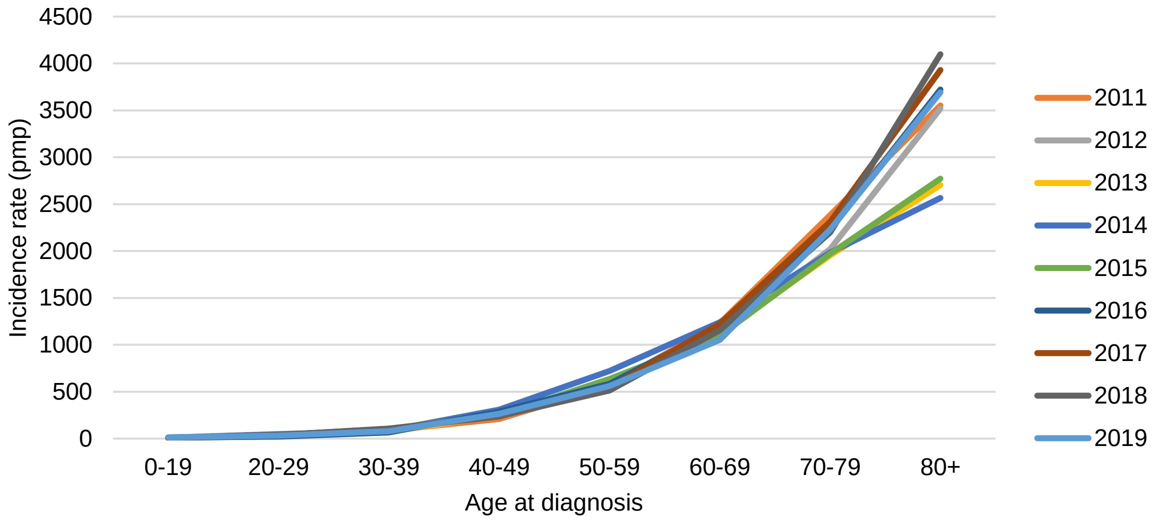
The incidence of CKD5 is mainly driven by the oldest age group (Figure 5.2.2b). The age-specific incidence rate for those aged 80 years and above dropped between 2011 and 2014, but it increased steadily thereafter, before dropping again in 2019. The age-specific incidence rates remained relatively stable over the years for all the other age groups.

Figure 5.2.2b: Age-specific incidence rate (pmp) of CKD5 across years



The age-specific incidence rates of CKD5 increased exponentially with age for all the years (Figure 5.2.3).

Figure 5.2.3: Age-specific incidence rate (pmp) of CKD5 across age groups



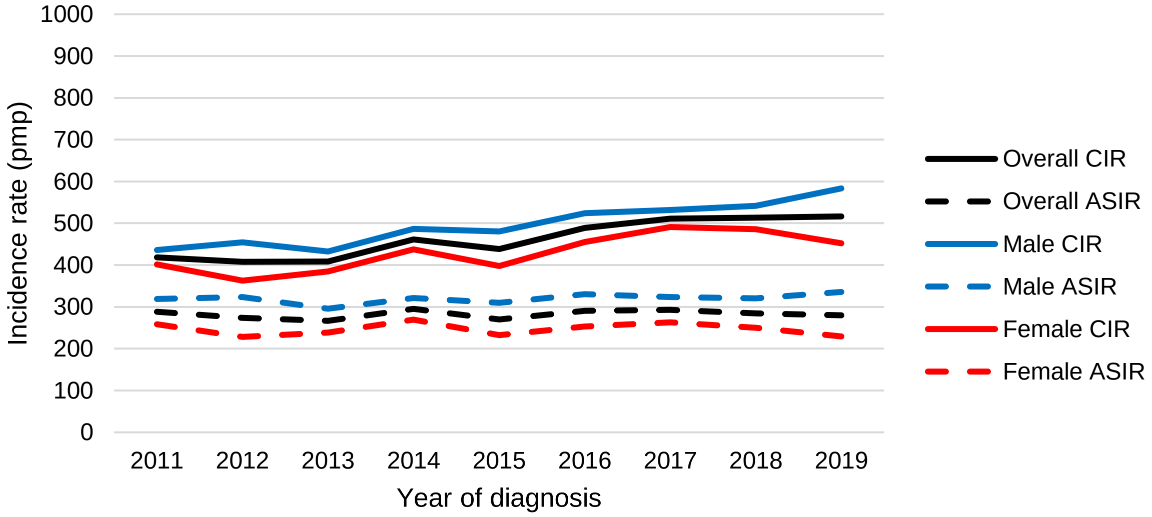
The ASIRs of CKD5 were consistently higher among males than females across the years (Table 5.2.3 and Figure 5.2.4). In 2019, the ASIR was 335.7 pmp and 229.1 pmp for males and females respectively. The ASIRs for both genders remained stable over the years.

Table 5.2.3: Incidence number and rate (pmp) of CKD5 by gender

Male				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2011	815	51.4	436.2	319.1
2012	854	54.8	454.3	323.5
2013	818	52.1	432.5	295.7
2014	925	51.8	486.2	321.2
2015	921	53.8	480.5	310.1
2016	1012	52.6	524.5	330.5
2017	1033	51.0	531.5	323.4
2018	1060	51.7	542.0	320.5
2019	1149	55.3	583.4	335.7
P for trend	-	-	<0.001	0.196

Female				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2011	771	48.6	401.4	258.4
2012	703	45.2	362.8	228.3
2013	752	47.9	385.0	238.8
2014	861	48.2	437.4	269.5
2015	790	46.2	397.8	232.1
2016	912	47.4	455.1	253.4
2017	993	49.0	491.0	263.0
2018	990	48.3	485.7	249.7
2019	930	44.7	452.2	229.1
P for trend	-	-	0.008	0.879

Figure 5.2.4: Incidence rate (pmp) of CKD5 by gender



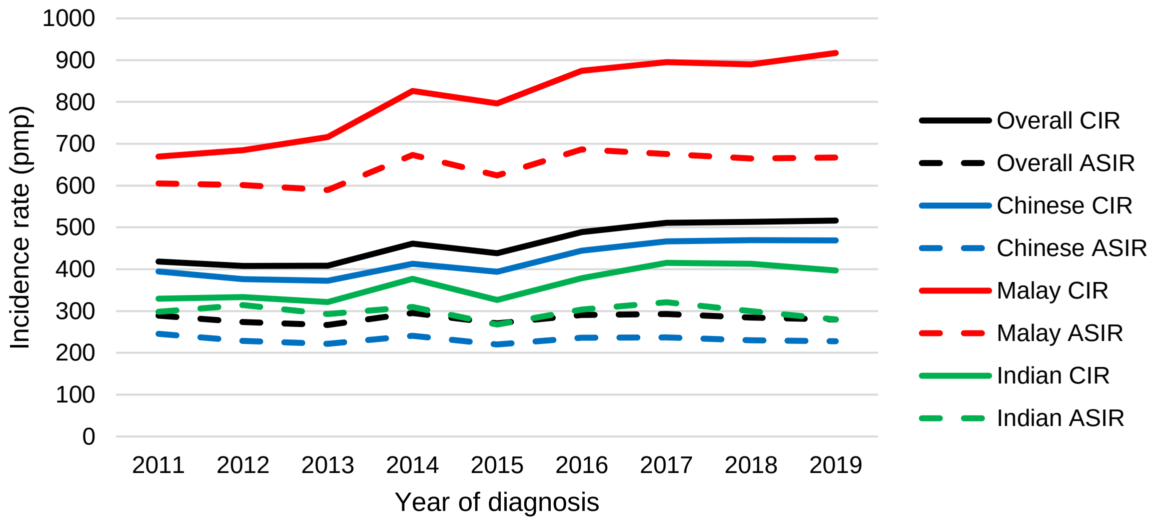
The ASIRs of CKD5 were consistently higher among Malays than Chinese and Indians across the years (Table 5.2.4 and Figure 5.2.5). In 2019, the ASIR among Malays was 667.3 pmp, which was about 3-fold compared to Chinese (227.7 pmp) and 2-fold compared to Indians (279.6 pmp). While the ASIR for Malays increased significantly over the years (p=0.017), the ASIRs for Chinese and Indians remained relatively stable.

Table 5.2.4: Incidence number and rate (pmp) of CKD5 by ethnicity

Chinese				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2011	1108	69.9	394.5	245.5
2012	1065	68.4	376.1	228.8
2013	1063	67.7	372.5	221.6
2014	1187	66.5	413.0	241.0
2015	1142	66.7	393.8	220.1
2016	1298	67.5	444.0	236.5
2017	1375	67.9	466.4	237.2
2018	1394	68.0	469.5	230.2
2019	1403	67.5	468.6	227.7
P for trend	-	-	0.001	0.599

Malay				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2011	339	21.4	669.4	604.8
2012	349	22.4	685.1	601.0
2013	367	23.4	715.8	589.5
2014	427	23.9	826.5	673.3
2015	415	24.3	796.7	624.3
2016	460	23.9	874.7	686.6
2017	475	23.4	895.0	675.9
2018	477	23.3	890.2	664.7
2019	496	23.9	917.2	667.3
P for trend	-	-	<0.001	0.017
Indian				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2011	115	7.3	329.7	298.0
2012	117	7.5	333.3	314.5
2013	113	7.2	321.5	293.2
2014	133	7.4	376.7	310.0
2015	116	6.8	326.8	267.7
2016	135	7.0	378.3	303.6
2017	149	7.4	415.2	321.0
2018	149	7.3	413.3	299.4
2019	144	6.9	397.1	279.6
P for trend	-	-	0.006	0.618

Figure 5.2.5: Incidence rate (pmp) of CKD5 by ethnicity



5.3 Incidence of ever-started dialysis

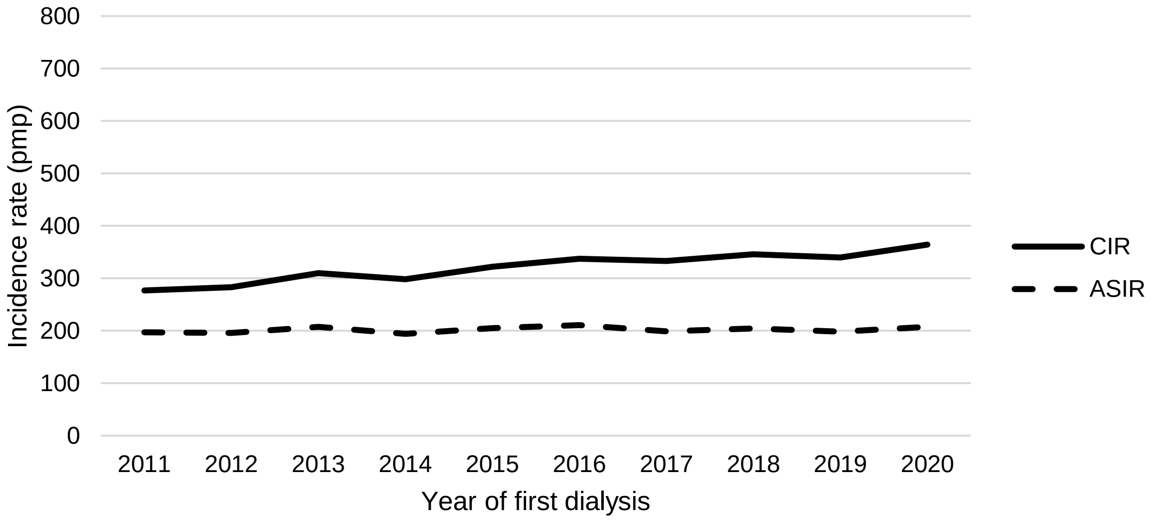
The incidence rate in each year was calculated by taking the number of new patients who ever-started on dialysis in a year, divided by the number of Singapore residents in the same year. The modality was based on the first dialysis. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

The number of new patients who initiated dialysis increased from 1,049 in 2011 to 1,473 in 2020 (Table 5.3.1 and Figure 5.3.1). Correspondingly, the CIR increased significantly from 276.8 pmp in 2011 to 364.2 pmp in 2020 (p<0.001). However, the ASIR remained relatively stable at between 194.1 pmp and 210.8 pmp during the same period.

Table 5.3.1: Incidence number and rate (pmp) of ever-started dialysis

Year of first dialysis	Number	CIR	ASIR
2011	1049	276.8	197.1
2012	1080	282.9	195.9
2013	1192	310.1	207.5
2014	1155	298.4	194.1
2015	1258	322.3	205.2
2016	1327	337.4	210.8
2017	1321	333.1	199.0
2018	1382	346.0	204.5
2019	1369	340.0	198.4
2020	1473	364.2	207.2
P for trend	-	<0.001	0.298

Figure 5.3.1: Incidence rate (pmp) of ever-started dialysis



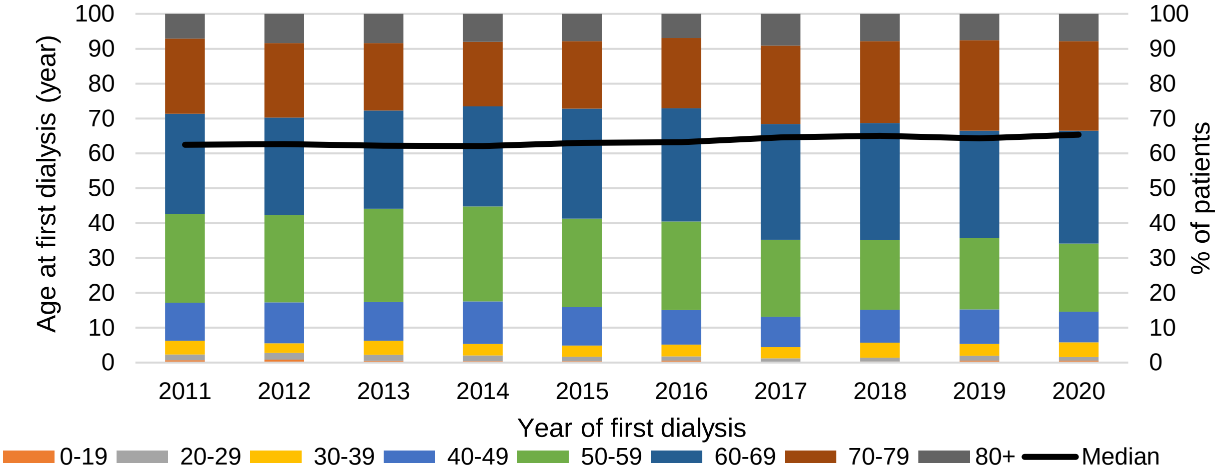
The majority of the new ever-started dialysis patients were aged 50 to 79 years, with close to 8 in 10 of the patients in this age group in 2020 (Table 5.3.2). Of the different age groups, the age-specific incidence rate was observed to increase significantly for those aged 30 to 39 years (p=0.016).

Table 5.3.2: Age distribution (%) and age-specific incidence rate (pmp) of ever-started dialysis

Year of first dialysis	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	7	0.7	7.8	17	1.6	32.8	42	4.0	68.4	114	10.9	180.8
2012	9	0.8	10.2	21	1.9	40.4	30	2.8	49.3	126	11.7	200.1
2013	6	0.5	6.9	21	1.8	40.2	48	4.0	79.7	132	11.1	209.9
2014	4	0.3	4.7	20	1.7	37.8	38	3.3	63.9	140	12.1	224.2
2015	5	0.4	5.9	16	1.3	29.9	41	3.3	69.3	138	11.0	222.5
2016	8	0.6	9.6	15	1.1	27.7	46	3.5	78.3	131	9.9	213.1
2017	3	0.2	3.6	13	1.0	23.7	42	3.2	72.4	115	8.7	187.0
2018	4	0.3	4.9	15	1.1	27.4	60	4.3	102.5	131	9.5	214.2
2019	8	0.6	9.8	19	1.4	35.4	46	3.4	77.4	136	9.9	222.1
2020	8	0.5	10.0	15	1.0	28.2	63	4.3	105.5	129	8.8	211.1
P for trend	-	-	0.993	-	-	0.085	-	-	0.016	-	-	0.241
Year of first dialysis	**Age 50-59**			**Age 60-69**			**Age 70-79**			**Age 80+**		
	Number	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**
2011	267	25.5	469.6	301	28.7	939.2	226	21.5	1354.1	75	7.1	1024.6
2012	271	25.1	465.5	302	28.0	881.0	230	21.3	1337.2	91	8.4	1172.7
2013	319	26.8	537.1	335	28.1	910.1	231	19.4	1311.8	100	8.4	1218.0
2014	315	27.3	521.6	331	28.7	842.9	214	18.5	1168.7	93	8.1	1065.4
2015	319	25.4	522.8	397	31.6	938.7	243	19.3	1321.8	99	7.9	1059.4
2016	337	25.4	547.8	430	32.4	955.8	268	20.2	1397.6	92	6.9	940.7
2017	292	22.1	475.2	439	33.2	940.8	297	22.5	1404.6	120	9.1	1184.9
2018	275	19.9	448.4	464	33.6	959.1	325	23.5	1420.0	108	7.8	1010.5
2019	281	20.5	461.8	420	30.7	839.8	356	26.0	1454.7	103	7.5	890.6
2020	288	19.6	478.5	476	32.3	926.0	378	25.7	1448.3	116	7.9	935.7
P for trend	-	-	0.465	-	-	0.880	-	-	0.054	-	-	0.070

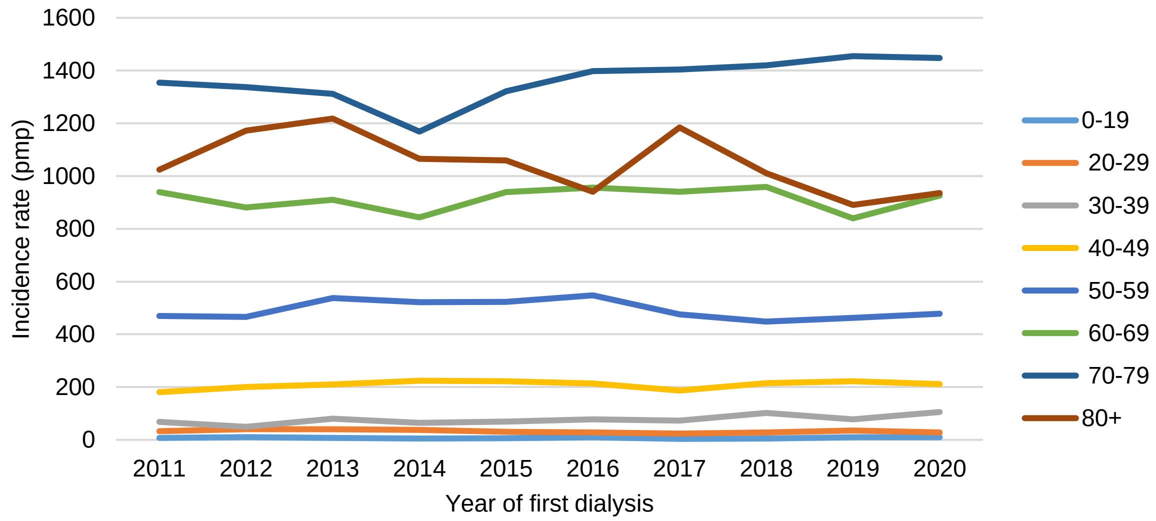
The median age at first dialysis increased slightly from 62.5 years in 2011 to 65.3 years in 2020 (Figure 5.3.2a).

Figure 5.3.2a: Median age (year) and age distribution (%) of ever-started dialysis patients



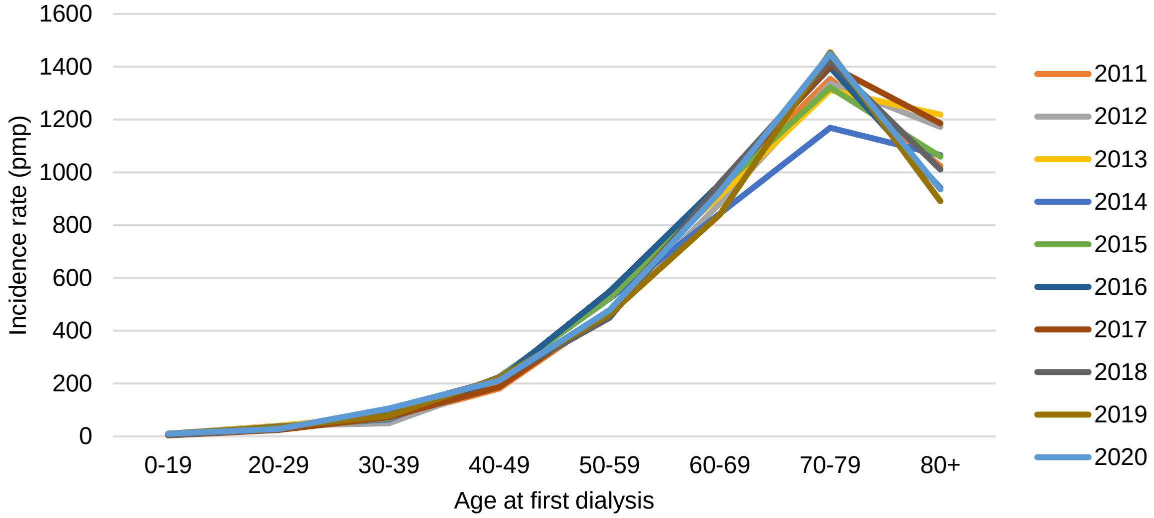
The age-specific incidence rate of ever-started dialysis was highest for those aged 70 to 79 years and it increased from 2014 onwards (Figure 5.3.2b).

Figure 5.3.2b: Age-specific incidence rate (pmp) of ever-started dialysis across years



Although the age-specific incidence rates of ever-started dialysis increased with age, a decline was observed from those aged 80 years and above for all the years (Figure 5.3.3). Possible reasons for this decline could be elderly patients passing away before their first planned dialysis or refusing dialysis as studies have shown that dialysis offers little advantage in improving survival, especially among those with pre-existing co-morbidities[10].

Figure 5.3.3: Age-specific incidence rate (pmp) of ever-started dialysis across age groups



The ASIRs of ever-started dialysis were consistently higher among males than females across the years (Table 5.3.3 and Figure 5.3.4). In 2020, the ASIR was 250.4 pmp and 167.7 pmp for males and females respectively. The ASIRs for both genders remained stable over the years.

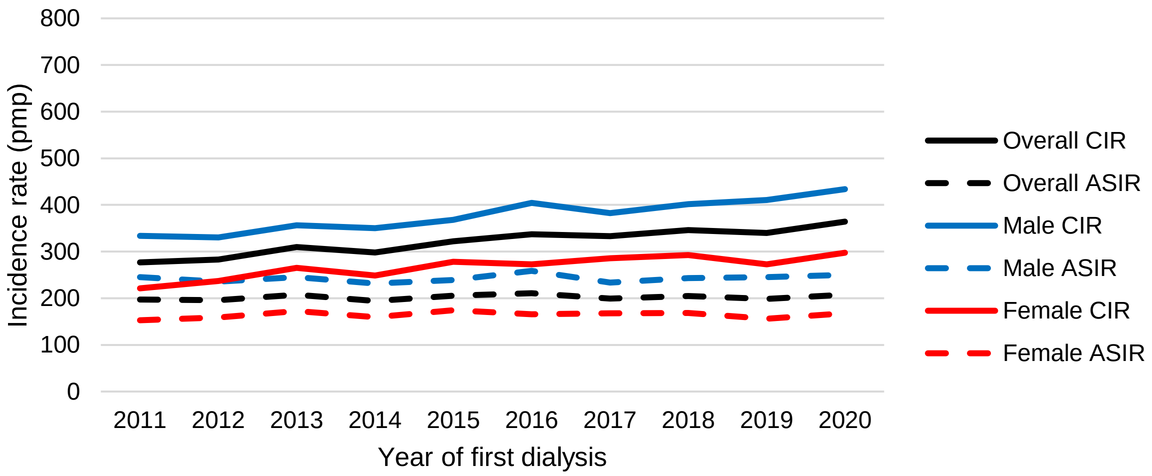
Table 5.3.3: Incidence number and rate (pmp) of ever-started dialysis by gender

	Male			
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	624	59.5	334.0	245.2
2012	621	57.5	330.4	235.4
2013	674	56.5	356.4	245.0
2014	666	57.7	350.1	231.6
2015	706	56.1	368.4	239.1
2016	780	58.8	404.2	258.7
2017	743	56.2	382.3	233.5
2018	786	56.9	401.9	243.4
2019	808	59.0	410.3	245.0
2020	858	58.2	433.9	250.4
P for trend	-	-	<0.001	0.409

[10] Sarbjit V and Watson D. Dialysis in late life: benefit or burden. Clinical Journal of American Society of Nephrology. 2009; 4: 2008-2012.

Female				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	425	40.5	221.2	152.8
2012	459	42.5	236.9	158.9
2013	518	43.5	265.2	172.5
2014	489	42.3	248.4	159.6
2015	552	43.9	277.9	174.3
2016	547	41.2	272.9	165.9
2017	578	43.8	285.8	168.0
2018	596	43.1	292.4	168.7
2019	561	41.0	272.8	155.7
2020	615	41.8	297.6	167.7
P for trend	-	-	0.001	0.425

Figure 5.3.4: Incidence rate (pmp) of ever-started dialysis by gender

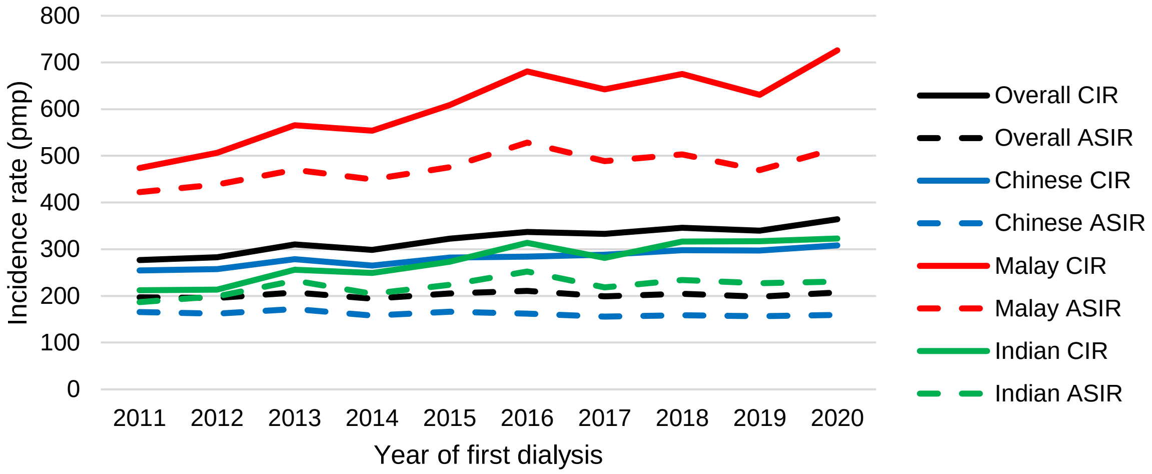


The ASIRs of ever-started dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.3.4 and Figure 5.3.5). In 2020, the ASIR was 159.6 pmp, 515.9 pmp and 230.7 pmp for Chinese, Malays and Indians respectively. While the ASIRs for Malays (p=0.010) and Indians (p=0.042) increased significantly over the years, the ASIR for Chinese remained relatively stable.

Table 5.3.4: Incidence number and rate (pmp) of ever-started dialysis by ethnicity

Chinese				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	715	68.2	254.6	165.6
2012	729	67.5	257.5	162.0
2013	795	66.7	278.6	172.0
2014	761	65.9	264.8	157.8
2015	819	65.1	282.4	166.1
2016	830	62.5	283.9	162.1
2017	850	64.3	288.3	155.8
2018	885	64.0	298.1	158.9
2019	889	64.9	297.0	156.3
2020	927	62.9	308.3	159.6
P for trend	-	-	<0.001	0.059
Malay				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	240	22.9	473.9	422.4
2012	258	23.9	506.5	438.7
2013	290	24.3	565.6	470.3
2014	286	24.8	553.6	449.3
2015	317	25.2	608.5	475.6
2016	358	27.0	680.8	528.3
2017	341	25.8	642.5	488.7
2018	362	26.2	675.6	503.1
2019	341	24.9	630.6	469.4
2020	396	26.9	725.9	515.9
P for trend	-	-	<0.001	0.010
Indian				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	74	7.1	212.2	186.8
2012	75	6.9	213.7	199.2
2013	90	7.6	256.0	233.0
2014	88	7.6	249.3	204.6
2015	97	7.7	273.3	224.1
2016	112	8.4	313.8	252.2
2017	101	7.6	281.5	218.3
2018	114	8.2	316.2	233.9
2019	115	8.4	317.1	227.3
2020	117	7.9	323.0	230.7
P for trend	-	-	<0.001	0.042

Figure 5.3.5: Incidence rate (pmp) of ever-started dialysis by ethnicity



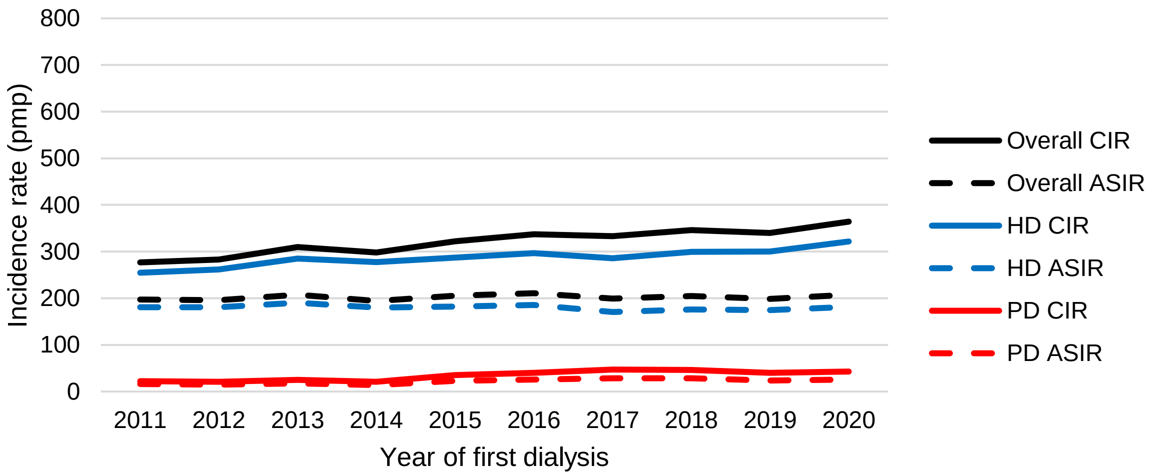
The ASIRs of ever-started dialysis were consistently higher among HD than PD across the years (Table 5.3.5 and Figure 5.3.6). In 2020, the ASIR was 181.3 pmp and 25.8 pmp for HD and PD respectively. While the ASIR for PD increased significantly over the years (p=0.004), the ASIR for HD remained relatively stable. The Ministry of Health has been working with the public healthcare institutions and dialysis service providers to promote the uptake of PD among local dialysis patients.

Table 5.3.5: Incidence number and rate (pmp) of ever-started dialysis by modality

HD				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	965	92.0	254.7	181.0
2012	1000	92.6	261.9	181.0
2013	1096	91.9	285.1	190.3
2014	1074	93.0	277.5	180.3
2015	1120	89.0	287.0	182.3
2016	1168	88.0	296.9	185.4
2017	1134	85.8	285.9	170.5
2018	1196	86.5	299.4	176.1
2019	1208	88.2	300.0	174.5
2020	1301	88.3	321.7	181.3
P for trend	-	-	<0.001	0.179

PD				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	84	8.0	22.2	16.2
2012	80	7.4	21.0	14.8
2013	96	8.1	25.0	17.2
2014	81	7.0	20.9	13.8
2015	138	11.0	35.4	22.9
2016	159	12.0	40.4	25.4
2017	187	14.2	47.2	28.4
2018	186	13.5	46.6	28.4
2019	161	11.8	40.0	23.9
2020	172	11.7	42.5	25.8
P for trend	-	-	0.001	0.004

Figure 5.3.6: Incidence rate (pmp) of ever-started dialysis by modality



5.4 Incidence of definitive dialysis

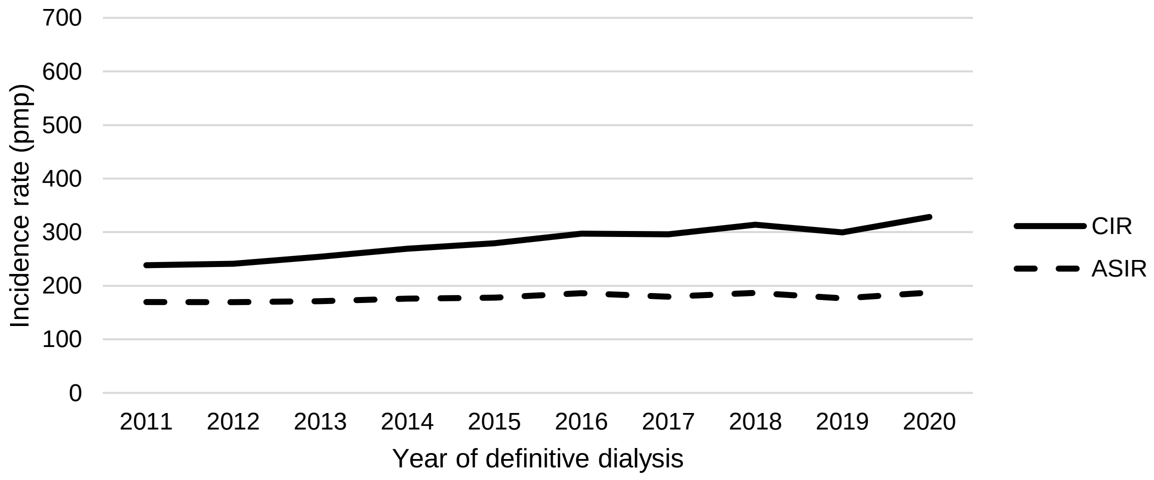
The incidence rate in each year was calculated by taking the number of new patients who survived >90 days after initiation of dialysis in a year, divided by the number of Singapore residents in the same year. The modality was based on the dialysis closest to the 91st day from initiation of dialysis. As some patients did not survive beyond three months from the first dialysis, those on definitive dialysis is a relatively more stable subset of the CKD5 and ever-started dialysis cohorts. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

The number of new patients on definitive dialysis increased from 903 in 2011 to 1,328 in 2020 (Table 5.4.1 and Figure 5.4.1). Correspondingly, the CIR increased significantly from 238.3 pmp in 2011 to 328.4 pmp in 2020 (p<0.001). The rise in ASIR from 169.6 pmp in 2011 to 187.3 pmp in 2020 was also significant (p=0.004), albeit of a smaller magnitude than the rise in CIR.

Table 5.4.1: Incidence number and rate (pmp) of definitive dialysis

Year of definitive dialysis	Number	CIR	ASIR
2011	903	238.3	169.6
2012	921	241.2	169.6
2013	978	254.4	171.2
2014	1042	269.2	176.1
2015	1090	279.3	177.7
2016	1170	297.4	186.2
2017	1174	296.0	179.6
2018	1255	314.2	186.5
2019	1207	299.8	176.3
2020	1328	328.4	187.3
P for trend	-	<0.001	0.004

Figure 5.4.1: Incidence rate (pmp) of definitive dialysis



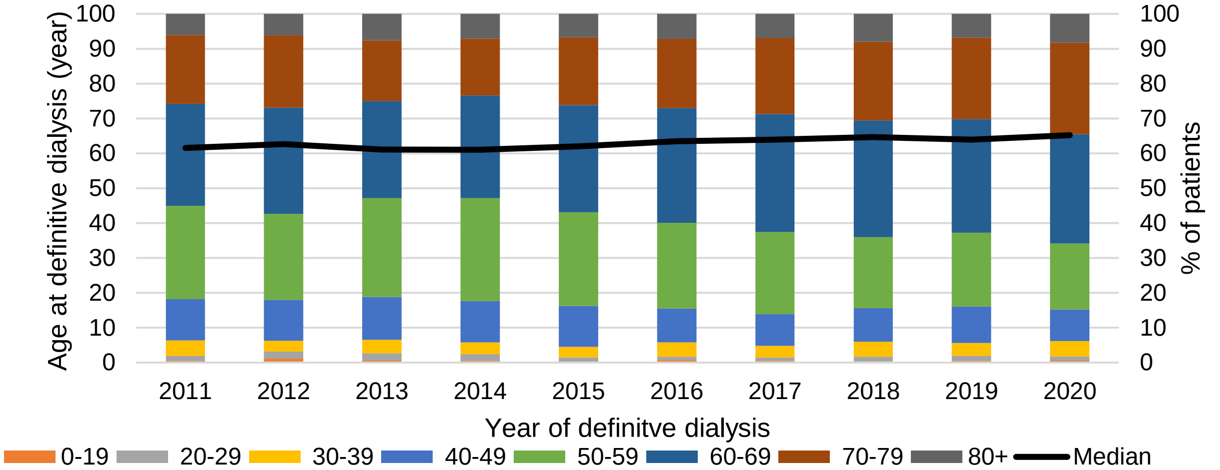
The majority of the new definitive dialysis patients were aged 50 to 79 years, with close to 80% of the patients in this age group in 2020 (Table 5.4.2).

Table 5.4.2: Age distribution (%) and age-specific incidence rate (pmp) of definitive dialysis

Year of definitive dialysis	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	4	0.4	4.5	14	1.6	27.0	39	4.3	63.5	107	11.8	169.7
2012	10	1.1	11.3	19	2.1	36.6	29	3.1	47.6	108	11.7	171.5
2013	6	0.6	6.9	20	2.0	38.3	38	3.9	63.1	120	12.3	190.8
2014	5	0.5	5.8	20	1.9	37.8	35	3.4	58.9	124	11.9	198.5
2015	2	0.2	2.4	14	1.3	26.2	33	3.0	55.8	128	11.7	206.4
2016	8	0.7	9.6	12	1.0	22.2	48	4.1	81.7	114	9.7	185.5
2017	6	0.5	7.3	12	1.0	21.8	38	3.2	65.5	107	9.1	174.0
2018	4	0.3	4.9	17	1.4	31.1	54	4.3	92.3	121	9.6	197.9
2019	6	0.5	7.4	17	1.4	31.6	45	3.7	75.7	126	10.4	205.7
2020	8	0.6	10.0	16	1.2	30.1	58	4.4	97.1	121	9.1	198.0
P for trend	-	-	0.612	-	-	0.467	-	-	0.008	-	-	0.081
Year of definitive dialysis	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	242	26.8	425.6	264	29.2	823.7	178	19.7	1066.5	55	6.1	751.4
2012	227	24.6	389.9	280	30.4	816.8	191	20.7	1110.5	57	6.2	734.5
2013	277	28.3	466.4	273	27.9	741.6	170	17.4	965.4	74	7.6	901.3
2014	307	29.5	508.4	307	29.5	781.8	170	16.3	928.4	74	7.1	847.7
2015	293	26.9	480.2	335	30.7	792.1	212	19.4	1153.2	73	6.7	781.2
2016	287	24.5	466.5	385	32.9	855.8	232	19.8	1209.9	84	7.2	858.9
2017	276	23.5	449.2	398	33.9	852.9	256	21.8	1210.7	81	6.9	799.8
2018	255	20.3	415.7	420	33.5	868.1	283	22.5	1236.5	101	8.0	945.0
2019	255	21.1	419.1	393	32.6	785.8	283	23.4	1156.4	82	6.8	709.0
2020	250	18.8	415.4	417	31.4	811.2	348	26.2	1333.3	110	8.3	887.3
P for trend	-	-	0.670	-	-	0.449	-	-	0.020	-	-	0.451

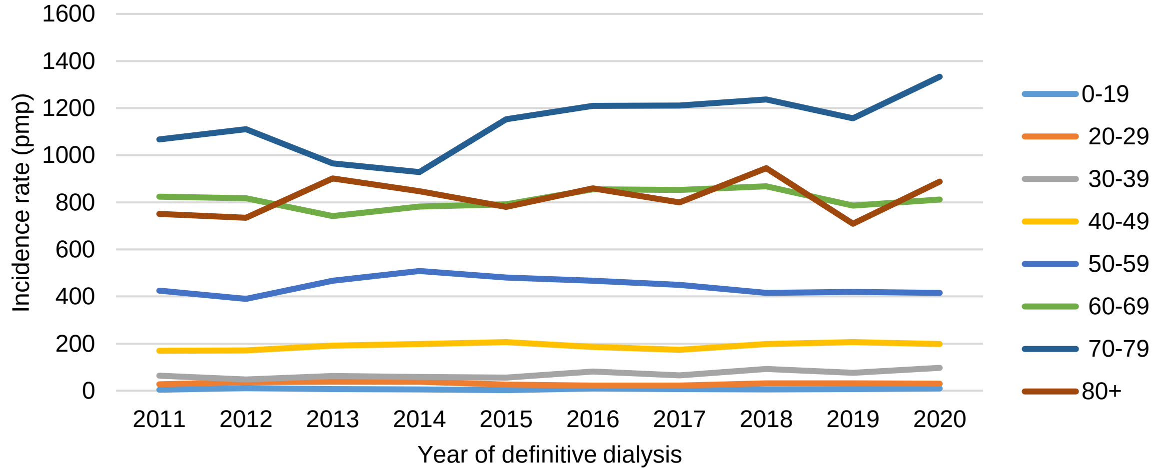
The median age at definitive dialysis increased slightly from 61.5 years in 2011 to 65.2 years in 2020 (Figure 5.4.2a).

Figure 5.4.2a: Median age (year) and age distribution (%) of new definitive dialysis patients



The age-specific incidence rate of definitive dialysis was highest for those aged 70 to 79 years and it increased significantly over the years (p=0.020) (Figure 5.4.2b). The age-specific incidence rate also increased significantly for those aged 30 to 39 years (p=0.008) (Table 5.4.2).

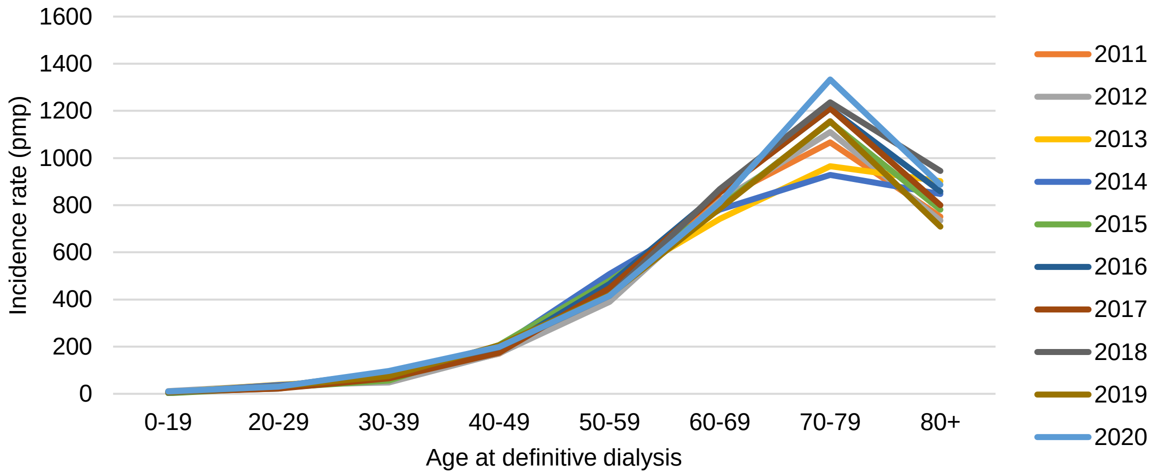
Figure 5.4.2b: Age-specific incidence rate (pmp) of definitive dialysis across years



The age-specific incidence rates of definitive dialysis increased with age, but a decline was observed from those aged 80 years and above for all the years (Figure 5.4.3). Possible reasons for this decline could be elderly patients passing away before reaching definitive dialysis or refusing dialysis as studies have shown that dialysis offers little advantage in improving survival, especially among those with pre-existing co-morbidities[11].

[11] Sarbjit V and Watson D. Dialysis in late life: benefit or burden. Clinical Journal of American Society of Nephrology. 2009; 4: 2008-2012.

Figure 5.4.3: Age-specific incidence rate (pmp) of definitive dialysis across age groups



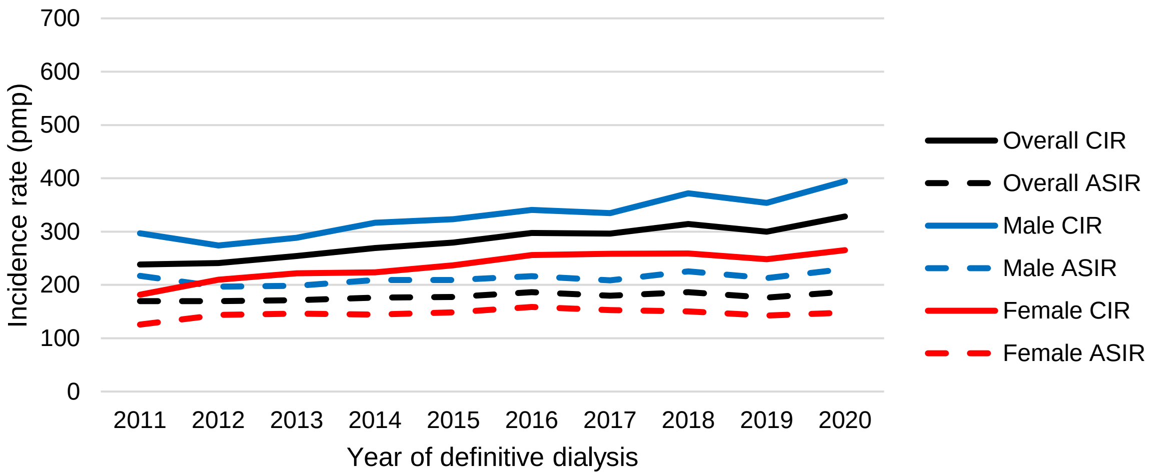
The ASIRs of definitive dialysis were consistently higher among males than females across the years (Table 5.4.3 and Figure 5.4.4). In 2020, the ASIR was 229.9 pmp and 148.2 pmp for males and females respectively. The ASIR increased significantly over the years for males (p=0.046), but not for females.

Table 5.4.3: Incidence number and rate (pmp) of definitive dialysis by gender

Male				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	554	61.4	296.5	217.1
2012	515	55.9	274.0	196.8
2013	545	55.7	288.2	198.4
2014	602	57.8	316.4	209.2
2015	620	56.9	323.5	209.2
2016	657	56.2	340.5	216.6
2017	651	55.5	335.0	208.4
2018	727	57.9	371.7	225.3
2019	697	57.7	353.9	212.7
2020	780	58.7	394.4	229.9
P for trend	-	-	<0.001	0.046

Female				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	349	38.6	181.7	125.6
2012	406	44.1	209.5	143.7
2013	433	44.3	221.7	145.9
2014	440	42.2	223.5	144.4
2015	470	43.1	236.6	148.6
2016	513	43.8	256.0	158.6
2017	523	44.5	258.6	152.6
2018	528	42.1	259.0	150.6
2019	510	42.3	248.0	142.3
2020	548	41.3	265.2	148.2
P for trend	-	-	<0.001	0.107

Figure 5.4.4: Incidence rate (pmp) of definitive dialysis by gender

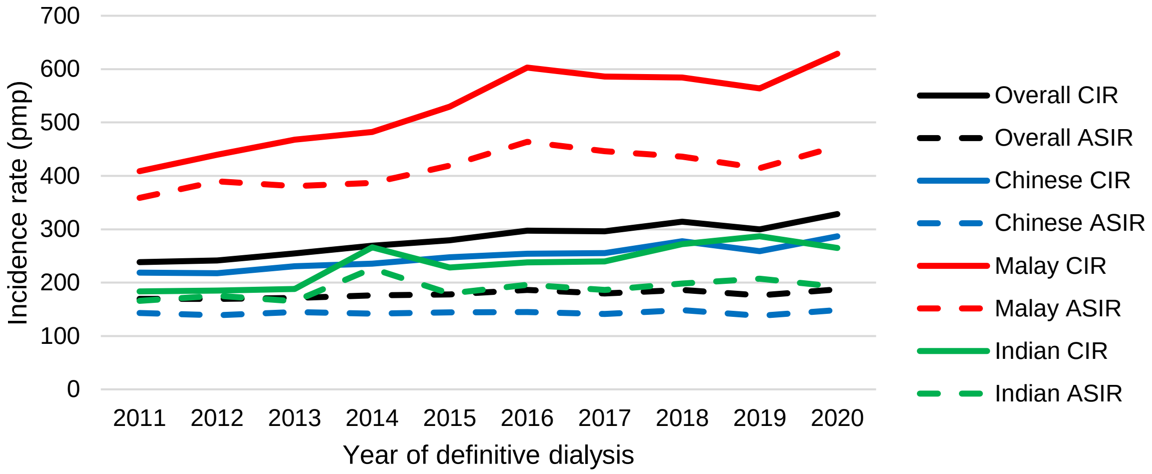


The ASIRs of definitive dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.4.4 and Figure 5.4.5). In 2020, the ASIR was 148.5 pmp, 455.2 pmp and 192.3 pmp for Chinese, Malays and Indians respectively. While the ASIRs for Malays increased significantly over the years (p=0.005), the ASIR for Chinese and Indians remained relatively stable.

Table 5.4.4: Incidence number and rate (pmp) of definitive dialysis by ethnicity

Chinese				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	614	68.0	218.6	143.2
2012	616	66.9	217.5	138.7
2013	658	67.3	230.6	144.6
2014	677	65.0	235.5	141.9
2015	717	65.8	247.2	144.4
2016	743	63.5	254.2	144.9
2017	753	64.1	255.4	141.3
2018	824	65.7	277.5	148.5
2019	775	64.2	258.9	137.8
2020	862	64.9	286.7	148.5
P for trend	-	-	<0.001	0.407
Malay				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	207	22.9	408.8	358.8
2012	224	24.3	439.7	389.9
2013	240	24.5	468.1	380.7
2014	249	23.9	481.9	386.6
2015	276	25.3	529.8	419.2
2016	317	27.1	602.8	463.7
2017	311	26.5	586.0	446.0
2018	313	24.9	584.1	436.2
2019	305	25.3	564.0	414.5
2020	343	25.8	628.8	455.2
P for trend	-	-	<0.001	0.005
Indian				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	64	7.1	183.5	166.0
2012	65	7.1	185.2	175.7
2013	66	6.7	187.8	165.1
2014	94	9.0	266.3	226.4
2015	81	7.4	228.2	179.5
2016	85	7.3	238.2	195.6
2017	86	7.3	239.7	186.5
2018	98	7.8	271.8	198.4
2019	104	8.6	286.8	207.2
2020	96	7.2	265.0	192.3
P for trend	-	-	0.001	0.109

Figure 5.4.5: Incidence rate (pmp) of definitive dialysis by ethnicity



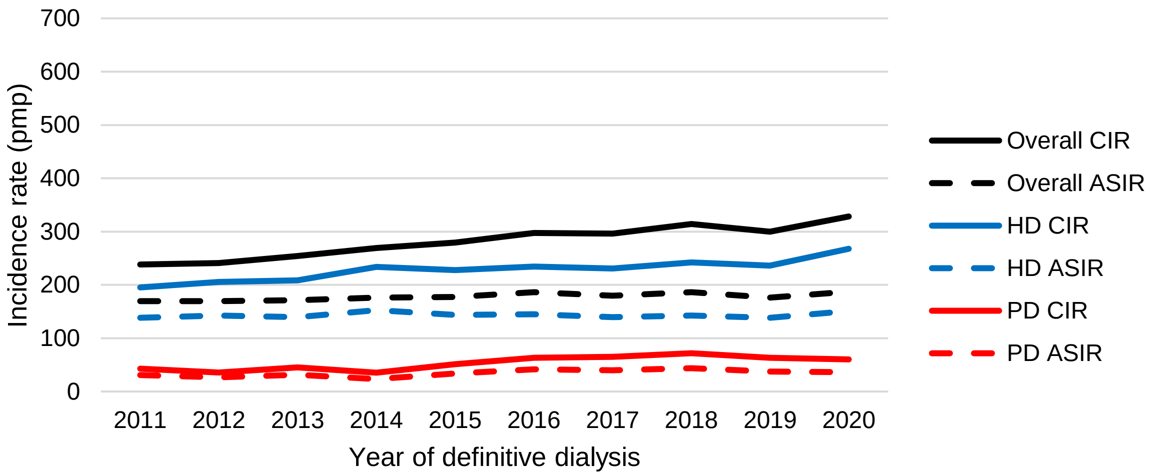
The ASIRs of definitive dialysis were consistently higher among HD than PD across the years (Table 5.4.5 and Figure 5.4.6). In 2020, the ASIR was 151.0 pmp and 36.3 pmp for HD and PD respectively. While the ASIR for PD increased significantly over the years (p=0.034), the ASIR for HD remained relatively stable.

Table 5.4.5: Incidence number and rate (pmp) of definitive dialysis by modality

	HD			
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	740	81.9	195.3	138.4
2012	784	85.1	205.4	142.8
2013	803	82.1	208.9	139.8
2014	905	86.9	233.8	152.7
2015	890	81.7	228.0	143.8
2016	921	78.7	234.1	144.8
2017	916	78.0	231.0	139.5
2018	968	77.1	242.3	142.7
2019	952	78.9	236.5	138.6
2020	1083	81.6	267.8	151.0
P for trend	-	-	<0.001	0.539

PD				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2011	163	18.1	43.0	31.1
2012	137	14.9	35.9	26.7
2013	175	17.9	45.5	31.4
2014	137	13.1	35.4	23.4
2015	200	18.3	51.2	33.9
2016	249	21.3	63.3	41.5
2017	258	22.0	65.1	40.1
2018	287	22.9	71.9	43.7
2019	255	21.1	63.3	37.7
2020	245	18.4	60.6	36.3
P for trend	-	-	0.004	0.034

Figure 5.4.6: Incidence rate (pmp) of definitive dialysis by modality



Among new patients on definitive dialysis, DN was the biggest contributor to CKD5, followed by GN (Table 5.4.6). In 2020, 67.8% of the new definitive dialysis patients had DN, while 12.2% had GN.

Table 5.4.6: Incidence number of definitive dialysis by etiology

Year of definitive dialysis	**DN**		**GN**		**Others**	
	Number	**%**	**Number**	**%**	**Number**	**%**
2011	553	61.2	159	17.6	191	21.2
2012	609	66.1	144	15.6	168	18.2
2013	637	65.1	156	16.0	185	18.9
2014	673	64.6	166	15.9	203	19.5
2015	727	66.7	176	16.1	187	17.2
2016	779	66.6	168	14.4	223	19.1
2017	789	67.2	173	14.7	212	18.1
2018	830	66.1	176	14.0	249	19.8
2019	824	68.3	140	11.6	243	20.1
2020	901	67.8	162	12.2	265	20.0

5.5 Prevalence of definitive dialysis

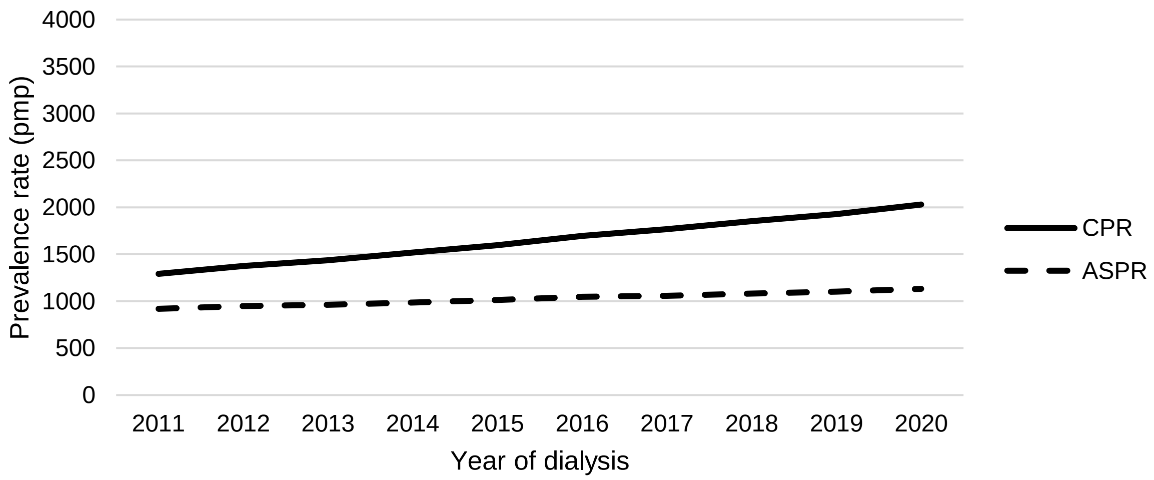
The prevalence rate in each year was calculated by taking the cumulative number of surviving (existing and new) definitive dialysis patients in a year, divided by the number of Singapore residents in the same year. Only patients surviving >90 days after initiation of dialysis were included. The modality was based on the last dialysis in each year. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

Like the incidence trends of definitive dialysis (Table 5.4.1 and Figure 5.4.1), the number of prevalent patients on definitive dialysis increased consistently since 2011 (Table 5.5.1 and Figure 5.5.1). Correspondingly, both the crude prevalence rate (CPR, $p<0.001$) and ASPR ($p<0.001$) increased significantly over the years. At the end of 2020, there were a total of 8,211 surviving definitive dialysis patients, with CPR of 2,030.3 pmp and ASPR of 1,132.0 pmp. The rise in ASPR suggests that the rise in new patients undergoing definitive dialysis was faster than the drop from those who died, even after adjusting for Singapore's ageing population.

Table 5.5.1: Prevalence number and rate (pmp) of definitive dialysis

Year of dialysis	Number	CPR	ASPR
2011	4895	1291.8	919.2
2012	5244	1373.6	949.0
2013	5521	1436.1	961.8
2014	5880	1519.1	987.1
2015	6231	1596.6	1012.2
2016	6672	1696.2	1048.2
2017	7006	1766.6	1058.7
2018	7406	1854.2	1081.7
2019	7763	1928.1	1100.9
2020	8211	2030.3	1132.0
P for trend	-	<0.001	<0.001

Figure 5.5.1: Prevalence rate (pmp) of definitive dialysis



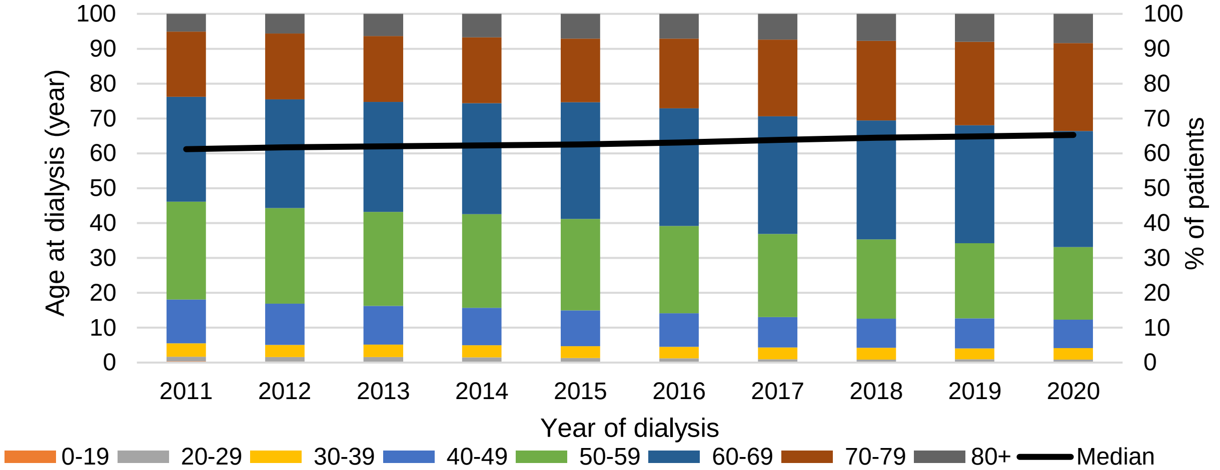
The majority of the prevalent definitive dialysis patients were aged 50 to 79 years, with close to 80% of the patients in this age group in 2020 (Table 5.5.2).

Table 5.5.2: Age distribution (%) and age-specific prevalence rate (pmp) of definitive dialysis

Year of dialysis	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2011	17	0.3	18.9	67	1.4	129.3	185	3.8	301.4	616	12.6	976.8
2012	16	0.3	18.1	68	1.3	131.0	182	3.5	298.8	620	11.8	984.6
2013	13	0.2	14.9	73	1.3	139.7	198	3.6	328.7	611	11.1	971.7
2014	12	0.2	14.0	75	1.3	141.6	207	3.5	348.3	629	10.7	1007.1
2015	12	0.2	14.2	70	1.1	130.8	210	3.4	354.9	639	10.3	1030.4
2016	13	0.2	15.6	67	1.0	123.9	224	3.4	381.2	637	9.5	1036.4
2017	12	0.2	14.5	55	0.8	100.1	234	3.3	403.2	611	8.7	993.6
2018	13	0.2	15.9	51	0.7	93.2	249	3.4	425.6	621	8.4	1015.6
2019	14	0.2	17.2	59	0.8	109.8	241	3.1	405.5	668	8.6	1090.7
2020	18	0.2	22.4	55	0.7	103.5	264	3.2	442.0	675	8.2	1104.7
P for trend	-	-	0.566	-	-	0.007	-	-	<0.001	-	-	0.003
Year of dialysis	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2011	1372	28.0	2412.9	1472	30.1	4592.8	917	18.7	5494.3	249	5.1	3401.6
2012	1439	27.4	2471.7	1633	31.1	4763.7	991	18.9	5761.6	295	5.6	3801.5
2013	1490	27.0	2508.8	1739	31.5	4724.3	1046	18.9	5939.8	351	6.4	4275.3
2014	1578	26.8	2613.0	1871	31.8	4764.5	1110	18.9	6062.0	398	6.8	4559.3
2015	1634	26.2	2678.0	2086	33.5	4932.4	1140	18.3	6201.0	440	7.1	4708.5
2016	1672	25.1	2717.9	2251	33.7	5003.6	1334	20.0	6956.9	474	7.1	4846.7
2017	1673	23.9	2722.6	2364	33.7	5066.2	1541	22.0	7287.9	516	7.4	5095.0
2018	1685	22.8	2747.2	2520	34.0	5208.9	1693	22.9	7397.1	574	7.8	5370.5
2019	1677	21.6	2756.2	2624	33.8	5246.7	1858	23.9	7592.1	622	8.0	5378.0
2020	1707	20.8	2836.0	2730	33.2	5311.1	2073	25.2	7942.6	689	8.4	5557.6
P for trend	-	-	<0.001	-	-	<0.001	-	-	<0.001	-	-	<0.001

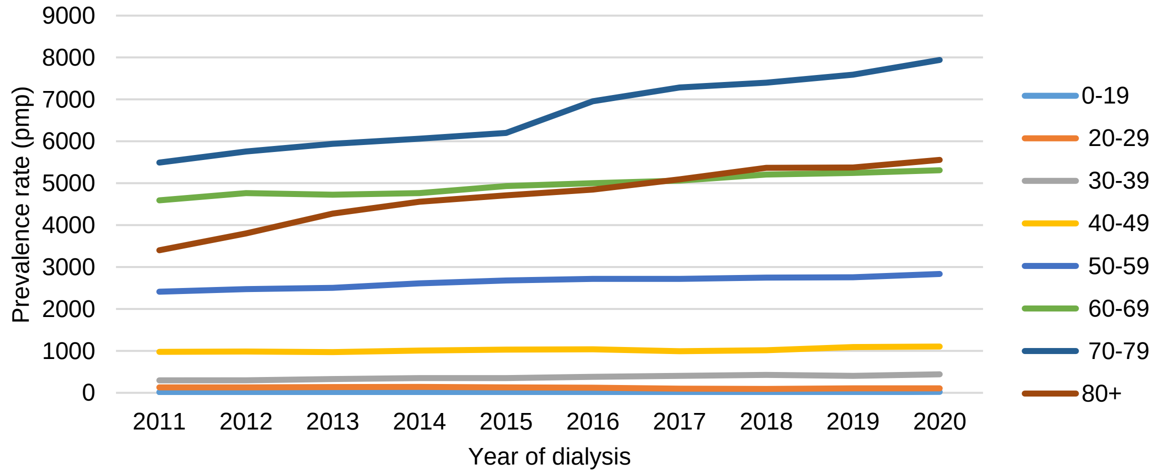
The median age among prevalent definitive dialysis patients increased slightly from 61.2 years in 2011 to 65.3 years in 2020 (Figure 5.5.2a).

Figure 5.5.2a: Median age (year) and age distribution (%) of prevalent definitive dialysis patients



The age-specific prevalence rate of definitive dialysis was highest for those aged 70 to 79 years (Figure 5.5.2b). There was a significant rise in age-specific prevalence rate for all age groups from 20 years and above (p<0.05) (Table 5.5.2).

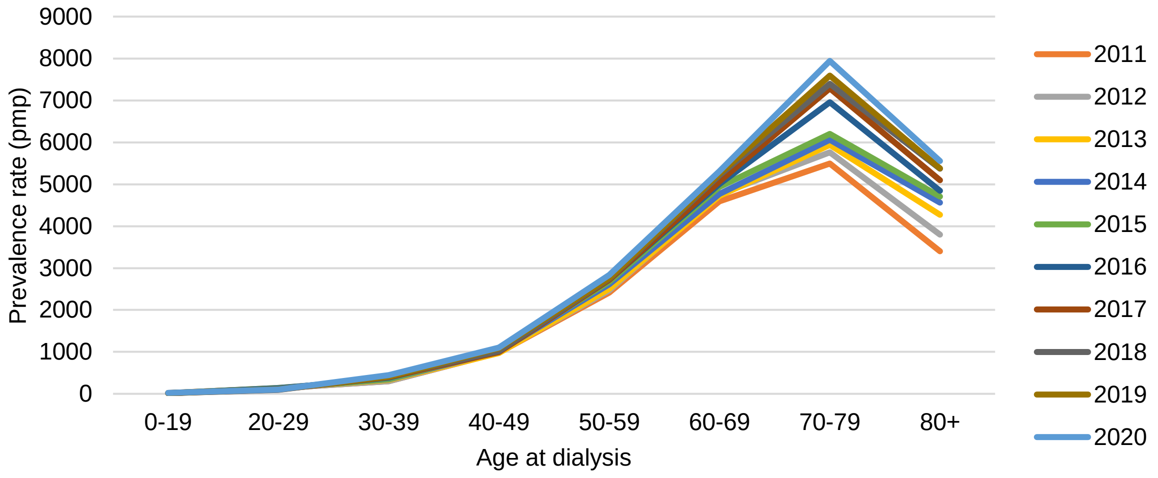
Figure 5.5.2b: Age-specific prevalence rate (pmp) of definitive dialysis across years



The age-specific prevalence rates of definitive dialysis increased with age, but a decline was observed from those aged 80 years and above for all the years (Figure 5.5.3). Possible reasons for this decline could be elderly patients passing away before reaching definitive dialysis or refusing dialysis as studies have shown that dialysis offers little advantage in improving survival, especially among those with pre-existing co-morbidities[12].

[12] Sarbjit V and Watson D. Dialysis in late life: benefit or burden. Clinical Journal of American Society of Nephrology. 2009; 4: 2008-2012.

Figure 5.5.3: Age-specific prevalence rate (pmp) of definitive dialysis across age groups



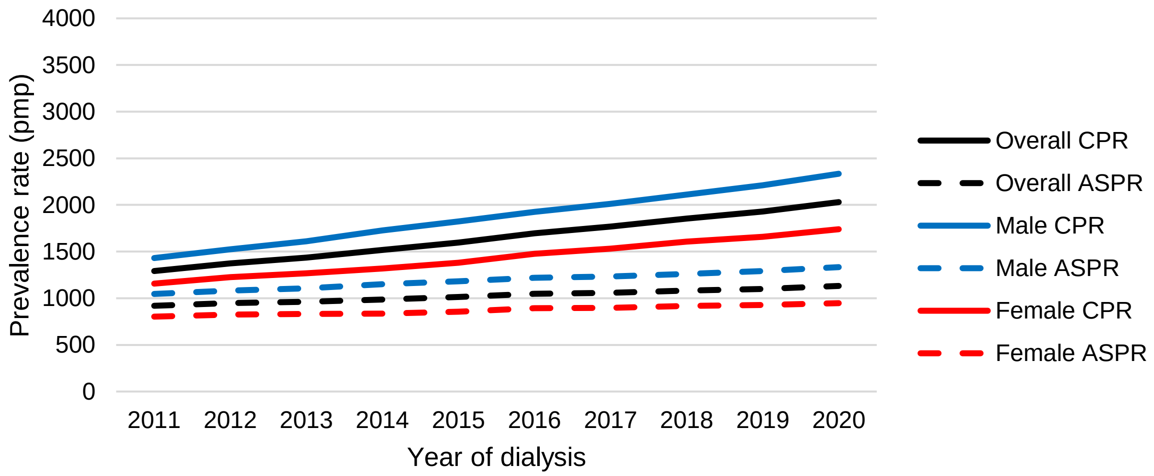
The ASPRs of definitive dialysis were consistently higher among males than females across the years (Table 5.5.3 and Figure 5.5.4). In 2020, the ASPR was 1333.3 pmp and 947.2 pmp for males and females respectively. The ASPRs for both genders increased significantly over the years ($p<0.001$).

Table 5.5.3: Prevalence number and rate (pmp) of definitive dialysis by gender

Male				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	2673	54.6	1430.8	1046.0
2012	2868	54.7	1525.7	1082.5
2013	3044	55.1	1609.5	1105.5
2014	3285	55.9	1726.8	1150.5
2015	3491	56.0	1821.4	1180.7
2016	3715	55.7	1925.3	1218.1
2017	3907	55.8	2010.2	1234.7
2018	4127	55.7	2110.1	1261.1
2019	4354	56.1	2210.8	1290.5
2020	4616	56.2	2334.2	1333.3
P for trend	-	-	<0.001	<0.001

Year of dialysis	Female			
	Number	%	CPR	ASPR
2011	2222	45.4	1156.7	802.9
2012	2376	45.3	1226.1	826.2
2013	2477	44.9	1268.2	830.4
2014	2595	44.1	1318.4	836.5
2015	2740	44.0	1379.6	856.8
2016	2957	44.3	1475.5	892.7
2017	3099	44.2	1532.5	898.3
2018	3279	44.3	1608.6	918.0
2019	3409	43.9	1657.4	928.3
2020	3595	43.8	1739.5	947.2
P for trend	-	-	<0.001	<0.001

Figure 5.5.4: Prevalence rate (pmp) of definitive dialysis by gender

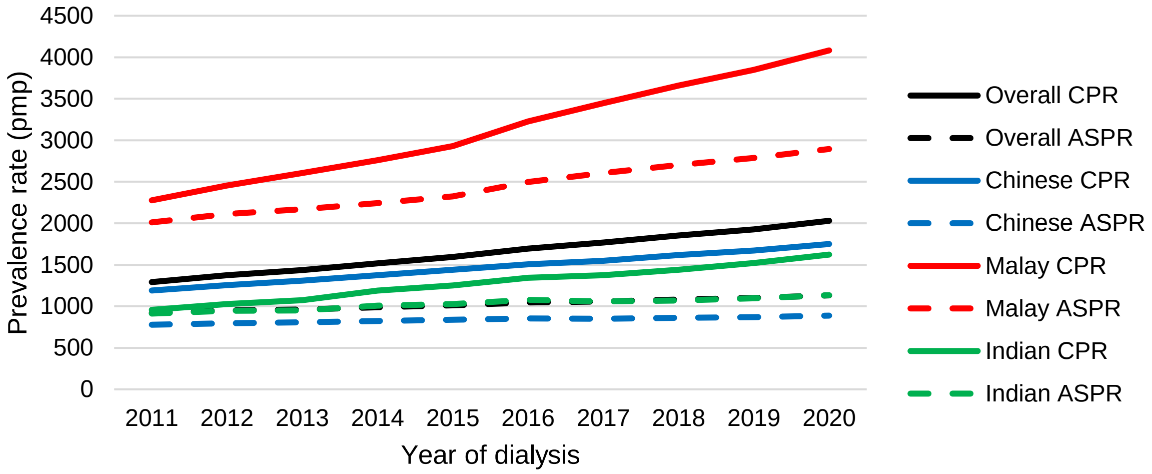


The ASPRs of definitive dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.5.4 and Figure 5.5.5). In 2020, the ASPR was 887.8 pmp, 2894.7 pmp and 1133.8 pmp for Chinese, Malays and Indians respectively. While the ASPRs for all the three ethnic groups increased significantly over the years ($p<0.001$), the increment for Malays was higher than Chinese and Indians.

Table 5.5.4: Prevalence number and rate (pmp) of definitive dialysis by ethnicity

Chinese				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	3344	68.3	1190.7	778.4
2012	3558	67.8	1256.5	796.5
2013	3739	67.7	1310.2	806.1
2014	3954	67.2	1375.6	821.1
2015	4178	67.1	1440.7	840.0
2016	4398	65.9	1504.5	853.6
2017	4571	65.2	1550.4	849.0
2018	4803	64.9	1617.6	859.9
2019	5003	64.4	1671.2	868.3
2020	5263	64.1	1750.4	887.8
P for trend	-	-	<0.001	<0.001
Malay				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	1153	23.6	2276.9	2011.4
2012	1251	23.9	2455.8	2111.7
2013	1336	24.2	2605.8	2169.1
2014	1426	24.3	2760.1	2244.1
2015	1526	24.5	2929.4	2325.8
2016	1698	25.4	3228.8	2499.5
2017	1830	26.1	3448.2	2607.7
2018	1961	26.5	3659.8	2703.8
2019	2081	26.8	3848.1	2786.9
2020	2227	27.1	4082.5	2894.7
P for trend	-	-	<0.001	<0.001
Indian				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	334	6.8	957.6	912.7
2012	361	6.9	1028.5	946.3
2013	378	6.8	1075.4	951.7
2014	420	7.1	1189.7	1006.7
2015	444	7.1	1250.9	1029.2
2016	479	7.2	1342.2	1076.0
2017	493	7.0	1373.9	1059.6
2018	519	7.0	1439.6	1069.6
2019	552	7.1	1522.2	1096.6
2020	588	7.2	1623.1	1133.8
P for trend	-	-	<0.001	<0.001

Figure 5.5.5: Prevalence rate (pmp) of definitive dialysis by ethnicity



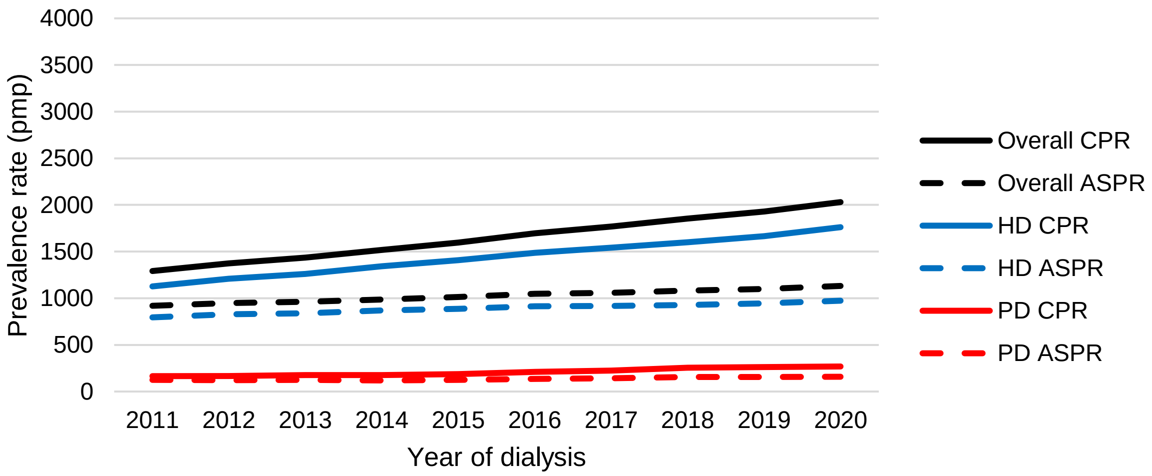
The ASPRs of definitive dialysis were consistently higher among HD than PD across the years (Table 5.5.5 and Figure 5.5.6). In 2020, the ASPR was 973.6 pmp and 158.4 pmp for HD and PD respectively. The ASPRs for both HD and PD increased significantly over the years (p<0.001).

Table 5.5.5: Prevalence number and rate (pmp) of definitive dialysis by modality

HD				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	4270	87.2	1126.9	795.2
2012	4612	87.9	1208.1	828.6
2013	4841	87.7	1259.2	837.8
2014	5199	88.4	1343.2	868.3
2015	5498	88.2	1408.8	886.9
2016	5849	87.7	1486.9	912.9
2017	6109	87.2	1540.4	917.6
2018	6388	86.3	1599.3	926.7
2019	6708	86.4	1666.1	944.7
2020	7125	86.8	1761.8	973.6
P for trend	-	-	<0.001	<0.001

PD				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2011	625	12.8	164.9	124.0
2012	632	12.1	165.5	120.4
2013	680	12.3	176.9	124.0
2014	681	11.6	175.9	118.8
2015	733	11.8	187.8	125.3
2016	823	12.3	209.2	135.3
2017	897	12.8	226.2	141.1
2018	1018	13.7	254.9	155.0
2019	1055	13.6	262.0	156.2
2020	1086	13.2	268.5	158.4
P for trend	-	-	<0.001	<0.001

Figure 5.5.6: Prevalence rate (pmp) of definitive dialysis by modality



The proportion of prevalent definitive dialysis patients with DN increased from 46.8% in 2011 to 56.0% in 2020 (Table 5.5.6). On the other hand, the proportion of prevalent definitive dialysis patients with GN dropped from 31.2% in 2011 to 22.5% in 2020.

Table 5.5.6: Prevalence number of definitive dialysis by etiology

Year of dialysis	DN		GN		Others	
	Number	**%**	**Number**	**%**	**Number**	**%**
2011	2290	46.8	1525	31.2	1080	22.1
2012	2543	48.5	1558	29.7	1143	21.8
2013	2760	50.0	1570	28.4	1191	21.6
2014	2998	51.0	1613	27.4	1269	21.6
2015	3272	52.5	1681	27.0	1278	20.5
2016	3568	53.5	1724	25.8	1380	20.7
2017	3801	54.3	1745	24.9	1460	20.8
2018	4062	54.8	1775	24.0	1569	21.2
2019	4287	55.2	1807	23.3	1669	21.5
2020	4600	56.0	1844	22.5	1767	21.5

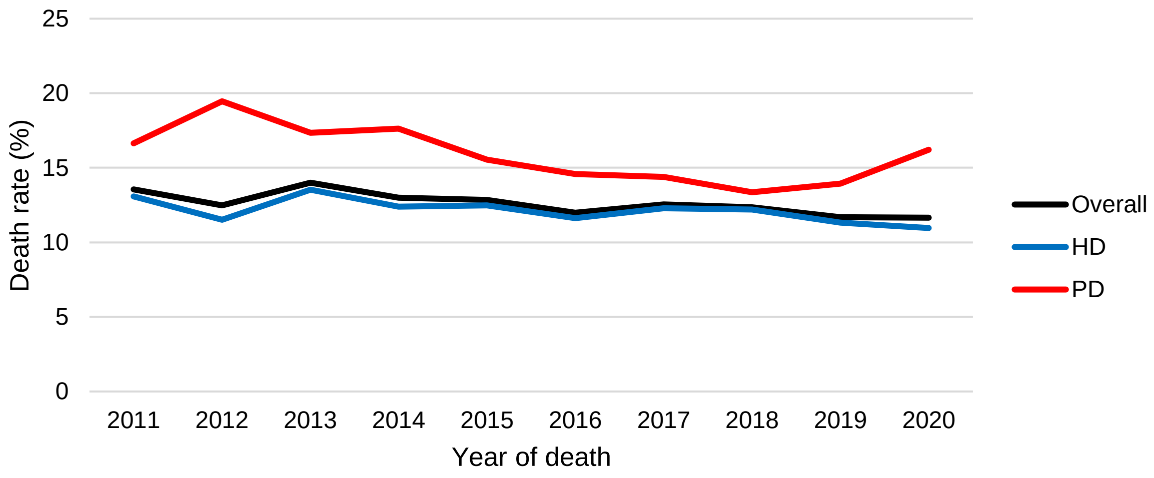
5.6 Mortality of definitive dialysis

Approximately 11% to 14% of the patients on definitive dialysis died every year in the past decade (Table 5.6.1 and Figure 5.6.1). Consistently, there were proportionally more deaths among PD patients than HD patients over the years, whereby the modality was based on the last modality that the dialysis patient received before death. The disparity in mortality between the two modalities narrowed over the years prior to 2018, but it started to widen from 2018 onwards. The mortality rate for PD dropped from 19.5% in 2012 to 13.4% in 2018 before rising to 16.2% in 2020, while it remained relatively stable at between 11.0% and 13.5% for HD in the past decade. The disparity in mortality between HD and PD will be further examined in the next section.

Table 5.6.1: All-cause mortality by modality

Year of death	Overall		HD		PD	
	Number	%	Number	%	Number	%
2011	663	13.5	559	13.1	104	16.6
2012	654	12.5	531	11.5	123	19.5
2013	773	14.0	655	13.5	118	17.4
2014	764	13.0	644	12.4	120	17.6
2015	800	12.8	686	12.5	114	15.6
2016	800	12.0	680	11.6	120	14.6
2017	879	12.5	750	12.3	129	14.4
2018	915	12.4	779	12.2	136	13.4
2019	907	11.7	760	11.3	147	13.9
2020	957	11.7	781	11.0	176	16.2

Figure 5.6.1: All-cause mortality by modality



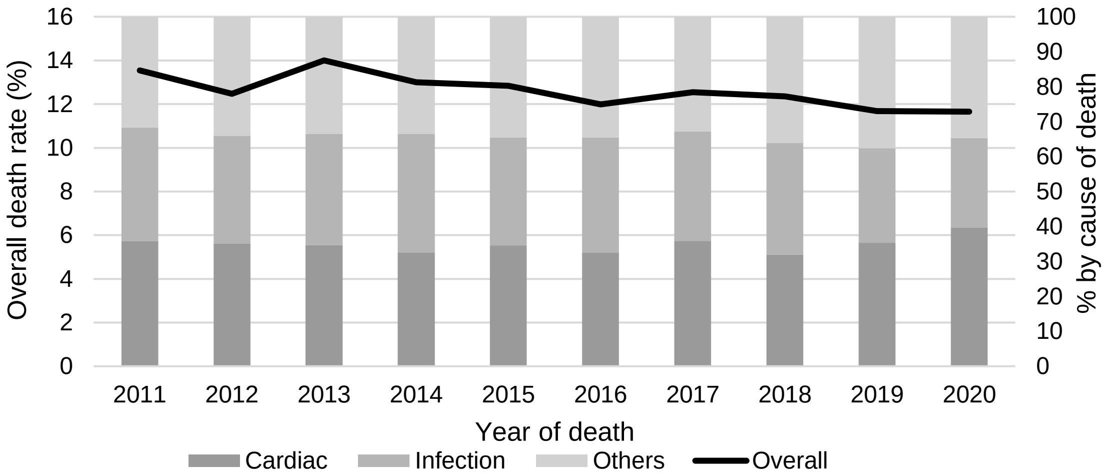
Deaths related to cardiac event and infection were the two most common causes of death and each of them accounted for about a third of all deaths across the years (Table 5.6.2 and Figure 5.6.2).

Table 5.6.2: Mortality by cause of death

Year of death	Overall		Cardiac event		Infection		Others	
	Number	%*	Number	%^	Number	%^	Number	%^
2011	663	13.5	237	35.7	216	32.6	210	31.7
2012	654	12.5	229	35.0	202	30.9	223	34.1
2013	773	14.0	268	34.7	246	31.8	259	33.5
2014	764	13.0	249	32.6	259	33.9	256	33.5
2015	800	12.8	277	34.6	247	30.9	276	34.5
2016	800	12.0	260	32.5	264	33.0	276	34.5
2017	879	12.5	315	35.8	275	31.3	289	32.9
2018	915	12.4	292	31.9	293	32.0	330	36.1
2019	907	11.7	320	35.3	246	27.1	341	37.6
2020	957	11.7	379	39.6	246	25.7	332	34.7

*Mortality among prevalent dialysis patients
^Mortality among prevalent dialysis patients who died

Figure 5.6.2: Mortality by cause of death



5.7 Survival of definitive dialysis

The unadjusted survival rate and median survival duration of new patients on definitive dialysis were estimated using the Kaplan-Meier method in Tables 5.7.2 to 5.7.10 and Figure 5.7.1. The event was defined as all-cause death. Patients were censored if they stopped definitive dialysis (i.e. received kidney transplant), or reached the end of the follow-up period (i.e. neither received kidney transplant nor died by 31 March 2021, the date until which the death status of all patients registered in the registry were updated for this report). Median survival duration is indicated as “not reached (NR)” if more than half of the patients were still alive as of 31 March 2021. Multivariable Cox regression model was used to adjust for the effects of potential confounders on the survival of patients in Table 5.7.11.

All analyses in this section were stratified by or adjusted for modality as the baseline characteristics (Table 5.7.1) and survival (Table 5.7.2) differed between HD and PD patients. The modality, age, gender, ethnicity, etiology and co-morbidities in this section were based on data captured by the registry at the start of definitive dialysis.

Compared to PD patients, the proportion of males was higher ($p<0.001$), but the proportion of Chinese was lower ($p<0.001$) among HD patients (Table 5.7.1). The proportions of those aged 60 years and above ($p=0.001$) and those with cerebrovascular disease ($p<0.001$) were lower among HD patients. However, HD patients had significantly higher proportions of peripheral vascular disease ($p=0.005$) and cancer ($p<0.001$).

Table 5.7.1: Baseline characteristics by modality

	HD	PD	Overall
Age group (%)			
≥60 years	54.2	57.0	54.8
Gender (%)			
Male	57.0	50.0	55.5
Ethnicity (%)			
Chinese	66.0	71.6	67.2
Malay	24.7	20.4	23.8
Indian	7.7	6.2	7.4
Etiology (%)			
DN	62.1	62.7	62.2
Co-morbidities (%)			
Ischemic heart disease	45.7	46.3	45.9
Cerebrovascular disease	22.7	25.5	23.3
Peripheral vascular disease	14.9	13.2	14.5
Cancer	8.6	4.3	7.7

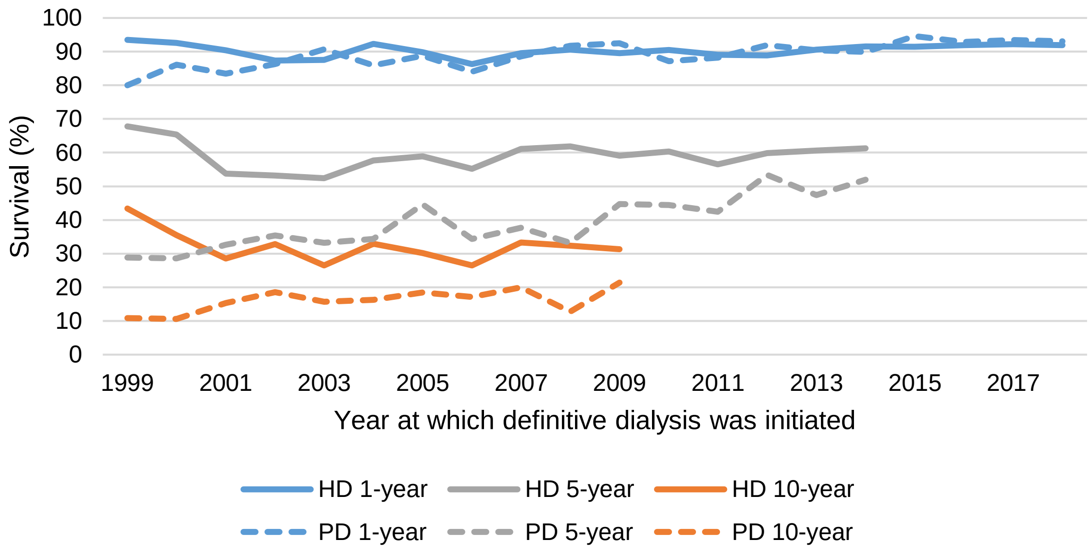
HD patients had significantly better survival than PD patients as indicated by their higher survival rates and longer median survival duration (p<0.001) (Table 5.7.2).

Table 5.7.2: Survival of definitive dialysis by modality

	HD	PD	Overall
1-year survival (%)	90.8	89.7	90.5
5-year survival (%)	60.8	41.4	56.4
10-year survival (%)	32.4	19.3	29.6
Median survival (years)	6.6	4.1	5.9

Although 5- and 10-year survival were higher among HD than PD patients, their gap narrowed over the years as the survival of HD patients remained stable while survival of PD patients significantly improved over the years (p<0.001) (Figure 5.7.1).

Figure 5.7.1: Survival of definitive dialysis by year and modality



Younger patients aged below 60 years had significantly better survival than older patients aged 60 years and above (p<0.001) (Table 5.7.3).

Table 5.7.3: Survival of definitive dialysis by age group and modality

	Age <60 years			Age ≥60 years		
	HD	**PD**	**Overall**	**HD**	**PD**	**Overall**
1-year survival (%)	93.6	93.3	93.5	88.4	87.0	88.1
5-year survival (%)	71.9	58.1	69.1	50.7	28.6	45.7
10-year survival (%)	46.8	34.3	44.3	19.1	7.7	16.5
Median survival (years)	9.3	6.2	8.7	5.1	3.3	4.5

Female HD patients had significantly better survival than male HD patients (p=0.033). However, survival among PD patients was fairly similar between the two genders (Table 5.7.4).

Table 5.7.4: Survival of definitive dialysis by gender and modality

	Male			Female		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	90.5	89.9	90.4	91.0	89.5	90.6
5-year survival (%)	59.9	42.7	56.5	61.4	40.2	56.2
10-year survival (%)	31.9	18.6	29.4	33.1	19.7	29.8
Median survival (years)	6.6	4.2	6.0	6.7	4.0	5.9

Malay HD patients had significantly better survival than Chinese and Indian HD patients (p<0.001). However, survival among PD patients was fairly similar across the three ethnic groups (Table 5.7.5).

Table 5.7.5: Survival of definitive dialysis by ethnicity and modality

	Chinese			Malay			Indian		
	HD	PD	Overall	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	90.8	89.9	90.6	90.9	89.2	90.6	90.2	89.3	90.0
5-year survival (%)	59.6	41.5	55.4	63.6	40.1	59.2	58.9	41.4	55.8
10-year survival (%)	31.2	18.8	28.4	36.5	21.0	33.6	29.7	16.8	27.4
Median survival (years)	6.4	4.1	5.8	7.1	3.9	6.4	6.0	3.8	5.8

Patients without DN had significantly better survival than those with DN regardless of modality (p<0.001) (Table 5.7.6).

Table 5.7.6: Survival of definitive dialysis by etiology and modality

	Non-DN			DN		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.5	93.4	92.7	89.7	87.5	89.2
5-year survival (%)	71.7	62.9	69.8	53.8	29.0	48.3
10-year survival (%)	49.4	37.9	47.0	21.4	8.5	18.5
Median survival (years)	9.8	7.4	9.3	5.5	3.3	4.8

Patients without ischemic heart disease (IHD) had significantly better survival than those with IHD regardless of modality (p<0.001) (Table 5.7.7).

Table 5.7.7: Survival of definitive dialysis by presence of IHD and modality

	No IHD			IHD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	93.0	92.9	93.0	88.3	86.4	87.9
5-year survival (%)	70.0	54.2	66.6	50.4	28.5	45.4
10-year survival (%)	43.5	30.2	40.7	19.9	8.8	17.3
Median survival (years)	8.6	5.5	8.0	5.0	3.2	4.4

Patients without cerebrovascular disease (CVD) had significantly better survival than those with CVD regardless of modality (p<0.001) (Table 5.7.8).

Table 5.7.8: Survival of definitive dialysis by presence of CVD and modality

	No CVD			CVD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.0	91.4	91.8	87.1	85.5	86.7
5-year survival (%)	64.7	47.2	61.0	48.1	27.0	42.8
10-year survival (%)	36.4	23.2	33.7	18.8	9.4	16.4
Median survival (years)	7.2	4.7	6.7	4.7	3.0	4.2

Patients without peripheral vascular disease (PVD) had significantly better survival than those with PVD regardless of modality (p<0.001) (Table 5.7.9).

Table 5.7.9: Survival of definitive dialysis by presence of PVD and modality

	No PVD			PVD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	91.9	91.1	91.7	85.4	82.3	84.8
5-year survival (%)	63.9	45.4	59.8	44.8	21.6	40.2
10-year survival (%)	35.8	22.0	32.8	14.6	4.0	12.5
Median survival (years)	7.2	4.5	6.5	4.3	2.7	3.9

Patients without cancer had significantly better survival than those with cancer regardless of modality (p<0.001) (Table 5.7.10).

Table 5.7.10: Survival of definitive dialysis by presence of cancer and modality

	No cancer			Cancer		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.0	91.6	91.9	82.9	87.8	83.5
5-year survival (%)	63.1	45.0	59.2	45.7	33.9	44.2
10-year survival (%)	34.1	21.3	31.4	20.3	10.2	19.0
Median survival (years)	6.9	4.5	6.3	4.5	3.3	4.3

PD, old age, DN, IHD, CVD, PVD and cancer remained as significant risk factors of death in the multivariable analysis (Table 5.7.11).

Compared to HD patients, the poorer survival among PD patients could be due to several factors, aside from the co-morbidities captured by the registry. For instance, as PD is done at home and self-managed by the patient him/herself or his/her caregiver at own convenience, the efficiency and quality of dialysis may be affected if it is not done properly and regularly at the recommended frequency. As PD patients also visit their healthcare providers less frequently, infections and complications may be less recognised, thereby affecting the timeliness of complication management[13].

[13] Yang F et al. Hemodialysis versus peritoneal dialysis: A comparison of survival outcomes in South-East Asian patients with end-stage renal disease. PLoS ONE. 2015; 10(10): e0140195.

Table 5.7.11: Adjusted risk of death by factors associated with survival of definitive dialysis

	Hazard ratio	95% confidence interval	P-value
Modality			
HD	1.00	Reference	<0.001
PD	1.53	1.46 – 1.60	
Age group			
<60 years	1.00	Reference	<0.001
≥60 years	1.92	1.83 – 2.00	
Gender			
Male	1.00	Reference	0.671
Female	0.99	0.95 – 1.03	
Ethnicity			
Chinese	1.00	Reference	
Malay	0.92	0.87 – 0.96	0.001
Indian	0.98	0.91 – 1.06	0.611
Etiology			
Non-DN	1.00	Reference	<0.001
DN	1.73	1.65 – 1.81	
IHD			
No	1.00	Reference	<0.001
Yes	1.46	1.40 – 1.53	
CVD			
No	1.00	Reference	<0.001
Yes	1.34	1.28 – 1.40	
PVD			
No	1.00	Reference	<0.001
Yes	1.48	1.40 – 1.56	
Cancer			
No	1.00	Reference	<0.001
Yes	1.49	1.39 – 1.60	

5.8 Management of definitive dialysis

The management of prevalent patients on dialysis was assessed based on several criteria: frequency of dialysis, management of urea, management of anaemia, and management of mineral and bone disease. The criteria of each of these aspects are as follow:

Criteria	Modality	Indication of adequacy
Frequency of dialysis and management of urea	HD	Thrice weekly dialysis
		Urea reduction ratio (URR) >=65% or fractional clearance of urea (Kt/V) >=1.2%
	PD	Kt/V >=2.0%
Management of anaemia	HD and PD	Haemoglobin (hb) >=10 g/dL with or without erythropoietin stimulating agent (ESA)
Management of mineral and bone disease	HD and PD	Corrected serum calcium (Ca) <2.37 mmol/L
		Serum phosphate (PO_4) >1.13 mmol/L and <1.78 mmol/L
		Serum intact parathyroid hormone (iPTH) >16.3 pmol/L and <33.0 pmol/L

The indications of adequacy listed above follow as closely to international guidelines[14,15,16,17] as possible. Notably, the reference range for the lab investigations differ from each healthcare institution and the registry does not capture the reference range for each patient.

All analyses in this section were stratified by service provider (public sector / VWOs / private sector) and modality (HD / PD) to look out for groups of patients in need of better dialysis management. The most recent reading of each biomarker for each patient in each year were taken and patients without measurement of biomarkers were excluded.

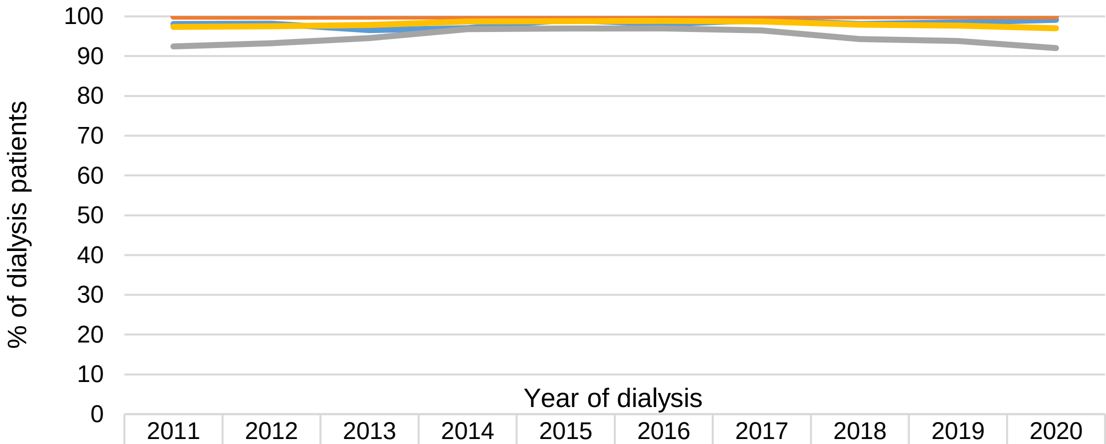
The majority of the prevalent HD patients were dialysed in centres run by the VWOs, followed by the private sector, then the public sector. In 2020, the proportions of HD patients under the care of the VWOs, private sector and public sector were 61.2%, 37.2% and 1.6% respectively (Table 5.1.2). Compared to the VWO and private sector in the past decade, the number of HD patients from the public sector was smaller, resulting in relatively less stable trends.

[14] National Kidney Foundation: K/DOQI clinical practice guidelines for hemodialysis adequacy, 2000. American Journal of Kidney Disease. 2001; 37 (suppl 1): S7-S64.
[15] NKF KDOQI Guidelines. National Kidney Foundation, New York. http://kidneyfoundation.cachefly.net/professionals/KDOQI/guideline_upHD_PD_VA/pd_guide2.htm Accessed on 1 Mar 2021.
[16] Mimura I, Tanaka T, Nangaku M. How the target hemoglobin of renal anemia should be? Nephron. 2015; 131: 202-209.
[17] NKF KDOQI Guidelines. National Kidney Foundation, New York. http://kidneyfoundation.cachefly.net/professionals/KDOQI/guidelines_bone/guidestate.htm Accessed on 1 Mar 2021.

On the other hand, almost all the prevalent PD patients were cared for by the public sector. In 2020, 99.4% of the PD patients fell under the care of the public sector, with no patient under the care of the VWOs (Table 5.1.2). As there were only a few PD patients from the private sector in the past decade and no PD patient from the VWOs since 2017, their trends were either unstable or not applicable. Hence, statistics related to PD patients from the private sector in the past decade and the VWOs from 2017 onwards were excluded from this section.

The proportion of prevalent HD patients with thrice weekly dialysis was consistently higher for the public sector and VWOs than the private sector across the years (Figure 5.8.1a). 99.1%, 100% and 92.0% of the patients from the public, VWOs and private sector underwent thrice weekly dialysis in 2020 respectively.

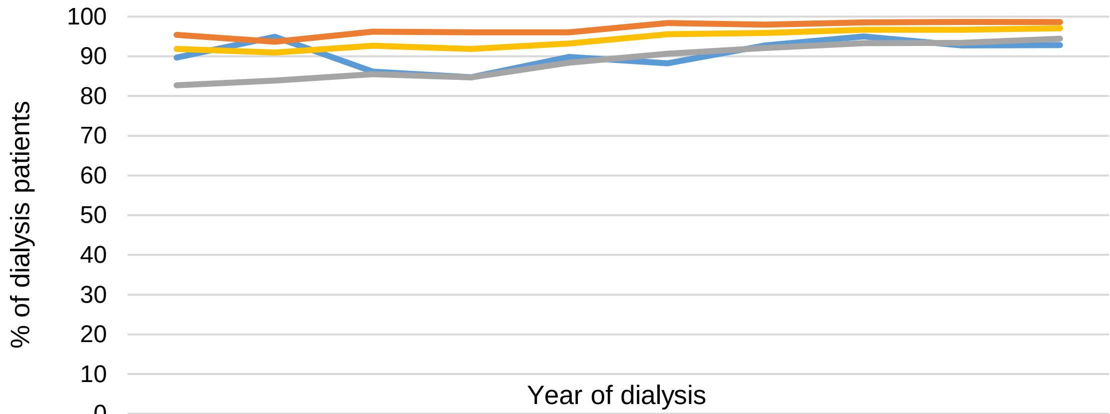
Figure 5.8.1a: Proportion of HD patients with thrice weekly dialysis



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	98.0	98.1	96.6	97.1	99.1	98.1	99.0	98.1	98.5	99.1
VWO	99.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Private	92.5	93.2	94.5	96.8	97.0	97.0	96.5	94.3	93.8	92.0
Overall	97.4	97.5	97.9	98.7	98.8	98.9	98.7	97.9	97.7	97.0

The proportion of prevalent HD patients who met the adequate management of urea criteria of URR >=65% or Kt/V >=1.2% was generally higher for the VWOs than the public and private sectors (Figure 5.8.1b). However, the private sector caught up, with proportion rising from 82.7% in 2011 to 94.4% in 2020. The proportion for the public sector and VWOs was 92.9% and 98.6% respectively in 2020.

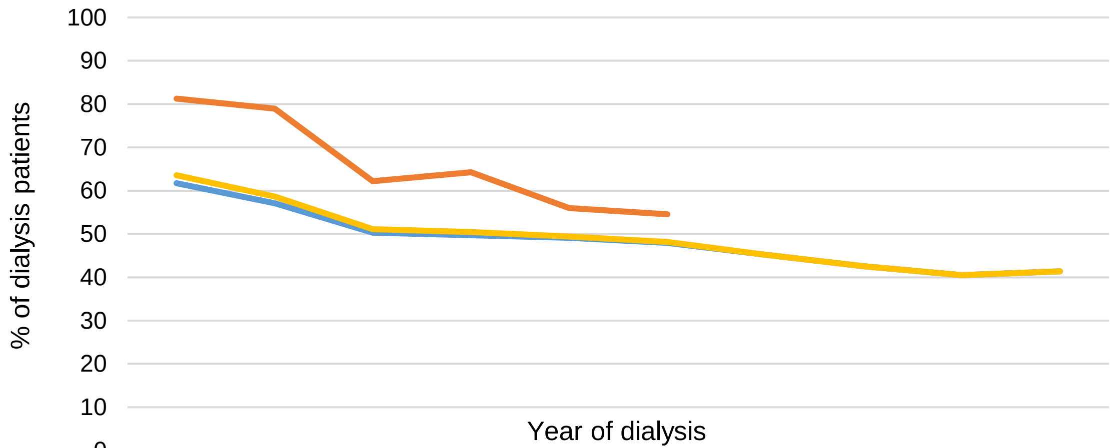
Figure 5.8.1b: Proportion of HD patients with adequate management of urea (URR >=65% or Kt/V >=1.2%)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	89.7	94.9	86.2	84.7	89.9	88.2	92.8	95.0	92.8	92.9
VWO	95.4	93.7	96.2	96.0	96.0	98.3	98.0	98.6	98.7	98.6
Private	82.7	83.9	85.5	84.7	88.4	90.6	92.1	93.3	93.4	94.4
Overall	91.9	91.0	92.6	91.9	93.3	95.5	95.9	96.7	96.7	97.1

The proportion of prevalent PD patients who met the adequate management of urea criteria of Kt/V >=2.0% was consistently higher for the VWOs than the public sector in 2011 to 2016 (Figure 5.8.2). 41.4% of the patients from public sector met the criteria in 2020.

Figure 5.8.2: Proportion of PD patients with adequate management of urea (Kt/V >=2%)

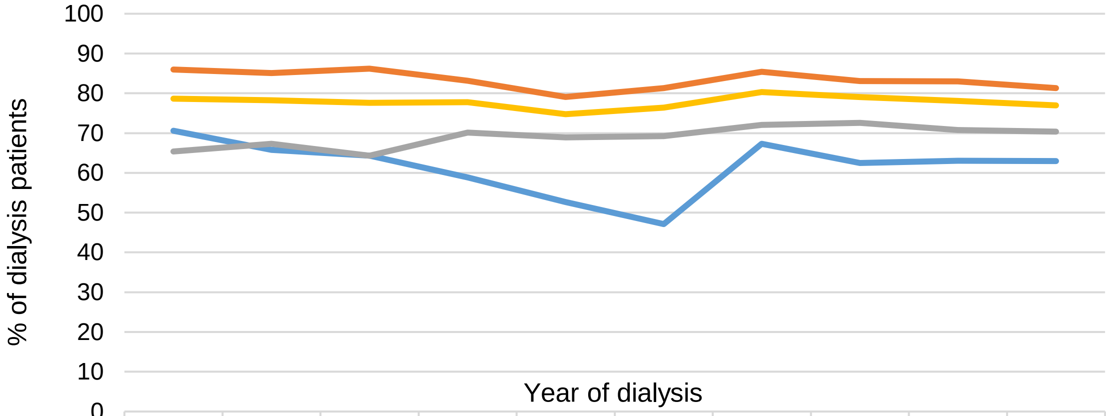


	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	61.7	57.1	50.3	49.7	49.1	47.9	45.2	42.6	40.5	41.4
VWO	81.3	78.9	62.2	64.3	56.0	54.5				
Overall	63.6	58.6	51.1	50.5	49.4	48.2	45.2	42.6	40.5	41.4

The proportion of prevalent HD patients who fulfilled the adequate management of anaemia criteria of hb >=10 g/dL was consistently higher for the VWOs than the public and private sectors across the years (Figure 5.8.3a). 62.9%, 81.3% and 70.4% of the patients from the public, VWOs and private sector met the criteria respectively in 2020.

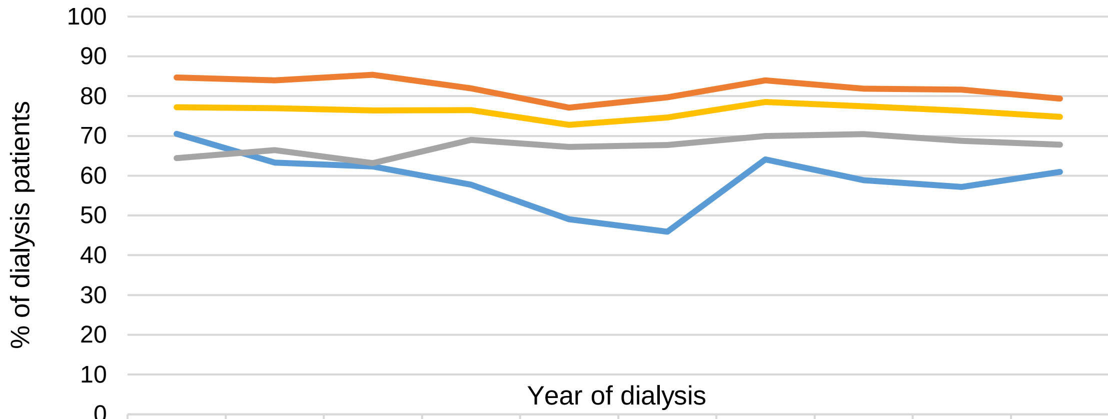
Similar trends were observed after stratification by ESA, a drug that stimulates the production of erythropoietin, a hormone produced primarily by the kidneys and plays a key role in the production of red blood cells (Figures 5.8.3b and 5.8.3c). In addition, the proportion of prevalent HD patients who fulfilled the adequate management of anaemia criteria was consistently higher among those who were not taking ESA than those on ESA (Figure 5.8.3b and Figure 5.8.3c). This could be due to patients who were prone to anaemia being on ESA.

Figure 5.8.3a: Proportion of HD patients with adequate management of anaemia (hb >=10 g/dL)



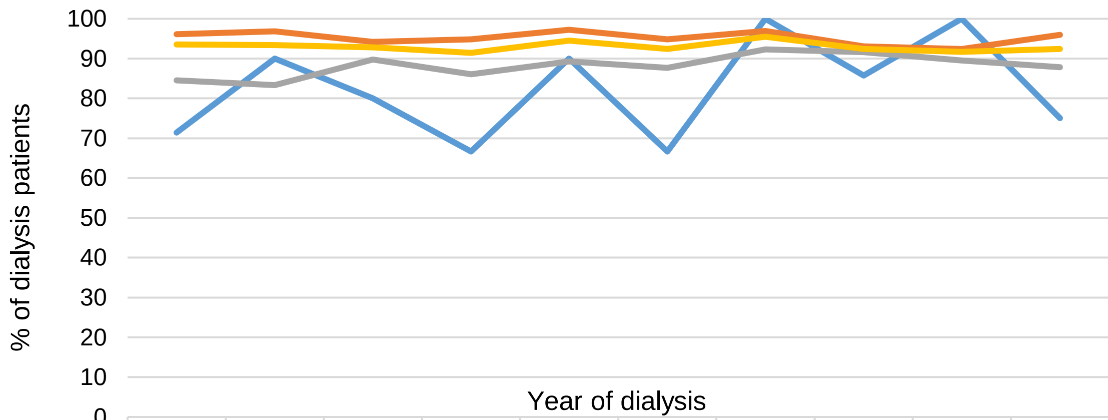
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	70.6	65.7	64.4	58.8	52.6	47.1	67.3	62.5	63.1	62.9
VWO	86.0	85.1	86.2	83.1	79.1	81.3	85.4	83.1	83.0	81.3
Private	65.4	67.3	64.3	70.1	68.9	69.3	72.1	72.6	70.7	70.4
Overall	78.7	78.2	77.6	77.7	74.7	76.4	80.3	79.0	78.1	77.0

Figure 5.8.3b: Proportion of HD patients on ESA with adequate management of anaemia (hb >=10 g/dL)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	70.5	63.3	62.3	57.8	49.0	45.9	64.1	58.9	57.1	61.0
VWO	84.7	83.9	85.4	81.9	77.1	79.7	84.0	81.9	81.7	79.4
Private	64.4	66.4	63.2	69.0	67.2	67.7	69.9	70.5	68.8	67.8
Overall	77.2	77.0	76.4	76.5	72.8	74.7	78.5	77.4	76.3	74.8

Figure 5.8.3c: Proportion of HD patients not on ESA with adequate management of anaemia (hb >=10 g/dL)

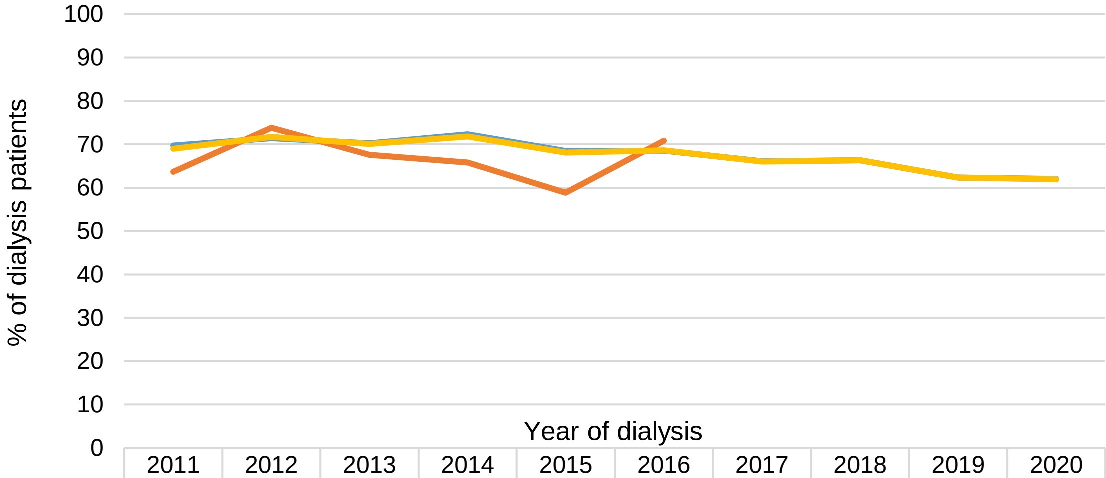


	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	71.4	90.0	80.0	66.7	90.0	66.7	100.0	85.7	100.0	75.0
VWO	96.1	96.9	94.2	94.8	97.2	94.8	96.9	93.0	92.4	95.9
Private	84.5	83.3	89.7	86.0	89.3	87.7	92.3	91.6	89.5	87.8
Overall	93.5	93.4	92.8	91.4	94.5	92.4	95.5	92.4	91.7	92.4

The proportion of prevalent PD patients who fulfilled the adequate management of anaemia criteria of hb >=10 g/dL was generally higher for the public sector than the VWO in 2011 to 2016 (Figure 5.8.4a). 62.0% of the public sector patients fulfilled the criteria in 2020.

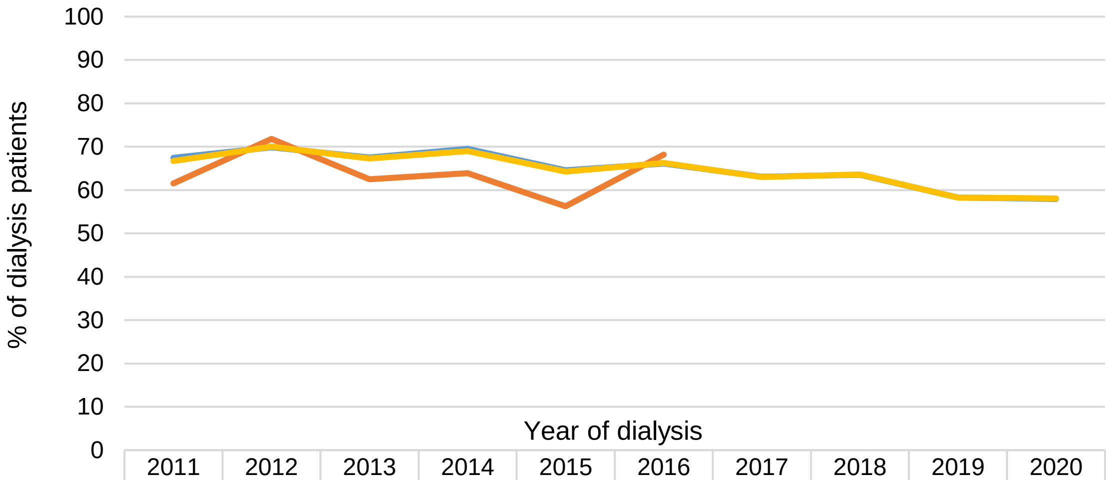
Similar trends were observed among PD patients who were taking ESA (Figure 5.8.4b). However, among PD patients who were not on ESA, all the patients from the VWOs fulfilled the criteria and their proportion was consistently higher than the public sector across the years (Figure 5.8.4c). Similar to HD patients, the proportion of PD patients fulfilling the criteria was consistently higher among those who were not taking ESA than those on ESA.

Figure 5.8.4a: Proportion of PD patients with adequate management of anaemia (hb >=10 g/dL)



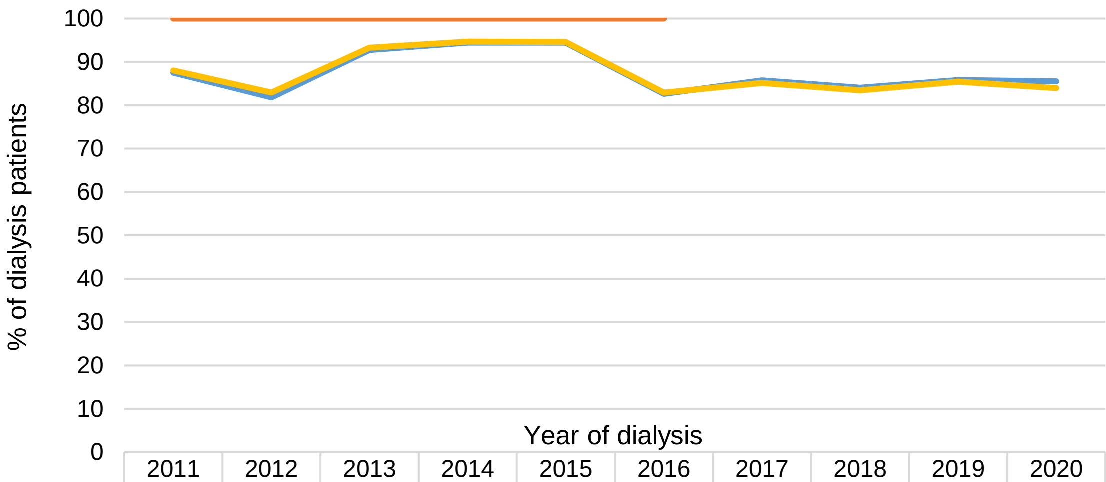
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	69.7	71.4	70.2	72.3	68.4	68.5	66.1	66.3	62.3	62.0
VWO	63.6	73.8	67.6	65.8	58.8	70.8				
Overall	69.0	71.7	70.1	71.8	68.1	68.6	66.0	66.3	62.3	61.9

Figure 5.8.4b: Proportion of PD patients on ESA with adequate management of anaemia (hb >=10 g/dL)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	67.4	69.8	67.5	69.5	64.6	66.1	63.0	63.5	58.3	57.9
VWO	61.5	71.8	62.5	63.9	56.3	68.2				
Overall	66.7	70.0	67.3	69.0	64.3	66.2	63.0	63.6	58.3	58.1

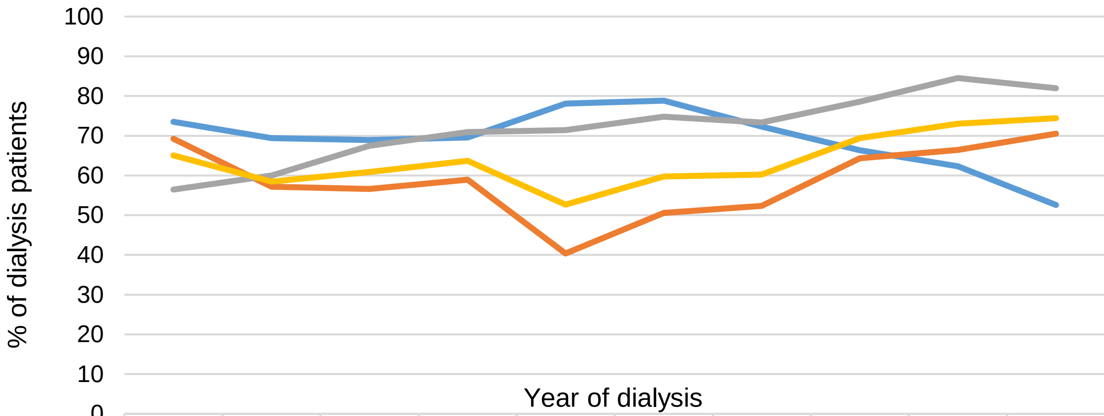
Figure 5.8.4c: Proportion of PD patients not on ESA with adequate management of anaemia (hb >=10 g/dL)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	87.5	81.8	92.8	94.4	94.4	82.6	85.7	84.1	85.8	85.5
VWO	100.0	100.0	100.0	100.0	100.0	100.0				
Overall	88.1	82.9	93.2	94.7	94.6	82.9	85.1	83.5	85.4	84.0

The proportion of prevalent HD patients who passed the adequate management of mineral and bone disease criteria of corrected serum Ca <2.37 mmol/L was generally an inverted U-shape trend for the public sector, a U-shape trend for the VWOs, and an upward trend for the private sector over the years (Figure 5.8.5). The proportions of patients passing the criteria were 52.6%, 70.5% and 81.9% for the public sector, VWOs and private sector respectively in 2020.

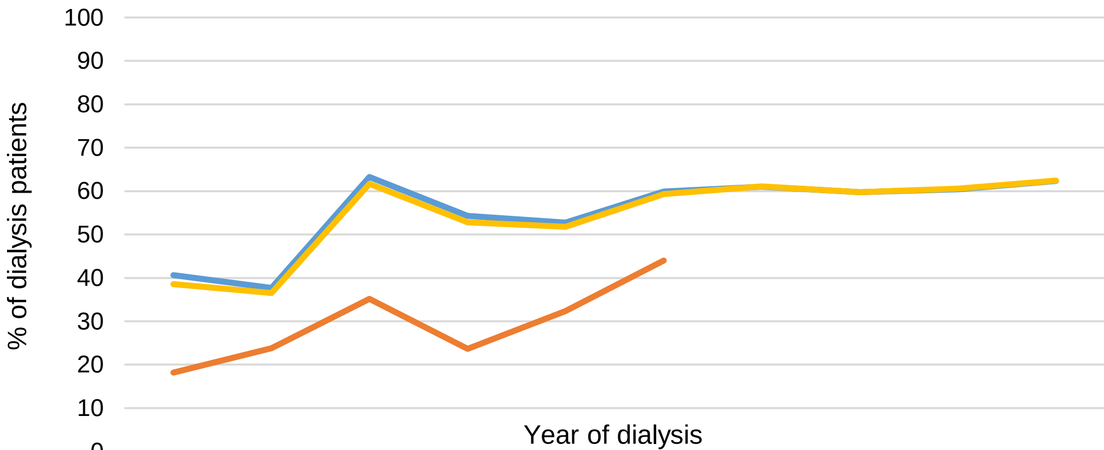
Figure 5.8.5: Proportion of HD patients with adequate management of mineral and bone disease (corrected serum Ca <2.37 mmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	73.5	69.4	69.0	69.6	78.1	78.8	72.3	66.3	62.3	52.6
VWO	69.3	57.2	56.6	59.0	40.4	50.6	52.4	64.3	66.4	70.5
Private	56.5	60.0	67.4	71.0	71.4	74.8	73.3	78.6	84.5	81.9
Overall	65.1	58.5	60.9	63.7	52.7	59.8	60.2	69.4	73.0	74.4

The proportion of prevalent PD patients who passed the adequate management of mineral and bone disease criteria of corrected serum Ca <2.37 mmol/L was consistently higher for the public sector than the VWOs in 2011 to 2016 (Figure 5.8.6). 62.3% of the patients from the public sector passed the criteria in 2020.

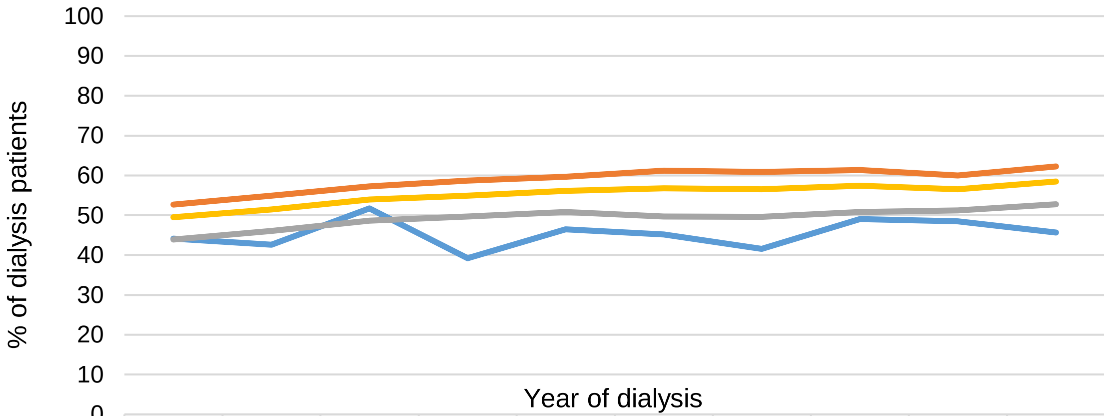
Figure 5.8.6: Proportion of PD patients with adequate management of mineral and bone disease (corrected serum Ca <2.37 mmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	40.6	37.7	63.2	54.3	52.7	59.9	61.0	59.8	60.4	62.3
VWO	18.2	23.8	35.1	23.7	32.4	44.0				
Overall	38.6	36.5	61.7	52.8	51.8	59.3	61.0	59.8	60.6	62.4

The proportion of prevalent HD patients who passed the adequate management of mineral and bone disease criteria of serum PO_4 >1.13 mmol/L and <1.78 mmol/L was consistently higher for the VWOs than the public and private sectors across the years (Figure 5.8.7). In 2020, the proportions of patients passing the criteria were 45.7%, 62.3% and 52.8% for the public sector, VWOs and private sector respectively.

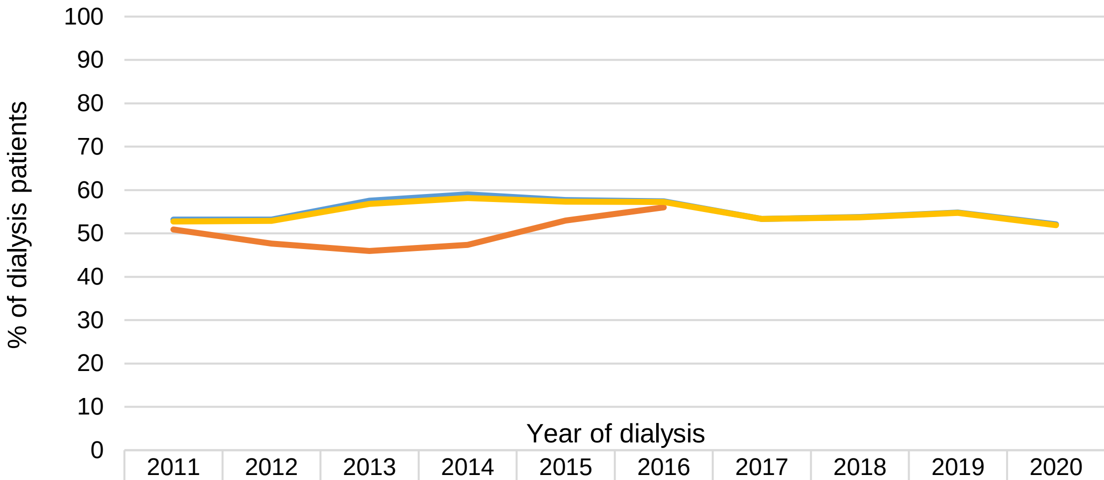
Figure 5.8.7: Proportion of HD patients with adequate management of mineral and bone disease (serum PO_4 >1.13 mmol/L and <1.78 mmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	44.1	42.6	51.7	39.2	46.5	45.2	41.6	49.0	48.5	45.7
VWO	52.7	54.9	57.3	58.7	59.7	61.2	60.9	61.4	60.0	62.3
Private	43.9	46.1	48.6	49.7	50.8	49.7	49.6	50.8	51.3	52.8
Overall	49.5	51.4	53.9	54.9	56.1	56.8	56.5	57.4	56.5	58.5

The proportion of prevalent PD patients who passed the adequate management of mineral and bone disease criteria of serum PO_4 >1.13 mmol/L and <1.78 mmol/L was consistently higher for the public sector than the VWOs in 2011 to 2016 (Figure 5.8.8). 52.1% of patients in the public sector met the criteria in 2020.

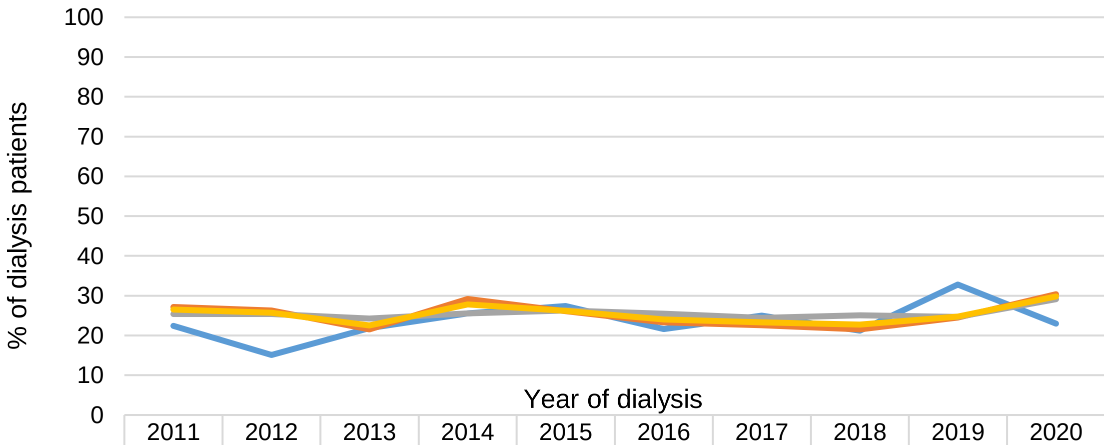
Figure 5.8.8: Proportion of PD patients with adequate management of mineral and bone disease (serum PO_4 >1.13 mmol/L and <1.78 mmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	53.2	53.2	57.6	59.0	57.7	57.4	53.4	53.8	54.8	52.1
VWO	50.9	47.6	45.9	47.4	52.9	56.0				
Overall	52.7	52.9	56.8	58.1	57.3	57.2	53.3	53.7	54.7	51.9

The proportion of prevalent HD patients who passed the adequate management of mineral and bone disease criteria of serum iPTH >16.3 pmol/L and <33.0 pmol/L was fairly similar across the three broad service providers for most of the years (Figure 5.8.9). In 2020, the proportions of patients passing the criteria were 22.9%, 30.4% and 29.1% for the public sector, VWOs and private sector respectively.

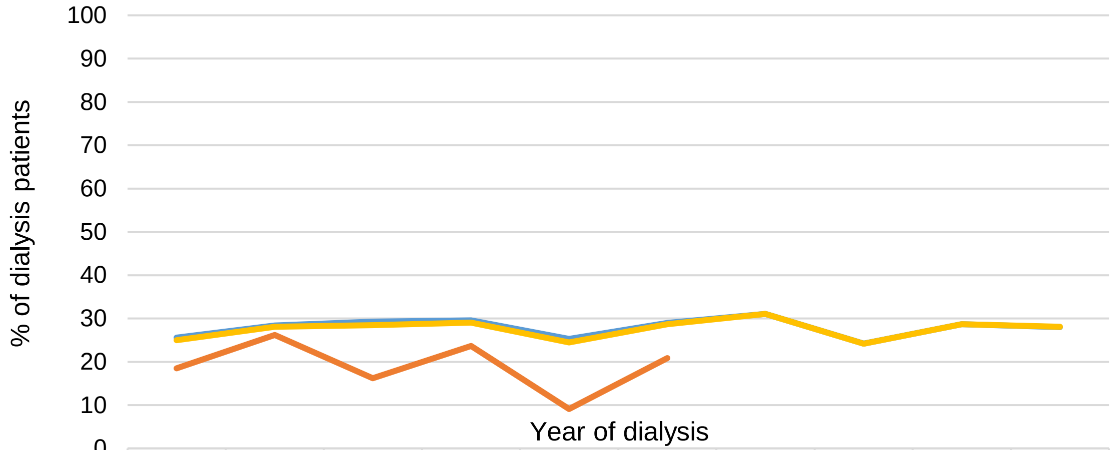
Figure 5.8.9: Proportion of HD patients with adequate management of mineral and bone disease (serum iPTH >16.3 pmol/L and <33.0 pmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	22.4	15.1	21.8	25.5	27.4	21.6	25.0	21.2	32.8	22.9
VWO	27.2	26.2	21.5	29.2	26.1	23.3	22.6	21.5	24.5	30.4
Private	25.4	25.4	24.3	25.6	26.3	25.5	24.4	25.1	24.7	29.1
Overall	26.5	25.7	22.5	27.8	26.2	24.0	23.3	22.8	24.7	29.8

The proportion of prevalent PD patients who passed the adequate management of mineral and bone disease criteria of serum iPTH >16.3 pmol/L and <33.0 pmol/L was consistently higher for the public sector than VWOs in 2011 to 2016 (Figure 5.8.10). 28.0% of the public sector patients passed the criteria in 2020.

Figure 5.8.10: Proportion of PD patients with adequate management of mineral and bone disease (serum iPTH >16.3 pmol/L and <33.0 pmol/L)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Public	25.6	28.4	29.2	29.5	25.3	29.0	31.1	24.2	28.6	28.0
VWO	18.5	26.2	16.2	23.7	9.1	20.8				
Overall	25.0	28.1	28.5	29.1	24.4	28.7	31.1	24.2	28.7	28.1

5.9 Incidence of kidney transplant

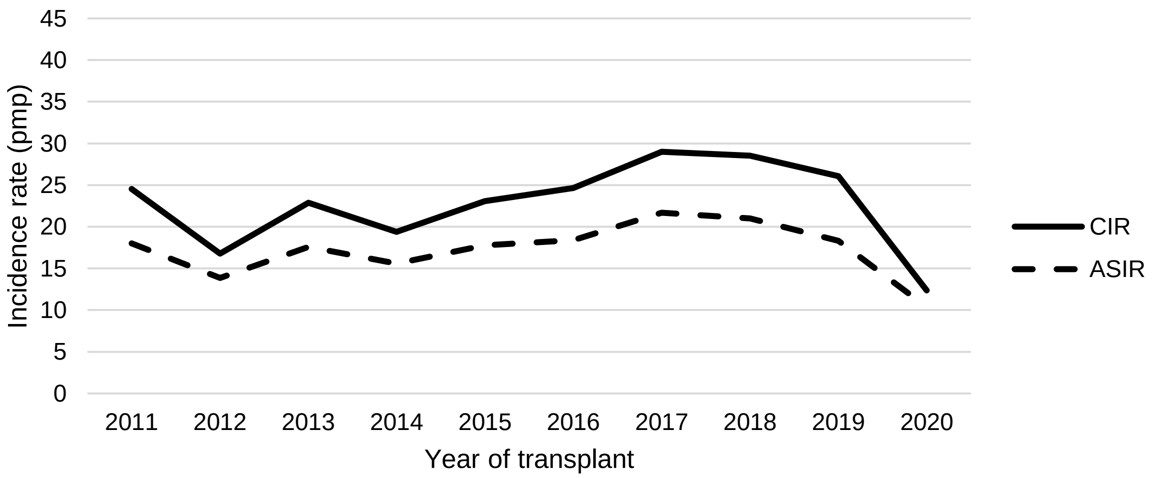
The incidence rate in each year was calculated by taking the number of new patients with kidney transplant in a year, divided by the number of Singapore residents in the same year. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

Prior to 2014, the number of new kidney transplants fluctuated year-on-year (Table 5.9.1 and Figure 5.9.1). There was an upward trend from 2014 to 2017, followed by a downward trend from 2017 to 2020. Similar trends were observed for the CIR and ASIR. The large drop in 2020 was likely due to the COVID-19 pandemic as people avoided going to the hospitals and hospitals postponed less urgent cases. 50 patients received kidney transplant in 2020, with CIR of 12.4 pmp and ASIR of 10.4 pmp.

Table 5.9.1: Incidence number and rate (pmp) of kidney transplant

Year of transplant	Number	CIR	ASIR
2011	93	24.5	18.0
2012	64	16.8	13.9
2013	88	22.9	17.6
2014	75	19.4	15.6
2015	90	23.1	17.8
2016	97	24.7	18.4
2017	115	29.0	21.7
2018	114	28.5	21.0
2019	105	26.1	18.3
2020	50	12.4	10.4
P for trend	-	0.896	0.794

Figure 5.9.1: Incidence rate (pmp) of kidney transplant



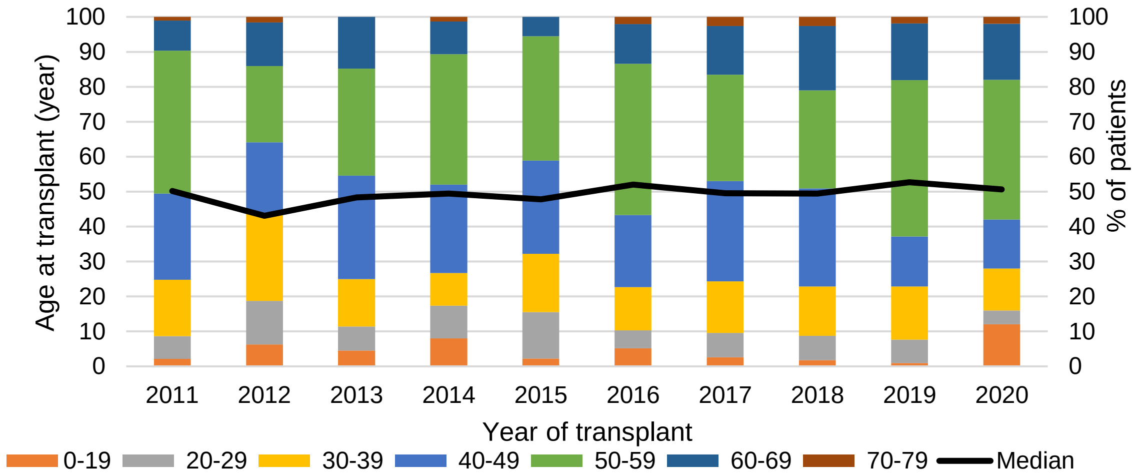
The majority of the new kidney transplant patients were aged 50 to 59 years, with 4 in 10 of the patients in this age group in 2020 (Table 5.9.2).

Table 5.9.2: Age distribution (%) and age-specific incidence rate (pmp) of kidney transplant

Year of transplant	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	2	2.2	2.2	6	6.5	11.6	15	16.1	24.4	23	24.7	36.5
2012	4	6.3	4.5	8	12.5	15.4	16	25.0	26.3	13	20.3	20.6
2013	4	4.5	4.6	6	6.8	11.5	12	13.6	19.9	26	29.5	41.3
2014	6	8.0	7.0	7	9.3	13.2	7	9.3	11.8	19	25.3	30.4
2015	2	2.2	2.4	12	13.3	22.4	15	16.7	25.4	24	26.7	38.7
2016	5	5.2	6.0	5	5.2	9.2	12	12.4	20.4	20	20.6	32.5
2017	3	2.6	3.6	8	7.0	14.6	17	14.8	29.3	33	28.7	53.7
2018	2	1.8	2.4	8	7.0	14.6	16	14.0	27.3	32	28.1	52.3
2019	1	1.0	1.2	7	6.7	13.0	16	15.2	26.9	15	14.3	24.5
2020	6	12.0	7.5	2	4.0	3.8	6	12.0	10.0	7	14.0	11.5
P for trend	-	-	0.828	-	-	0.227	-	-	0.605	-	-	0.476
Year of transplant	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2011	38	40.9	66.8	8	8.6	25.0	1	1.1	6.0	0	0.0	0.0
2012	14	21.9	24.0	8	12.5	23.3	1	1.6	5.8	0	0.0	0.0
2013	27	30.7	45.5	13	14.8	35.3	0	0.0	0.0	0	0.0	0.0
2014	28	37.3	46.4	7	9.3	17.8	1	1.3	5.5	0	0.0	0.0
2015	32	35.6	52.4	5	5.6	11.8	0	0.0	0.0	0	0.0	0.0
2016	42	43.3	68.3	11	11.3	24.5	2	2.1	10.4	0	0.0	0.0
2017	35	30.4	57.0	16	13.9	34.3	3	2.6	14.2	0	0.0	0.0
2018	32	28.1	52.2	21	18.4	43.4	3	2.6	13.1	0	0.0	0.0
2019	47	44.8	77.2	17	16.2	34.0	2	1.9	8.2	0	0.0	0.0
2020	20	40.0	33.2	8	16.0	15.6	1	2.0	3.8	0	0.0	0.0
P for trend	-	-	0.618	-	-	0.794	-	-	0.641	-	-	-

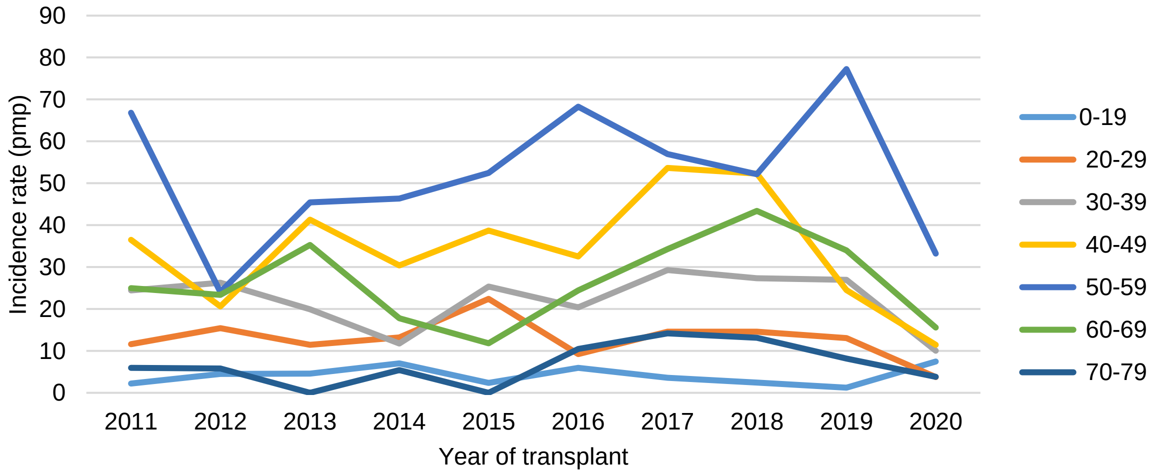
The median age at kidney transplant fluctuated between 43.1 years and 52.7 years in the past decade (Figure 5.9.2a).

Figure 5.9.2a: Median age (year) and age distribution (%) of new kidney transplant patients



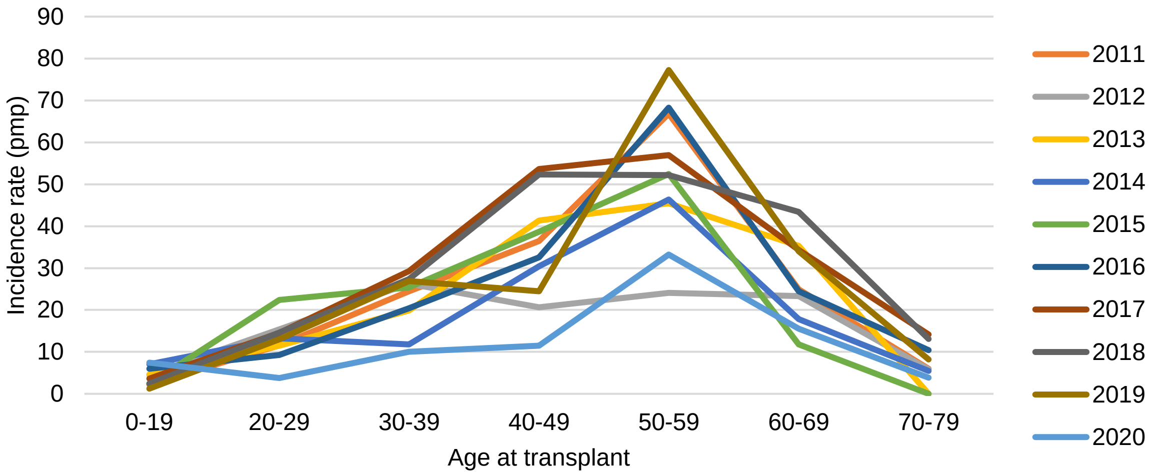
Due to the small number of kidney transplants done each year, the age-specific incidence rates of kidney transplant for all age groups fluctuated randomly over the years (Figure 5.9.2b).

Figure 5.9.2b: Age-specific incidence rate (pmp) of kidney transplant across years



The age-specific incidence rate of kidney transplant peaked at age 50-59 years for all the years, except for 2012 where most of the transplants were almost evenly distributed in the four 10-year age groups between 30-69 years (Figure 5.9.3).

Figure 5.9.3: Age-specific incidence rate (pmp) of kidney transplant across age groups



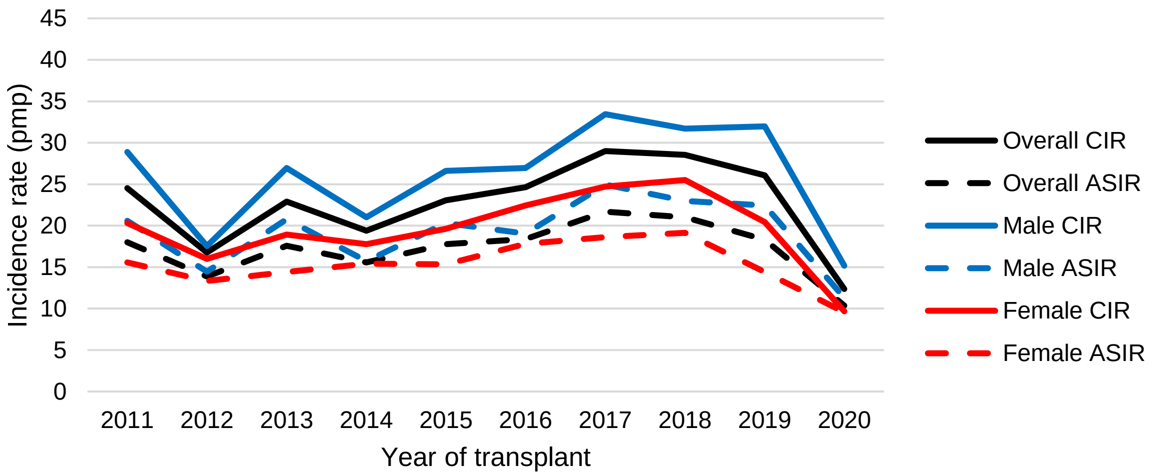
The ASIRs of kidney transplant were generally higher among males than females across the years (Table 5.9.3 and Figure 5.9.4). In 2020, the ASIR was 11.3 pmp and 9.6 pmp for males and females respectively. The ASIRs for both genders fluctuated randomly over the years due to the small number of kidney transplants.

Table 5.9.3: Incidence number and rate (pmp) of kidney transplant by gender

Male				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2011	54	58.1	28.9	20.6
2012	33	51.6	17.6	14.5
2013	51	58.0	27.0	20.8
2014	40	53.3	21.0	15.7
2015	51	56.7	26.6	20.3
2016	52	53.6	26.9	19.0
2017	65	56.5	33.4	25.0
2018	62	54.4	31.7	23.0
2019	63	60.0	32.0	22.4
2020	30	60.0	15.2	11.3
P for trend	-	-	0.909	0.913

Female				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2011	39	41.9	20.3	15.6
2012	31	48.4	16.0	13.3
2013	37	42.0	18.9	14.4
2014	35	46.7	17.8	15.4
2015	39	43.3	19.6	15.3
2016	45	46.4	22.5	17.8
2017	50	43.5	24.7	18.6
2018	52	45.6	25.5	19.1
2019	42	40.0	20.4	14.4
2020	20	40.0	9.7	9.6
P for trend	-	-	0.668	0.667

Figure 5.9.4: Incidence rate (pmp) of kidney transplant by gender

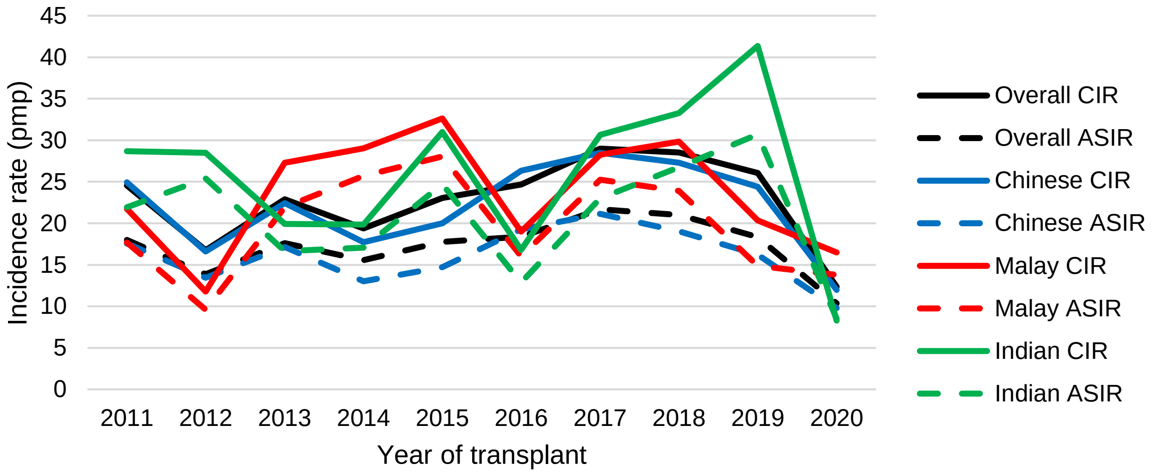


There was no ethnic group with consistently higher or lower incidence rates of kidney transplant across the years (Table 5.9.4 and Figure 5.9.5). In 2020, the ASIR was 9.8 pmp, 13.8 pmp and 8.5 pmp for Chinese, Malays and Indians respectively. The ASIRs for all the three ethnic groups fluctuated randomly over the years due to the small number of kidney transplants.

Table 5.9.4: Incidence number and rate (pmp) of kidney transplant by ethnicity

Chinese				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2011	70	75.3	24.9	17.6
2012	47	73.4	16.6	13.4
2013	64	72.7	22.4	17.2
2014	51	68.0	17.7	13.0
2015	58	64.4	20.0	14.7
2016	77	79.4	26.3	19.3
2017	84	73.0	28.5	21.1
2018	81	71.1	27.3	19.0
2019	73	69.5	24.4	16.2
2020	36	72.0	12.0	9.8
P for trend	-	-	0.827	0.706
Malay				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2011	11	11.8	21.7	17.7
2012	6	9.4	11.8	9.6
2013	14	15.9	27.3	21.9
2014	15	20.0	29.0	25.7
2015	17	18.9	32.6	28.1
2016	10	10.3	19.0	16.0
2017	15	13.0	28.3	25.3
2018	16	14.0	29.9	23.9
2019	11	10.5	20.3	14.9
2020	9	18.0	16.5	13.8
P for trend	-	-	0.854	0.922
Indian				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2011	10	10.8	28.7	21.9
2012	10	15.6	28.5	25.4
2013	7	8.0	19.9	16.7
2014	7	9.3	19.8	17.1
2015	11	12.2	31.0	24.7
2016	6	6.2	16.8	12.9
2017	11	9.6	30.7	23.0
2018	12	10.5	33.3	26.8
2019	15	14.3	41.4	30.7
2020	3	6.0	8.3	8.5
P for trend	-	-	0.561	0.550

Figure 5.9.5: Incidence rate (pmp) of kidney transplant by ethnicity



Most of the new kidney transplants were done locally, with 92.0% being local transplants in 2020 (Table 5.9.5). The ratio of living donors with reference to deceased donors among local transplants increased from 2016 onwards. Transplants done overseas were not further stratified into living or deceased donor as the registry does not have the data.

Table 5.9.5: Incidence number of kidney transplant by type of donor

Year of transplant	Local transplant				Overseas transplant	
	Living donor		Deceased donor			
	Number	%	Number	%	Number	%
2011	31	33.3	36	38.7	26	28.0
2012	28	43.8	23	35.9	13	20.3
2013	35	39.8	34	38.6	19	21.6
2014	40	53.3	17	22.7	18	24.0
2015	40	44.4	32	35.6	18	20.0
2016	32	33.0	40	41.2	25	25.8
2017	41	35.7	53	46.1	21	18.3
2018	42	36.8	38	33.3	34	29.8
2019	56	53.3	33	31.4	16	15.2
2020	31	62.0	15	30.0	4	8.0

GN was the main cause of CKD5 among new kidney transplant patients (Table 5.9.6). The proportion of new kidney transplant patients with GN was 46.0% in 2020, while the proportion with DN was 18.0%. There were more patients with GN undergoing transplant than those with DN as patients with DN tend to have more co-morbidities and higher risk of post-transplant complications[18,19].

[18] Chantrel F et al. Abysmal prognosis of patients with type 2 diabetes entering dialysis. Nephrology Dialysis Transplant 1999; 14: 129-136.
[19] Hashmi S et al. Overview of renal transplantation. Minerva Med 2007. 98(6): 713-729.

Table 5.9.6: Incidence number of kidney transplant by etiology

Year of transplant	DN		GN		Others	
	Number	%	Number	%	Number	%
2011	9	9.7	59	63.4	25	26.9
2012	9	14.1	46	71.9	9	14.1
2013	8	9.1	55	62.5	25	28.4
2014	11	14.7	42	56.0	22	29.3
2015	18	20.0	49	54.4	23	25.6
2016	17	17.5	53	54.6	27	27.8
2017	19	16.5	70	60.9	26	22.6
2018	17	14.9	69	60.5	28	24.6
2019	24	22.9	50	47.6	31	29.5
2020	9	18.0	23	46.0	18	36.0

5.10 Prevalence of kidney transplant

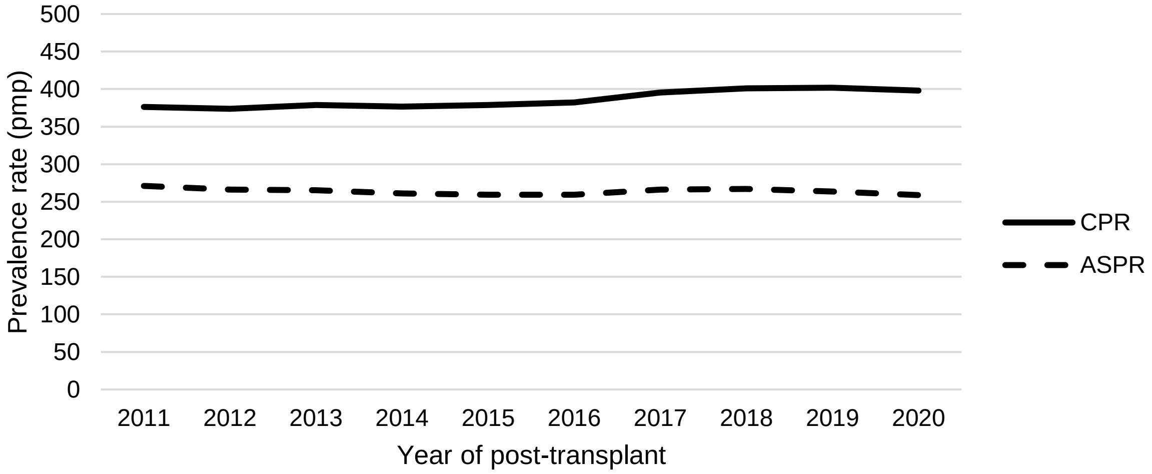
The prevalence rate in each year was calculated by taking the cumulative number of surviving (existing and new) patients with kidney transplant in a year, divided by the number of Singapore residents in the same year. Patients were categorised into 10-year age groups and age standardisation was done using the direct method with the Segi World population as the reference population.

Unlike the incidence trends of kidney transplant which decreased since 2017 with the sharpest drop in 2020 (Table 5.9.1 and Figure 5.9.1), the number of prevalent patients with kidney transplant increased consistently since 2011 with a slight dip in 2020 (Table 5.10.1 and Figure 5.10.1). There was a significant rise in CPR from 376.1 pmp in 2011 to 397.9 pmp in 2020 ($p<0.001$), while the ASPR remained relatively stable at between 258.9 pmp and 271.1 pmp during the same period. The stable ASPR trend suggests that the rise in new patients undergoing kidney transplant was fairly similar to the drop from those who died, after adjusting for Singapore's ageing population.

Table 5.10.1: Prevalence number and rate (pmp) of kidney transplant

Year of post-transplant	Number	CPR	ASPR
2011	1425	376.1	271.1
2012	1427	373.8	266.2
2013	1456	378.7	265.5
2014	1458	376.7	261.2
2015	1478	378.7	259.4
2016	1503	382.1	259.4
2017	1568	395.4	266.1
2018	1602	401.1	267.2
2019	1618	401.9	263.5
2020	1609	397.9	258.9
P for trend	-	<0.001	0.165

Figure 5.10.1: Prevalence rate (pmp) of kidney transplant



The majority of the prevalent kidney transplant patients were aged 50 to 69 years, with close to two-thirds of the patients in this age group in 2020 (Table 5.10.2).

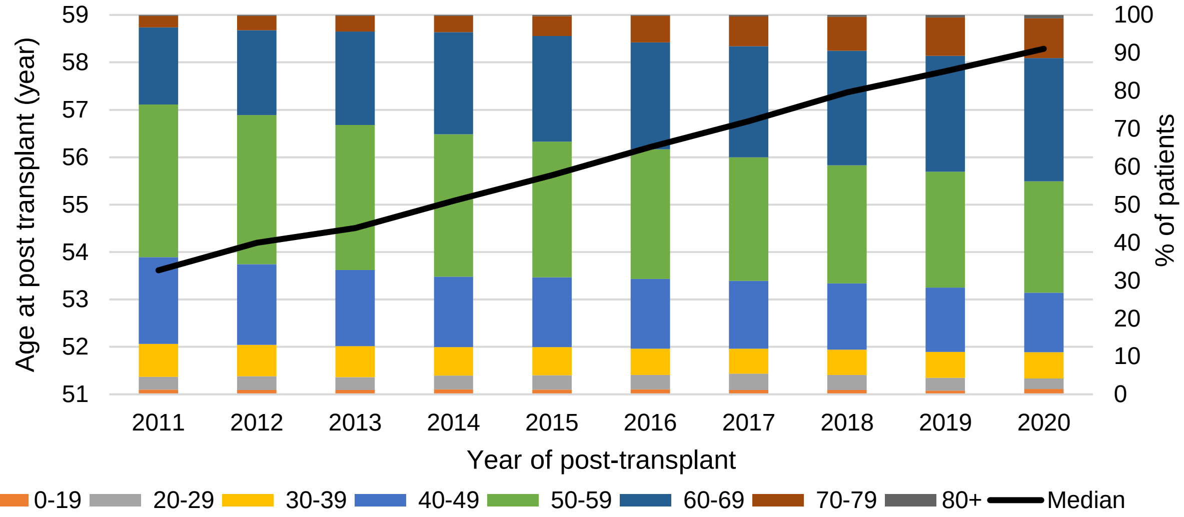
Table 5.10.2: Age distribution (%) and age-specific prevalence rate (pmp) of kidney transplant

Year of post-transplant	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2011	17	1.2	18.9	49	3.4	94.6	123	8.6	200.4	326	22.9	517.0
2012	16	1.1	18.1	52	3.6	100.2	118	8.3	193.7	304	21.3	482.8
2013	17	1.2	19.5	49	3.4	93.8	119	8.2	197.5	292	20.1	464.4
2014	19	1.3	22.2	53	3.6	100.1	109	7.5	183.4	271	18.6	433.9
2015	18	1.2	21.3	56	3.8	104.6	110	7.4	185.9	272	18.4	438.6
2016	20	1.3	23.9	57	3.8	105.4	104	6.9	177.0	276	18.4	449.1
2017	18	1.1	21.8	67	4.3	122.0	104	6.6	179.2	280	17.9	455.3
2018	19	1.2	23.2	63	3.9	115.1	107	6.7	182.9	279	17.4	456.3
2019	16	1.0	19.7	55	3.4	102.4	110	6.8	185.1	274	16.9	447.4
2020	22	1.4	27.4	45	2.8	84.7	111	6.9	185.8	253	15.7	414.1
P for trend	-	-	0.020	-	-	0.702	-	-	0.032	-	-	0.014

Year of post-transplant	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2011	574	40.3	1009.5	289	20.3	901.7	44	3.1	263.6	3	0.2	41.0
2012	560	39.2	961.9	320	22.4	933.5	54	3.8	314.0	3	0.2	38.7
2013	557	38.3	937.9	359	24.7	975.3	60	4.1	340.7	3	0.2	36.5
2014	548	37.6	907.4	392	26.9	998.2	63	4.3	344.1	3	0.2	34.4
2015	529	35.8	867.0	411	27.8	971.8	77	5.2	418.8	5	0.3	53.5
2016	514	34.2	835.5	423	28.1	940.3	105	7.0	547.6	4	0.3	40.9
2017	510	32.5	830.0	460	29.3	985.8	123	7.8	581.7	6	0.4	59.2
2018	499	31.1	813.6	484	30.2	1000.4	143	8.9	624.8	8	0.5	74.9
2019	495	30.6	813.6	493	30.5	985.8	165	10.2	674.2	10	0.6	86.5
2020	473	29.4	785.8	522	32.4	1015.5	169	10.5	647.5	14	0.9	112.9
P for trend	-	-	<0.001	-	-	0.012	-	-	<0.001	-	-	0.001

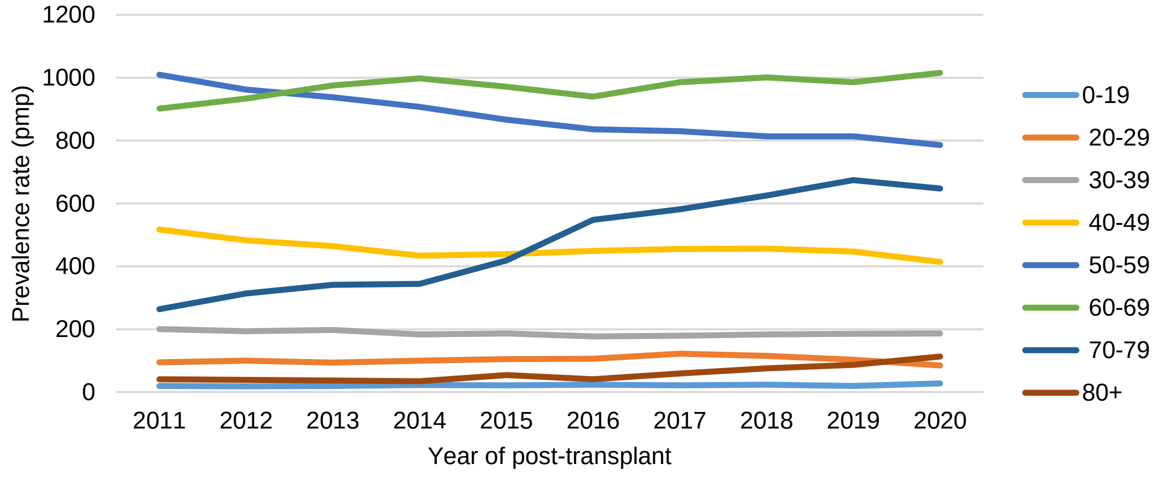
The median age among prevalent kidney transplant patients increased slightly from 53.6 years in 2011 to 58.3 years in 2020 (Figure 5.10.2a).

Figure 5.10.2a: Median age (year) and age distribution (%) of prevalent kidney transplant patients



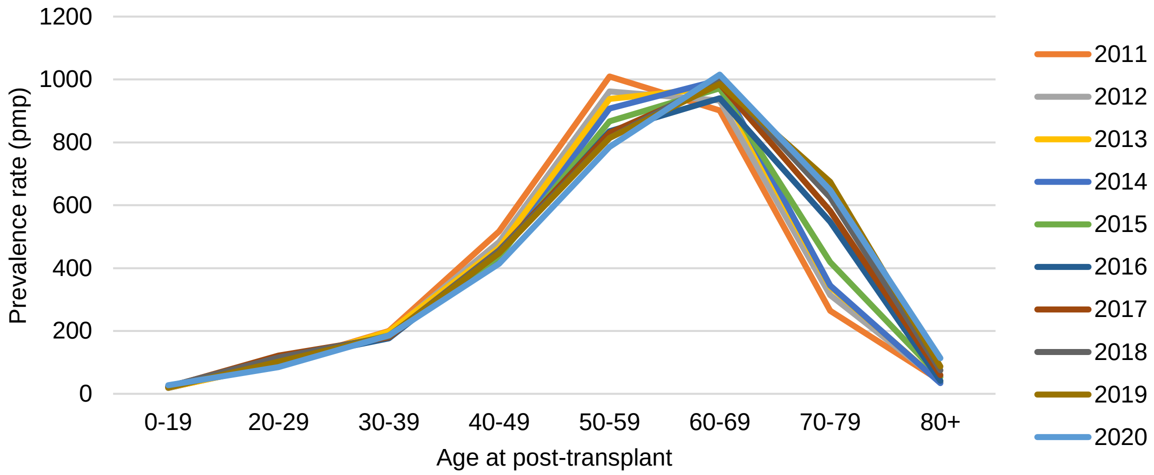
While the CPR of kidney transplant increased significantly for the 0-19 years (p=0.020), 60-69 years (p=0.012), 70-79 years (p<0.001) and 80+ years (p=0.001) age groups over the years, it dropped significantly for the 30-39 years (p=0.032), 40-49 years (p=0.014) and 50-59 years (p<0.001) age groups (Figure 5.10.2b and Table 5.10.2).

Figure 5.10.2b: Age-specific prevalence rate (pmp) of kidney transplant across years



Prior to 2013, the CPR of kidney transplant peaked at age 50-59 years. However, the peak shifted to age 60-69 years from 2013 onwards (Figure 5.10.3).

Figure 5.10.3: Age-specific prevalence rate (pmp) of kidney transplant across age groups



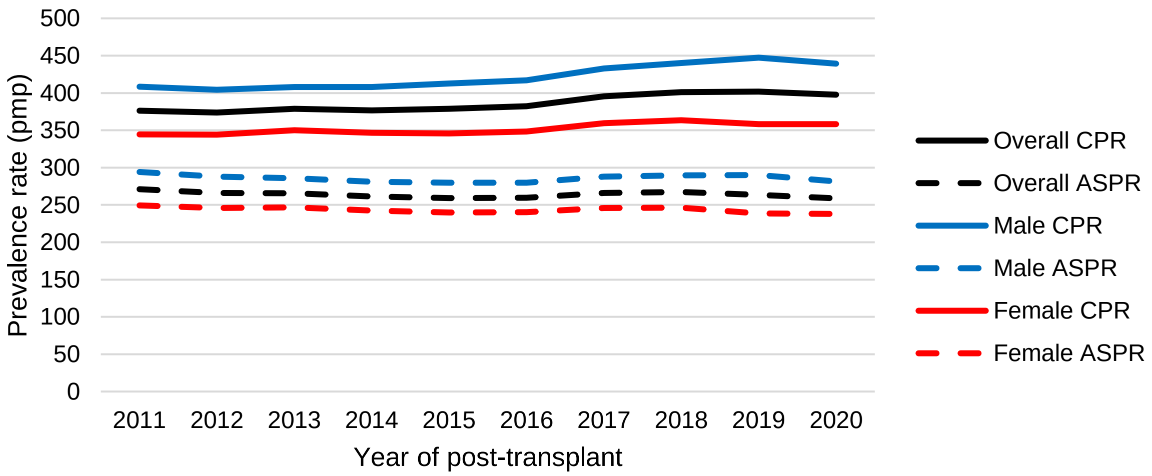
The ASPRs of kidney transplant were consistently higher among males than females across the years (Table 5.10.3 and Figure 5.10.4). In 2020, the ASPR was 281.6 pmp and 238.0 pmp for males and females respectively. The ASPR for males remained stable, while the ASPR for females dropped significantly over the years (p=0.031).

Table 5.10.3: Prevalence number and rate (pmp) of kidney transplant by gender

Male				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2011	763	53.5	408.4	294.2
2012	760	53.3	404.3	287.9
2013	772	53.0	408.2	285.7
2014	776	53.2	407.9	281.0
2015	791	53.5	412.7	279.9
2016	805	53.6	417.2	279.8
2017	841	53.6	432.7	287.8
2018	861	53.7	440.2	289.8
2019	881	54.4	447.3	290.1
2020	869	54.0	439.4	281.6
P for trend	-	-	<0.001	0.564

Female				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2011	662	46.5	344.6	249.4
2012	667	46.7	344.2	245.9
2013	684	47.0	350.2	246.8
2014	682	46.8	346.5	242.7
2015	687	46.5	345.9	240.0
2016	698	46.4	348.3	240.2
2017	727	46.4	359.5	245.9
2018	741	46.3	363.5	246.1
2019	737	45.6	358.3	238.8
2020	740	46.0	358.1	238.0
P for trend	-	-	0.002	0.031

Figure 5.10.4: Prevalence rate (pmp) of kidney transplant by gender

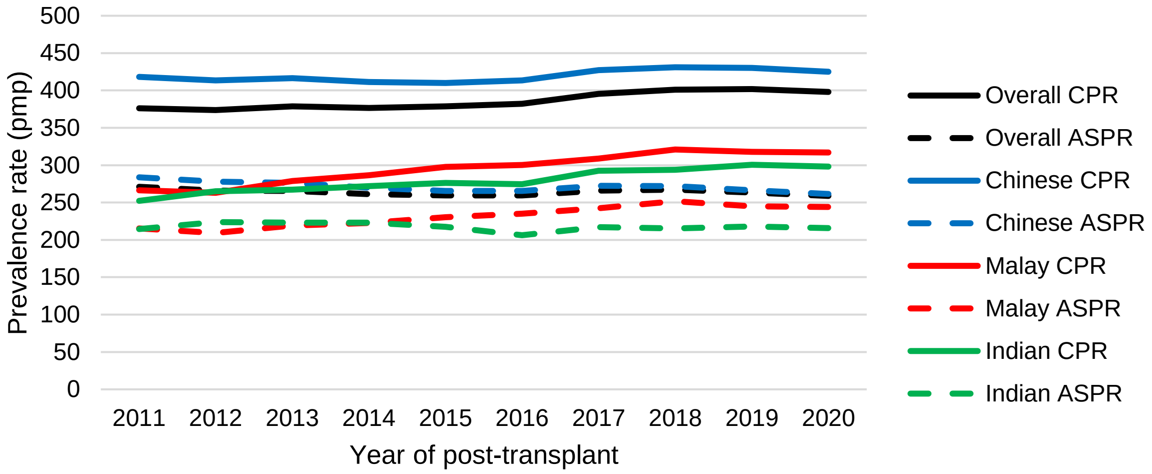


The ASPRs of kidney transplant were consistently higher among Chinese than Malays and Indians across the years (Table 5.10.4 and Figure 5.10.5). While the ASPR for Chinese dropped significantly from 283.8 pmp in 2011 to 261.5 pmp in 2020 (p=0.005), the ASPR for Malays increased significantly from 215.3 pmp in 2011 to 244.2 pmp in 2020 (p<0.001) and the ASPR for Indians remained relatively stable at between 206.3 pmp and 223.8 pmp in the past decade.

Table 5.10.4: Prevalence number and rate (pmp) of kidney transplant by ethnicity

Chinese				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2011	1174	82.4	418.0	283.8
2012	1171	82.1	413.5	277.8
2013	1188	81.6	416.3	276.1
2014	1182	81.1	411.2	269.7
2015	1189	80.4	410.0	265.7
2016	1209	80.4	413.6	265.7
2017	1259	80.3	427.0	272.4
2018	1280	79.9	431.1	271.8
2019	1288	79.6	430.2	266.4
2020	1278	79.4	425.0	261.5
P for trend	-	-	0.025	0.005
Malay				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2011	135	9.5	266.6	215.3
2012	134	9.4	263.1	209.3
2013	143	9.8	278.9	219.2
2014	148	10.2	286.5	222.7
2015	155	10.5	297.5	230.3
2016	158	10.5	300.4	235.2
2017	164	10.5	309.0	242.4
2018	172	10.7	321.0	251.7
2019	172	10.6	318.1	245.0
2020	173	10.8	317.1	244.2
P for trend	-	-	<0.001	<0.001
Indian				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2011	88	6.2	252.3	214.5
2012	93	6.5	265.0	223.8
2013	94	6.5	267.4	223.2
2014	96	6.6	271.9	223.1
2015	98	6.6	276.1	217.6
2016	98	6.5	274.6	206.3
2017	105	6.7	292.6	217.0
2018	106	6.6	294.0	215.5
2019	109	6.7	300.6	218.0
2020	108	6.7	298.1	215.7
P for trend	-	-	<0.001	0.340

Figure 5.10.5: Prevalence rate (pmp) of kidney transplant by ethnicity



Most of the prevalent kidney transplants were done locally, with 73.7% being local transplants in 2020 (Table 5.10.5). The number of prevalent kidney transplants from local deceased donors were consistently higher than from local living donors across the years. However, the proportion of prevalent kidney transplants from local living donors increased over the years, while the proportion from local deceased donors dropped. Transplants done overseas were not further stratified into living or deceased donor as the registry does not have the data.

Table 5.10.5: Prevalence number of kidney transplant by type of donor

Year of post-transplant	Local transplant				Overseas transplant	
	Living donor		Deceased donor			
	Number	%	Number	%	Number	%
2011	388	27.2	602	42.2	435	30.5
2012	404	28.3	589	41.3	434	30.4
2013	429	29.5	591	40.6	436	29.9
2014	454	31.1	571	39.2	433	29.7
2015	479	32.4	570	38.6	429	29.0
2016	485	32.3	585	38.9	433	28.8
2017	508	32.4	616	39.3	444	28.3
2018	527	32.9	629	39.3	446	27.8
2019	562	34.7	624	38.6	432	26.7
2020	574	35.7	611	38.0	424	26.4

The proportion of prevalent kidney transplant patients with DN was lower than those with GN (Table 5.10.6). However, while the proportion of prevalent kidney transplant patients with DN increased from 7.5% in 2011 to 10.4% in 2020, those with GN dropped from 71.1% in 2011 to 66.7% in 2020.

Table 5.10.6: Prevalence number of kidney transplant by etiology

Year of post-transplant	DN		GN		Others	
	Number	%	Number	%	Number	%
2011	107	7.5	1013	71.1	305	21.4
2012	113	7.9	1014	71.1	300	21.0
2013	116	8.0	1031	70.8	309	21.2
2014	122	8.4	1021	70.0	315	21.6
2015	134	9.1	1024	69.3	320	21.7
2016	141	9.4	1035	68.9	327	21.8
2017	152	9.7	1074	68.5	342	21.8
2018	155	9.7	1092	68.2	355	22.2
2019	171	10.6	1084	67.0	363	22.4
2020	168	10.4	1074	66.7	367	22.8

5.11 Survival of kidney transplant

Graft survival: the unadjusted survival rate and median survival duration of new kidney transplants were estimated using the Kaplan-Meier method in Tables 5.11.1 to 5.11.10. The event was defined as graft loss (i.e. return to dialysis or kidney transplant waitlist due to non-functioning graft) or all-cause death. Patients were censored if they neither suffered from graft loss nor died by 31 March 2021. Median survival duration is indicated as “not reached (NR)” if more than half of the patients did not suffer from graft loss and were still alive as of 31 March 2021. Grafts that stopped functioning within 30 days were excluded from this section.

Patient survival: the unadjusted survival rate and median survival duration of new kidney transplant patients were estimated using the Kaplan-Meier method in Tables 5.11.1 to 5.11.10. The event was defined as all-cause death. Patients were censored if they did not die by 31 March 2021. Median survival duration is indicated as “not reached (NR)” if more than half of the patients were still alive as of 31 March 2021. Multivariable Cox regression model was used to adjust for the effects of potential confounders on the survival of local transplant patients in Table 5.11.11.

The age, gender, ethnicity, etiology and co-morbidities in Tables 5.11.1 to 5.11.11 were based on data captured by the registry around the date of kidney transplant.

In Table 5.11.12, multivariable Cox regression model was used to estimate the adjusted risk of death among dialysis and local transplant patients. For patients who underwent dialysis prior to kidney transplant, their survival time were counted twice: (1) as dialysis patients where their survival time = time from start of definitive dialysis to transplant, they were censored at the date of transplant, and the potential confounders were based on data captured by the registry at the start of definitive dialysis; (2) as transplant patients where their survival time = time from date of transplant to death or 31 March 2021 (whichever earlier), and the potential confounders were based on data captured by the registry around the date of transplant.

Graft survival were high at 97.5%, 89.6% and 75.9% at 1-, 5- and 10-year post-transplant (Table 5.11.1). Patient survival was also high at 98.3%, 93.8% and 85.0% at 1-, 5- and 10-year post-transplant and outperformed patients on dialysis (90.5%, 56.4% and 29.6% at 1-, 5- and 10-year from the start of definitive dialysis; Table 5.7.2).

Table 5.11.1: Graft and patient survival of kidney transplant

	Graft	Patient
1-year survival (%)	97.5	98.3
5-year survival (%)	89.6	93.8
10-year survival (%)	75.9	85.0
Median survival (years)	19.6	NR

Among transplants done locally, patients who received kidney from living donors had significantly better graft (p<0.001) and patient (p<0.001) survival than those who received kidney from deceased donors (Table 5.11.2).

Table 5.11.2: Graft and patient survival of kidney transplant by type of donor

	Living		Deceased	
	Graft	Patient	Graft	Patient
1-year survival (%)	99.2	99.2	96.1	97.5
5-year survival (%)	93.8	96.2	86.2	91.8
10-year survival (%)	82.9	89.3	68.4	81.6
Median survival (years)	20.1	NR	16.8	NR

Younger patients aged below 60 years had significantly better graft (p=0.004) and patient (p<0.001) survival than older patients aged 60 years and above (Table 5.11.3).

Table 5.11.3: Graft and patient survival of kidney transplant by age group

	Age <60 years		Age ≥60 years	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.7	98.6	95.0	95.5
5-year survival (%)	90.0	94.4	85.7	88.1
10-year survival (%)	76.7	86.4	67.8	70.6
Median survival (years)	20.1	NR	20.8	20.8

Graft and patient survival were fairly similar between the two genders (Table 5.11.4).

Table 5.11.4: Graft and patient survival of kidney transplant by gender

	Male		Female	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.3	98.3	97.6	98.3
5-year survival (%)	89.1	94.0	90.2	93.5
10-year survival (%)	74.4	84.8	77.8	85.4
Median survival (years)	18.3	NR	NR	NR

Chinese had significantly better graft survival than Malays (p=0.003) and Indians (p<0.001) (Table 5.11.5). However, patient survival was fairly similar across the three ethnic groups.

Table 5.11.5: Graft and patient survival of kidney transplant by ethnicity

	Chinese		Malay		Indian	
	Graft	Patient	Graft	Patient	Graft	Patient
1-year survival (%)	97.6	98.4	96.2	97.0	98.1	98.8
5-year survival (%)	90.6	94.0	85.8	93.0	83.9	91.3
10-year survival (%)	77.7	84.9	69.2	87.4	63.9	81.4
Median survival (years)	20.8	NR	16.2	NR	12.7	NR

Patients without DN had significantly better graft (p<0.001) and patient (p<0.001) survival than those with DN (Table 5.11.6).

Table 5.11.6: Graft and patient survival of kidney transplant by etiology

	Non-DN		DN	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.6	98.4	96.6	97.3
5-year survival (%)	90.4	94.7	83.6	87.2
10-year survival (%)	77.3	86.6	65.4	73.3
Median survival (years)	20.8	NR	12.3	15.5

Patients without IHD had significantly better graft (p=0.001) and patient (p<0.001) survival than those with IHD (Table 5.11.7).

Table 5.11.7: Graft and patient survival of kidney transplant by presence of IHD

	No IHD		IHD	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.5	98.5	98.0	98.0
5-year survival (%)	90.4	94.9	86.1	88.6
10-year survival (%)	77.0	86.6	70.5	77.4
Median survival (years)	20.8	NR	15.0	16.8

Patients without CVD had significantly better graft (p=0.029) and patient (p=0.001) survival than those with CVD (Table 5.11.8).

Table 5.11.8: Graft and patient survival of kidney transplant by presence of CVD

	No CVD		CVD	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.9	98.6	90.0	93.7
5-year survival (%)	90.0	94.1	85.8	90.9
10-year survival (%)	76.2	85.5	74.5	77.7
Median survival (years)	20.1	NR	14.5	15.0

Patients without PVD had significantly better graft (p=0.041) and patient (p<0.001) survival than those with PVD (Table 5.11.9).

Table 5.11.9: Graft and patient survival of kidney transplant by presence of PVD

	No PVD		PVD	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.6	98.4	93.6	96.8
5-year survival (%)	90.0	94.2	83.2	86.5
10-year survival (%)	76.2	85.6	72.4	70.5
Median survival (years)	20.1	NR	12.9	12.3

Patients without cancer seemed to have better graft and patient survival than those with cancer (Table 5.11.10). However, the differences in survival were not statistically significant due to the small numbers involved.

Table 5.11.10: Graft and patient survival of kidney transplant by presence of cancer

	No cancer		Cancer	
	Graft	**Patient**	**Graft**	**Patient**
1-year survival (%)	97.8	98.6	96.5	96.5
5-year survival (%)	90.6	94.7	82.1	88.1
10-year survival (%)	76.8	86.0	68.1	77.2
Median survival (years)	20.1	NR	NR	NR

Among transplants done locally, transplant from deceased donor, old age, DN and IHD remained as significant risk factors of death in the multivariable analysis (Table 5.11.11).

Table 5.11.11: Adjusted risk of death by factors associated with patient survival among kidney transplant patients

	Hazard ratio	95% confidence interval	P-value
Transplant from			
Living donor	1.00	Reference	<0.001
Deceased donor	2.32	1.70 – 3.16	
Age group			
<60 years	1.00	Reference	<0.001
≥60 years	2.88	1.70 – 4.88	
Gender			
Male	1.00	Reference	0.825
Female	0.97	0.74 – 1.27	
Ethnicity			
Chinese	1.00	Reference	
Malay	0.99	0.69 – 1.43	0.966
Indian	1.33	0.84 – 2.11	0.218
Etiology			
Non-DN	1.00	Reference	<0.001
DN	2.43	1.52 – 3.88	
IHD			
No	1.00	Reference	0.011
Yes	1.61	1.12 – 2.33	
CVD			
No	1.00	Reference	0.070
Yes	1.85	0.95 – 3.60	
PVD			
No	1.00	Reference	0.067
Yes	2.04	0.95 – 4.37	
Cancer			
No	1.00	Reference	0.786
Yes	1.13	0.46 – 2.77	

Aside from transplant patients, Table 5.11.12 also includes dialysis patients without transplant. Patients with kidney transplant, be it from living or deceased donors, had significantly lower risk of death than dialysis patients without transplant. Old age, DN, IHD, CVD, PVD and cancer were significant risk factors of death among dialysis and transplant patients.

Table 5.11.12: Adjusted risk of death by factors associated with patient survival among definitive dialysis and kidney transplant patients

	Hazard ratio	95% confidence interval	P-value
Renal replacement therapy			
Dialysis	1.00	Reference	
Transplant from living donor	0.21	0.16 – 0.26	<0.001
Transplant from deceased donor	0.43	0.36 – 0.50	<0.001
Age group			
<60 years	1.00	Reference	<0.001
≥60 years	1.88	1.80 – 1.96	
Gender			
Male	1.00	Reference	0.768
Female	1.01	0.97 – 1.05	
Ethnicity			
Chinese	1.00	Reference	
Malay	0.90	0.85 – 0.94	<0.001
Indian	0.97	0.90 – 1.05	0.515
Etiology			
Non-DN	1.00	Reference	<0.001
DN	1.69	1.61 – 1.77	
IHD			
No	1.00	Reference	<0.001
Yes	1.46	1.40 – 1.53	
CVD			
No	1.00	Reference	<0.001
Yes	1.35	1.29 – 1.41	
PVD			
No	1.00	Reference	<0.001
Yes	1.45	1.38 – 1.53	
Cancer			
No	1.00	Reference	<0.001
Yes	1.42	1.32 – 1.52	

6. CONCLUSION

Although survival among dialysis patients has improved over the years, on top of the direct costs from medical expenses, there are also lifestyle changes required to accommodate the treatment. Kidney transplant is a good alternative treatment to dialysis as transplant patients have better survival and quality of life with fewer disruptions to their daily living, compared to dialysis patients who must set aside several hours for each dialysis session. However, the rate of transplant is dropping while the rate of CKD5 is rising in recent years. Moreover, the combined (living and deceased) kidney transplant rate is much lower than the demand, which is expected to further increase in future with an ageing population and concomitant increase in chronic diseases prevalence in Singapore. It is therefore important for individuals who have not been diagnosed with CKD to take preventive action.

CKD can be prevented by leading a healthy lifestyle, such as eating all food in moderation and opting for healthier products, exercising and maintaining a healthy weight, not smoking and going for regular health screening. As diabetes and hypertension are common chronic diseases that increase the risk of CKD, individuals with these conditions should seek regular review with their family doctor for timely intervention. For individuals who have been diagnosed with CKD in the early stages, progression to late stages can be controlled with appropriate medication and healthy lifestyle.

Annex

Prevalent patients by service providers as of 31 December 2020

Public hospitals and affiliated dialysis centres	HD	PD	Transplant
SINGAPORE GENERAL HOSPITAL	11	460	817
TAN TOCK SENG RENAL CENTRE	7	158	37
CHANGI GENERAL HOSPITAL	2	66	2
KHOO TECK PUAT HOSPITAL	5	128	0
NG TENG FONG GENERAL HOSPITAL	5	46	1
SENGKANG GENERAL HOSPITAL	4	16	0
TTSH RENAL DIALYSIS CENTRE	0	0	0
NATIONAL UNIVERSITY HOSPITAL	0	187	563
NUH DIALYSIS CENTRE	58	0	0
NUH RENAL CENTRE	20	0	0
SHAW NKF - NUH CHILDREN'S KIDNEY CENTRE	4	19	42
Subtotal	116	1080	1462
Voluntary Welfare Organisations	**HD**	**PD**	**Transplant**
ANG MO KIO THYE HUA KWAN HOSPITAL DIALYSIS CENTRE	62	0	0
FOO HAI - NKF DIALYSIS CENTRE	72	0	0
HONG LEONG - NKF DIALYSIS CENTRE (ALJUNIED CRESCENT)	102	0	0
IFPAS - NKF DIALYSIS CENTRE (SERANGOON)	100	0	0
JAPAN AIRLINE - NKF DIALYSIS CENTRE (ANG MO KIO I)	0	0	0
JO & GERRY ESSERY NKF DIALYSIS CENTRE (BLK 204 MARSILING)	97	0	0
KDF - BISHAN CENTRE	104	0	0
KDF - GHIM MOH CENTRE (HD)	86	0	0
KDF - KRETA AYER (HD)	77	0	0
KWAN IM THONG HOOD CHO TEMPLE - NKF DIALYSIS CENTRE (KOLAM AYER)	123	0	0
KWAN IM THONG HOOD CHO TEMPLE - NKF DIALYSIS CENTRE (SIMEI)	150	0	0
LE CHAMP - NKF DIALYSIS CENTRE (BLK 639 YISHUN ST 61)	115	0	0
LEONG HWA CHAN SI TEMPLE - NKF DIALYSIS CENTRE (TECK WHYE)	102	0	0
MTFA DIALYSIS CENTRE (MDC)	61	0	0
NEW CREATION CHURCH - NKF DIALYSIS CENTRE	91	0	0
NKF BUKIT PANJANG DIALYSIS CENTRE	91	0	0
NKF DIALYSIS CENTRE (BLK 365 WOODLANDS II)	99	0	0
NKF DIALYSIS CENTRE SUPPORTED BY KEPPEL	33	0	0
NKF DIALYSIS CENTRE SUPPORTED BY NGIAM KIA HUM & FAMILY	157	0	0
NKF HOUGANG PUNGGOL DIALYSIS CENTRE	116	0	0
NKF INTEGRATED RENAL CENTRE (CP1)	185	0	0
NKF INTEGRATED RENAL CENTRE (CP2)	22	0	0
NKF JURONG EAST DIALYSIS CENTRE SUPPORTED BY YUHUA GRASSROOTS ORGANISATIONS	73	0	0
NTUC INCOME - NKF DIALYSIS CENTRE (BUKIT BATOK)	88	0	0

NTUC/SINGAPORE POOLS - NKF DIALYSIS CENTRE (TAMPINES)	139	0	0
PEI HWA FOUNDATION - NKF DIALYSIS CENTRE (ANG MO KIO)	120	0	0
QUEENSTOWN - NKF DIALYSIS CENTRE	57	0	0
SAF - NKF DIALYSIS CENTRE (CLEMENTI)	87	0	0
SAKYADHITA -NKF DIALYSIS CENTRE (UPPER BOON KENG)	96	0	0
SCAL - NKF DIALYSIS CENTRE (YISHUN)	76	0	0
SECK HONG CHOON - NKF DIALYSIS CENTRE	45	0	0
SHENG HONG TEMPLE - NKF DIALYSIS CENTRE (JURONG WEST)	111	0	0
SIA - NKF DIALYSIS CENTRE (TOA PAYOH)	72	0	0
SINGAPORE BUDDHIST WELFARE SERVICES - NKF DIALYSIS CENTRE (HOUGANG)	155	0	0
SINGAPORE POOLS - NKF DIALYSIS CENTRE (BEDOK)	108	0	0
TAMPINES CHINESE TEMPLE - NKF DIALYSIS CENTRE (PASIR RIS)	84	0	0
TAY CHOON HYE - NKF DIALYSIS CENTRE (KIM KEAT)	81	0	0
THE HOUR GLASS - NKF DIALYSIS CENTRE (WEST COAST)	74	0	0
THE HOUR GLASS NKF DIALYSIS CENTRE (ADMIRALTY BRANCH)	104	0	0
THE SINGAPORE BUDDHIST LODGE - NKF DIALYSIS CENTRE (128 BUKIT MERAH VIEW)	99	0	0
THE SIRIVADHANABHAKDI FOUNDATION NKF DIALYSIS CENTRE (JW2)	101	0	0
THONG TECK SIAN TONG LIAN SIN SIA - NKF DIALYSIS CENTRE (WOODLANDS)	114	0	0
TOA PAYOH SEU TECK SEAN TONG - NKF DIALYSIS CENTRE (YISHUN)	75	0	0
WESTERN DIGITAL - NKF DIALYSIS CENTRE (ANG MO KIO)	154	0	0
WOH HUP - NKF DIALYSIS CENTRE (GHIM MOH)	74	0	0
WONG SUI HA EDNA - NKF DIALYSIS CENTRE	130	0	0
Subtotal	4362	0	0
Private clinics and dialysis centres	**HD**	**PD**	**Transplant**
ADVANCE DIALYSIS SERVICES PTE LTD	29	0	0
ADVANCE RENAL CARE (KOVAN) PTE LTD	49	0	0
ADVANCE RENAL CARE (NOVENA)	9	0	0
AEGIS DIALYSIS CENTRE	33	0	0
ARCA (FARRER PARK) DIALYSIS PTE LTD	32	0	0
ASIA KIDNEY DIALYSIS CENTRE (BEDOK)	62	0	0
ASIA KIDNEY DIALYSIS CENTRE (JURONG)	27	0	0
ASIA KIDNEY DIALYSIS CENTRE (TAMPINES) BLK 139	67	0	0
ASIA KIDNEY DIALYSIS CENTRE (TECK WHYE)	40	0	0
ASIA KIDNEY DIALYSIS CENTRE (TP) BLK-484	70	0	0
ASIA KIDNEY DIALYSIS CENTRE (TPY)	43	0	0
B. BRAUN DIALYSIS CENTRE (EAST COAST)	30	0	0
CENTRE FOR KIDNEY DISEASE PTE LTD (LUCKY PLAZA)	0	0	39
COMPLEX MEDICAL CENTRE (CHANGI)	5	0	0

DAVITA MEDICAL & DIALYSIS CENTRE (JURONG EAST)	14	0	0
DAVITA MEDICAL AND DIALYSIS CENTRE @ FARRER PARK MEDICAL CENTRE	0	0	0
DAVITA MEDICAL AND DIALYSIS CENTRE @ ROYAL SQUARE MEDICAL SUITES (NOVENA)	23	0	0
ECON ADVANCE RENAL CARE (YUNG KUANG)	24	0	0
ECON ADVANCE RENAL CARE PTE LTD (BEDOK)	19	0	0
FRESENIUS KIDNEY CARE ANG MO KIO DIALYSIS CLINIC (BLK 422)	43	0	0
FRESENIUS KIDNEY CARE ANG MO KIO DIALYSIS CLINIC (BLK 443)	40	0	0
FRESENIUS KIDNEY CARE BUKIT BATOK DIALYSIS CLINIC (BLK 213)	44	0	0
FRESENIUS KIDNEY CARE CLEMENTI DIALYSIS CLINIC	19	0	0
FRESENIUS KIDNEY CARE JURONG BOON LAY DIALYSIS CLINIC (BLK 353)	40	0	0
FRESENIUS KIDNEY CARE JURONG EAST CENTRAL DIALYSIS CLINIC (BLK 104)	61	0	0
FRESENIUS KIDNEY CARE JURONG EAST DIALYSIS CLINIC (BLK 326)	49	0	0
FRESENIUS KIDNEY CARE KATONG DIALYSIS CLINIC	45	0	0
FRESENIUS KIDNEY CARE KEMBANGAN DIALYSIS CLINIC	45	0	0
FRESENIUS KIDNEY CARE KOVAN DIALYSIS CLINIC	55	0	0
FRESENIUS KIDNEY CARE LUCKY PLAZA DIALYSIS CLINIC	4	1	0
FRESENIUS KIDNEY CARE MT ELIZABETH DIALYSIS CLINIC	22	0	0
FRESENIUS KIDNEY CARE NAPIER DIALYSIS CLINIC	26	4	0
FRESENIUS KIDNEY CARE TANGLIN DIALYSIS CLINIC	24	0	0
FRESENIUS KIDNEY CARE TOA PAYOH DIALYSIS CLINIC (BLK 92)	38	0	0
FRESENIUS KIDNEY CARE WHAMPOA DIALYSIS CLINIC	46	0	0
FRESENIUS MEDICAL CARE (TECK WHYE) DIALYSIS CLINIC	54	0	0
FRESENIUS MEDICAL CARE BEDOK NORTH DIALYSIS CLINIC (BLK 527)	28	0	0
FRESENIUS MEDICAL CARE BEDOK RESERVOIR DIALYSIS CLINIC (BLK 744)	57	0	0
FRESENIUS MEDICAL CARE BUKIT MERAH DIALYSIS CLINIC (BLK 161)	55	0	0
FRESENIUS MEDICAL CARE HOUGANG DIALYSIS CLINIC (BLK 620)	43	0	0
FRESENIUS MEDICAL CARE KHATIB DIALYSIS CLINIC	35	0	0
FRESENIUS MEDICAL CARE MARSILING DIALYSIS CLINIC	39	0	0
FRESENIUS MEDICAL CARE SERANGOON DIALYSIS CLINIC	66	0	0
FRESENIUS MEDICAL CARE TAMPINES DIALYSIS CLINIC (BLK 107)	55	0	0

FRESENIUS MEDICAL CARE YISHUN DIALYSIS CLINIC (BLK 236)	41	0	0
FRESENIUS MEDICAL CARE YISHUN RING DIALYSIS CLINIC	39	0	0
GLENEAGLES HOSPITAL	1	0	0
GRACE LEE RENAL AND MEDICAL CLINIC PTE LTD	0	0	7
IMMANUEL DIALYSIS CENTRE (MAYFLOWER) PTE LTD	18	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (ANG MO KIO)	22	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (MT ALVERNIA)	25	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (WOODLANDS)	28	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (YISHUN)	19	0	0
KIDNEY & MEDICAL CENTRE	0	0	7
KIDNEY LIFE CENTRE	0	0	7
KIDNEYCARE DIALYSIS CENTRE @ PASIR RIS	47	0	0
KIDNEYCARE DIALYSIS CENTRE @ WEST COAST	18	0	0
KIDNEYCARE DIALYSIS CENTRE @ YISHUN	22	0	0
KU KIDNEY & MEDICAL CENTRE	0	0	0
MOUNT ELIZABETH NOVENA HOSPITAL	0	0	0
PACIFIC ADVANCE RENAL CARE (CHOA CHU KANG)	36	0	0
PACIFIC ADVANCE RENAL CARE (FAJAR)	43	0	0
PACIFIC ADVANCE RENAL CARE (SENG KANG)	45	0	0
PACIFIC ADVANCE RENAL CARE PTE LTD (PUNGGOL WAY)	36	0	0
PACIFIC ADVANCE RENAL CARE PTE LTD (TAMPINES)	42	0	0
PACIFIC ADVANCE RENAL CARE PTE LTD (WOODLANDS)	52	0	0
RAFFLES DIALYSIS CENTRE	4	0	0
RAFFLES HOSPITAL	0	0	2
RENAL HEALTH PTE LTD	55	0	0
RENAL LIFE (ALEXANDRA) DIALYSIS CENTRE PTE LTD	16	0	0
RENAL LIFE (HOUGANG) DIALYSIS CENTRE PTE LTD	18	0	0
RENAL LIFE (W) DIALYSIS CENTRE PTE LTD (BLK 207 BUKIT BATOK)	30	0	0
RENAL LIFE DIALYSIS CENTRE PTE LTD (BLK 463 JURONG WEST)	23	1	0
RENAL LIFE(PIONEER) DIALYSIS CENTRE PTE LTD	36	0	0
RENALTEAM DIALYSIS CENTRE - ANG MO KIO	38	0	0
RENALTEAM DIALYSIS CENTRE - BEDOK	46	0	0
RENALTEAM DIALYSIS CENTRE - BUKIT MERAH	31	0	0
RENALTEAM DIALYSIS CENTRE - JURONG EAST	0	0	0
RENALTEAM DIALYSIS CENTRE - REN CI COMMUNITY HOSPITAL	49	0	0
RENALTEAM DIALYSIS CENTRE - TAMPINES	53	0	0
RENALTEAM DIALYSIS CENTRE FENGSHAN	23	0	0
RENALTEAM DIALYSIS CENTRE WOODLANDS PEAK	38	0	0
ROGER KIDNEY CLINIC	0	0	7

SH TAN KIDNEY & MEDICAL CLINIC	0	0	3
STEPHEW CHEW CENTRE FOR KIDNEY DISEASE AND HYPERTENSION (MAH)	0	0	18
STEPHEW CHEW CENTRE FOR KIDNEY DISEASE AND HYPERTENSION (MEH)	0	0	4
T.G. NG KIDNEY & MEDICAL CENTRE	0	0	2
TAL DIALYSIS CLEMENTI	44	0	0
THE KIDNEY CLINIC PTE LTD	0	0	15
THE SINGAPORE CLINIC FOR KIDNEY DISEASES	0	0	3
WU NEPHROLOGY & MEDICAL CLINIC (WU MEDICAL CLINIC PTE LTD)	0	0	33
Subtotal	2647	6	147
Grand total	**7125**	**1086**	**1609**