Health Promotion Board

Singapore Renal Registry

Annual Report 2024

National Registry of Diseases Office

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Contents

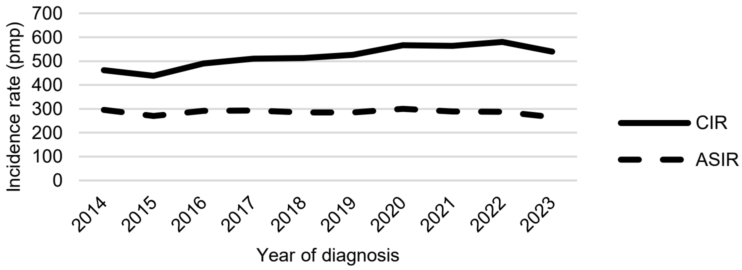
1. GLOSSARY

AD	Autoimmune Disease/GN with Systemic Manifestations
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
HYP	Hypertension and Renovascular Disease
iPTH	Intact parathyroid hormone
OBS	Obstruction
PD	Peritoneal dialysis
PKD	Polycystic Kidney Disease/Other Cystic Diseases
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

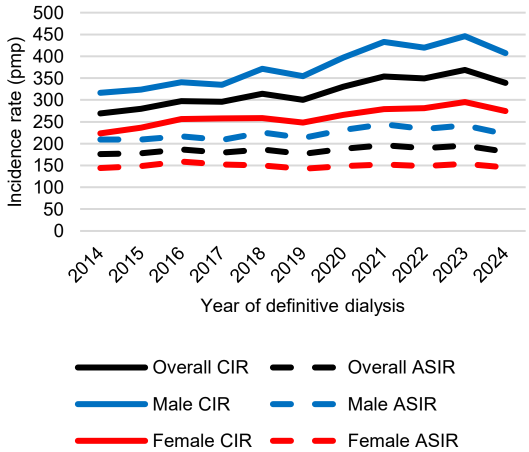
INCIDENCE OF CKD5

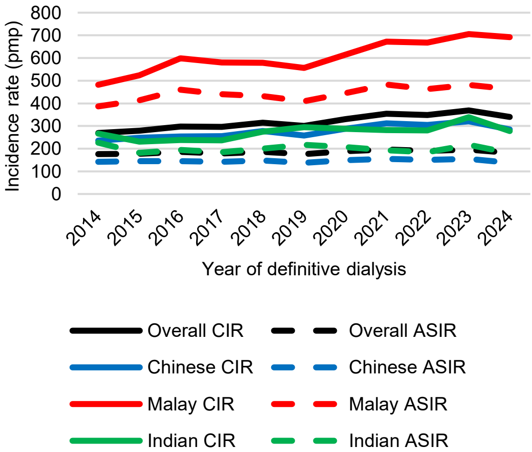
- Crude incidence rate (CIR) of chronic kidney disease stage 5 (CKD5) has increased significantly from 462.2 per million population (pmp) in 2014 to 538.9 pmp in 2023.
- Age-standardised incidence rate (ASIR) of CKD5 remained stable and ranged between 265.6 pmp and 300.0 pmp from 2014-2023.



INCIDENCE OF DEFINITIVE DIALYSIS

- ASIR of definitive dialysis increased from 176.1 pmp in 2014 to 181.8 pmp in 2024.
- Males consistently showed a higher ASIR for definitive dialysis compared to females from 2013-2024 (222.0 pmp for males and 145.4 pmp for females in 2024).
- Malays consistently had a higher ASIR for definitive dialysis compared to Chinese and Indians in the past decade (138.5 pmp for Chinese, 462.8 pmp for Malays and 180.4 pmp for Indians in 2024).



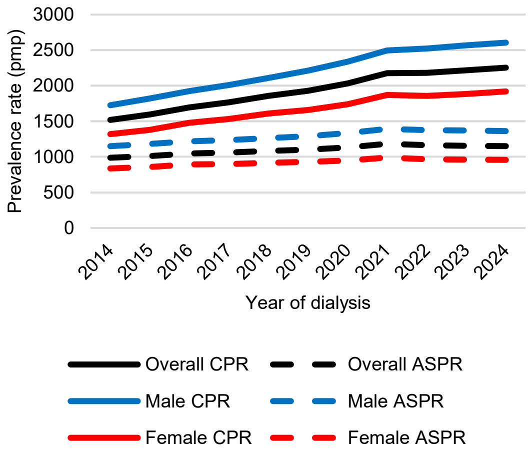


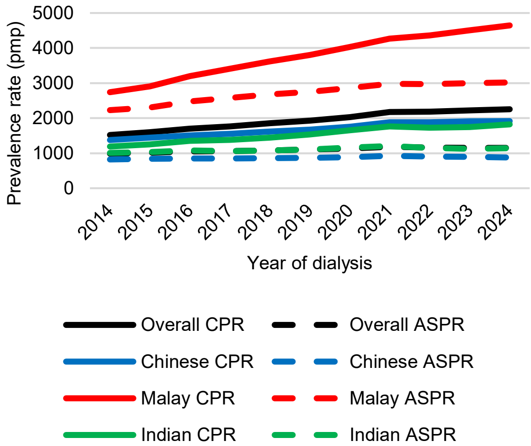
- In 2024, 81.0% of new dialysis patients received haemodialysis (HD) whilst the rest received peritoneal dialysis (PD).
- Diabetic nephropathy (DN), hypertension (HYP) and glomerulonephritis (GN) were consistently the top three leading causes of CKD5 in new dialysis patients (67.0%, 15.4% and 10.9% of new dialysis patients had DN, HYP and GN respectively in 2024).

PREVALENCE OF DEFINITIVE DIALYSIS

- The age-standardised prevalence rate (ASPR) of definitive dialysis increased significantly from 987.1 pmp in 2014 to 1,148.8 pmp in 2024. As of December 2024, there was a total of 9,422 Singapore residents on definitive dialysis, compared to 5,880 in 2014.
- Males consistently showed a higher ASPR for definitive dialysis compared to females from 2014-2024 (1,360.3 pmp for males and 956.8 pmp for females in 2024).

- Malays consistently had a higher ASPR for definitive dialysis compared to Chinese and Indians in the past decade (878.9 pmp for Chinese, 3,018.8 pmp for Malays and 1,140.2 pmp for Indians in 2024).

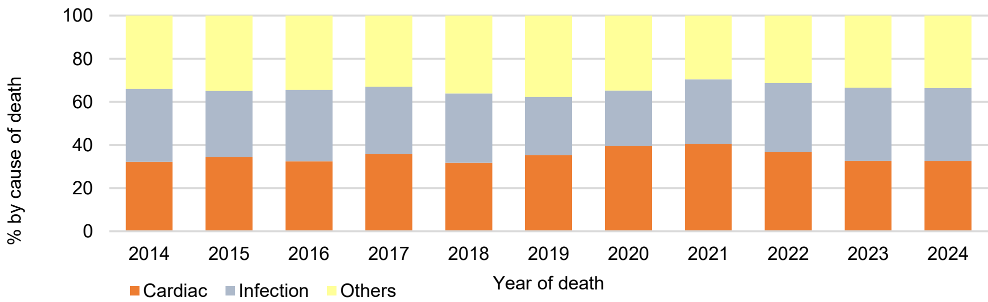




- In 2024, 87.2% of prevalent patients received HD whilst the rest undertook PD.
- DN, GN and HYP were consistently the top three leading causes of CKD5 in prevalent dialysis patients (55.9%, 20.7% and 14.8% of prevalent dialysis patients had DN, GN and HYP respectively in 2024).

MORTALITY AND SURVIVAL OF PREVALENT DIALYSIS PATIENTS

- The top two leading causes of death among prevalent dialysis patients had consistently been infections and cardiac events in the past decade (33.9% for infections and 32.5% for cardiac events in 2024).



- After adjusting for demographics, CKD5 etiology and co-morbidities, PD patients had 1.48 times higher mortality risk than HD patients. However, this survival gap has narrowed over time due to improving PD outcomes whilst HD survival remained stable.

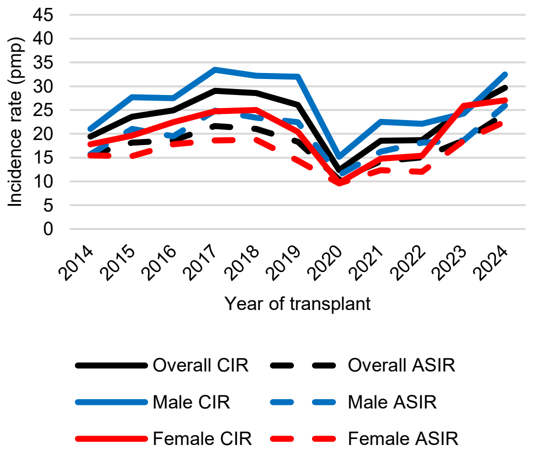
MANAGEMENT OF PREVALENT DIALYSIS PATIENTS

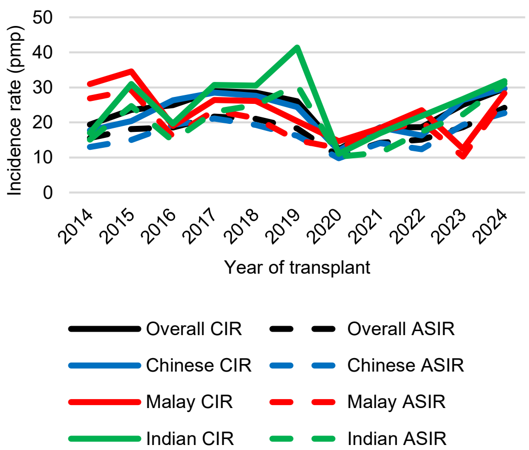
- The management of prevalent patients on dialysis was assessed using several criteria: frequency of dialysis, management of urea, management of anaemia, and management of mineral and bone disease.
- 95.9% of the HD patients had thrice weekly dialysis in 2024.
- Urea was well managed in 97.5% of the HD patients and 66.3% of the PD patients, based on their urea reduction ratio or fractional clearance of urea in 2024.
- Anaemia was well managed in 77.5% of the HD patients and 60.9% of the PD patients, based on their haemoglobin level in 2024.

- Bone metabolism was well managed in 75.2%, 58.8% and 27.0% of the HD patients and 60.6%, 55.8% and 29.6% of the PD patients based on their calcium level, phosphate level and intact parathyroid hormone level respectively in 2024.

INCIDENCE OF KIDNEY TRANSPLANT

- Between 2014 and 2024, the ASIR of kidney transplant fluctuated due to low annual transplant volumes, which ranged between 50 to 124 transplants during this period. The ASIR of kidney transplant was 24.2 pmp in 2024.
- Males typically had higher kidney transplant incidence rates than females. In 2024, the ASIR for males was 25.9 pmp versus 22.5 pmp for females.
- No consistent ethnic differences were observed in kidney transplant incidence rates. In 2024, the ASIR was 22.7 pmp for Chinese, 26.8 pmp for Malays and 31.0 pmp for Indians.

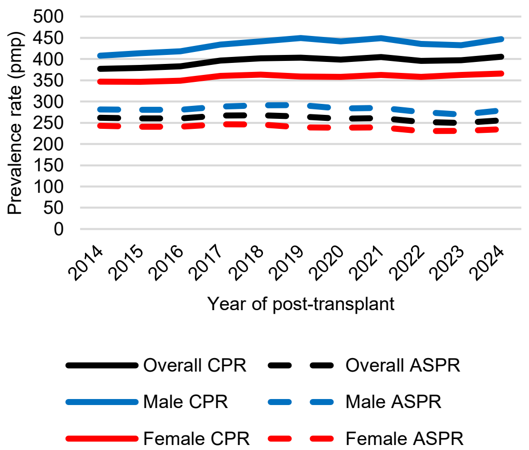


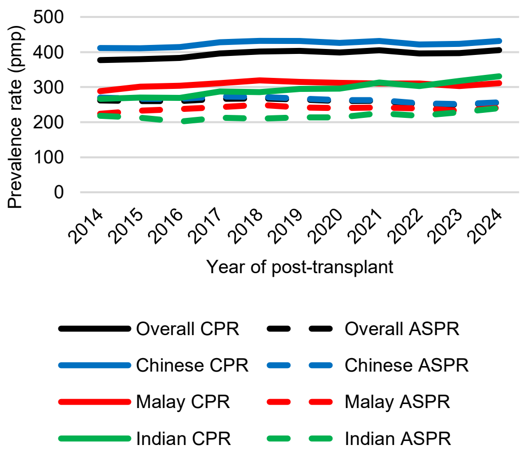


- Most new transplants were performed locally, with 83.1% performed in Singapore in 2024.
- GN, DN and HYP were consistently the top three causes of CKD5 among new transplant patients (50.8%, 18.5% and 12.9% of the new transplant patients had GN, DN and HYP respectively in 2024).

PREVALENCE OF KIDNEY TRANSPLANT

- The ASPR of kidney transplant decreased slightly from 261.5pmp in 2014 to 255.9 pmp in 2024.
- Males consistently had higher transplant prevalence rates than females. In 2024, the ASPR among males was 279.0 pmp versus 234.5 pmp for females.
- Chinese had the highest transplant prevalence rate compared to Malays and Indians. In 2024, ASPR was 256.7 pmp for Chinese, 241.3 pmp for Malays and 239.9 pmp for Indians.





- Most prevalent transplants were performed locally, with 76.4% performed in Singapore in 2024.

- GN, DN and HYP were consistently the top three leading causes of CKD5 among prevalent transplant patients (62.8%, 12.4% and 8.0% of prevalent transplant patients had GN, DN and HYP in 2024).

SURVIVAL OF PATIENTS WITH KIDNEY TRANSPLANT

- Patients with kidney transplants from living donors had better survival (5-year graft survival: 93.9%, 5-year patient survival: 96.1%) than those with kidney transplants from deceased donors (5-year graft survival: 86.3%, 5-year patient survival: 91.4%).
- After adjusting for demographics, CKD5 etiology and co-morbidities, the risk of death was lower for CKD5 patients with transplant, regardless of donor type, than those who were on dialysis.

3. INTRODUCTION

Chronic kidney disease (CKD) is a worldwide epidemic[1], with diabetes and hypertension as important contributing causes[2]. Based on the National Population Health Survey 2024, about 1 in 11 (9.1%) Singapore residents have diabetes whilst about 1 in 3 (33.8%) Singapore residents have hypertension[3]. Our ageing population further compounds the situation in Singapore as decline in kidney function tends to rise with age[4].

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: haemodialysis (HD) and peritoneal dialysis (PD). Older patients and/or those with medical conditions are usually preferentially placed on PD, a gentler therapy compared to HD.

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[1] Mallamaci F. Highlights of the 2015 ERA-EDTA congress: chronic kidney disease, hypertension. Nephrology Dialysis Transplant. 2016; 31(7): 1044-1046.

[2] National Institute of Diabetes and Digestive and Kidney Diseases. (2016, October). Causes of Chronic Kidney Disease. National Institute of Diabetes and Digestive and Kidney Diseases. https://www.niddk.nih.gov/health-information/kidney-disease/chronic-kidney-disease-ckd/causes

[3] National Population Health Survey 2024 (Household Interview and Health Examination). Ministry of Health, Singapore. https:// www.moh.gov.sg/others/resources-and-statistics/national-population-health-survey--nphs--2024-report/. Accessed on 18 November 2025.

[4] 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 (NRDO) collects and analyses epidemiological data to support policy planning and review as well as programme evaluation.

In most renal registries, only patients who initiated dialysis are captured[5]. There are also others, such as the United States Renal Data System[6], which capture only patients who survived >90 days after initiation of dialysis. However, these registries may underestimate the burden of kidney failure in the country and the workload of healthcare professionals. Hence, the Singapore Renal Registry (SRR) captures patients with CKD5, regardless whether they have initiated dialysis or survived >90 days after initiation of dialysis.

All public and private healthcare institutions provide lists of patients with eGFR <15 ml/min/1.73m^2 to the SRR in accordance with legislation mandating notification, which has been in effect since 2010.

<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.

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 that are at least six months apart before accepting the case as CKD5. The monitoring period is to let the eGFR readings stabilise over a period of time 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[7].

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 30 April 2025 by matching the patients’ unique National Registration Identity Card number with information from the Death Registry.

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.

[5] 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.
[6] United States Renal Data System (USRDS). www.usrds.org Accessed on 1 Mar 2021.
[7] Chronic Kidney Disease: Evaluation, Classification, and Stratification 2002. National Kidney Foundation, New York.

Singapore citizens and permanent residents) annually[8]. The Segi World population estimates used for age standardisation are available on the World Health Organisation website[9].

This report focuses on Singapore residents with CKD5 and underwent dialysis or kidney transplant in 2014 to 2024, as they stood on 25 June 2025. Statistics on prevalence and survival included patients since the start of the SRR in 1999. A detailed definition of each indicator is given at the start of each section of this report.

[8] 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 18 November 2025.
[9] 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 from 2020 to 2024. The number of new dialysis patients and deaths among dialysis patients generally increased from 2020-2023 before dipping slightly in 2024. The number of prevalent dialysis patients generally increased over the years. The number of new kidney transplant patients increased from 2020-2024. The numbers of prevalent kidney transplant patients increased slightly over the years.

Table 5.1.1: Stock and flow in 2020 – 2024

	2020	2021	2022	2023	2024
Incidence					
Definitive dialysis	1335	1412	1422	1530	1419
Transplant	50	74	76	104	124
Death					
Definitive dialysis	957	1030	1294	1258	1220
Transplant	30	34	41	37	42
Prevalence					
Definitive dialysis	8223	8674	8886	9202	9422
Transplant	1613	1614	1613	1647	1695

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 a nephrologist, and the prevalence numbers in Table 5.1.2 were based on the last follow-up visit for each patient.

HD patients are routinely followed up by their nephrologists in the public hospitals and nephrology clinics[10] and they also have regular follow-up at the dialysis centre where they go for their regular dialysis. In 2024, 7 in 10 of the prevalent HD patients were last followed up at dialysis centres run by the Voluntary Welfare Organisations (VWOs 69.4%), while the remaining were last followed up by the private clinics and dialysis centres (29.2%), and public hospitals and affiliated dialysis centres (1.4%).

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 (97.9%) were last followed up at the public hospitals and affiliated dialysis centres in 2024.

Similarly, follow-up among transplant patients is typically for consultation with their nephrologists, where transplant was done. 9 in 10 prevalent transplant patients (91.5%) were followed up at the public hospitals and affiliated dialysis centres in 2024.

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

[10] Patients on HD routinely follow up with a primary nephrologist at the Specialist Outpatient Clinics (SOC) in the public hospitals and private nephrology clinics once every 4-6 months.

Table 5.1.2: Prevalent patients as at 31 December 2024

	HD		PD		Transplant	
	Number	%	Number	%	Number	%
Public hospitals and affiliated dialysis centres	112	1.4	1177	97.9	1551	91.5
Dialysis centres under Voluntary Welfare Organisations	5704	69.4	0	0.0	0	0.0
Private clinics and dialysis centres	2404	29.2	25	2.1	143	8.4
Overseas	0	0.0	0	0.0	1	0.1
Total	8220	100	1202	100	1695	100

5.2 Incidence of CKD5

The incidence rate of CKD5 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.

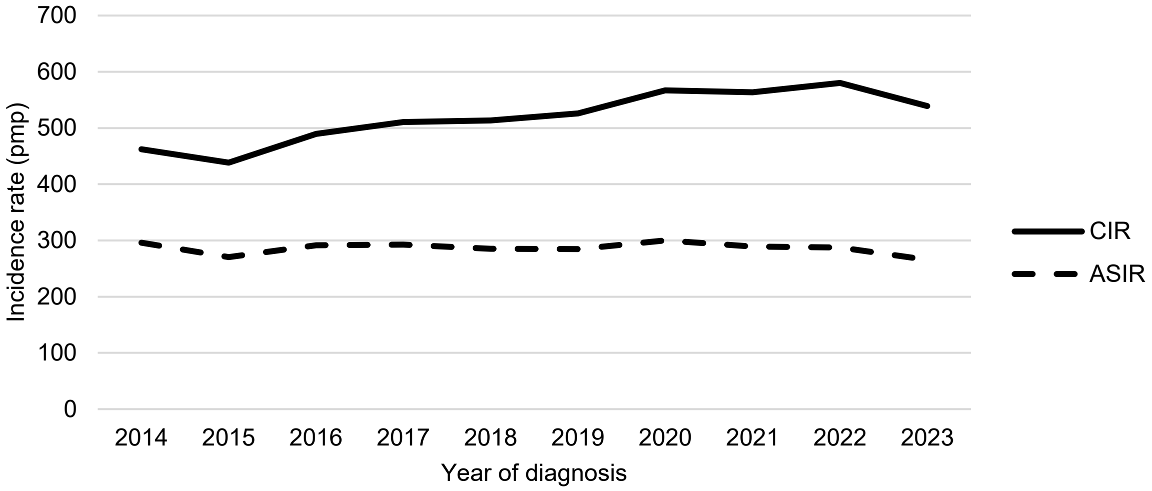
As the registry monitors the patient's eGFR readings for at least six months before accepting a case as CKD5 to allow for accurate case ascertainment, all statistics related to new CKD5 patients for 2024 are not shown in this section.

The number of new patients diagnosed with CKD5 increased from 1,789 in 2014 to 2,236 in 2024, an increase of 25% (Table 5.2.1, Figure 5.2.1). Correspondingly, the CIR increased significantly from 462.2 pmp in 2014 to 538.9 pmp in 2023 (p<0.001). However, the ASIR remained stable, ranging between 265.6 pmp and 300.0 pmp during the same period (p=0.499). 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
2014	1789	462.2	296.1
2015	1711	438.4	270.3
2016	1926	489.6	291.2
2017	2024	510.4	292.7
2018	2050	513.2	285.0
2019	2117	525.8	284.7
2020	2293	567.0	300.0
2021	2246	563.4	289.0
2022	2363	580.1	287.6
2023	2236	538.9	265.6
P for trend	-	<0.001**	0.499

Figure 5.2.1: Incidence rate (pmp) of CKD5



For age-specific incidence rate, a general upward trend was observed for those in the oldest age bands (70 years and above); and interestingly, a significant increase in CKD5 incidence was noted for those aged 30-39 years (p=0.041). According to the Global Burden of Disease (GBD), CKD5 incidence rates among 30-39 year olds in the USA, another high-income country similar to Singapore, also increased significantly from 2014-2023 (p<0.001)[11]. For the other age bands below 70 years old, a general downward trend was observed, with a significant decrease in age-specific CKD incidence found among those aged 50-59 years (p=0.042) (Table 5.2.2).

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

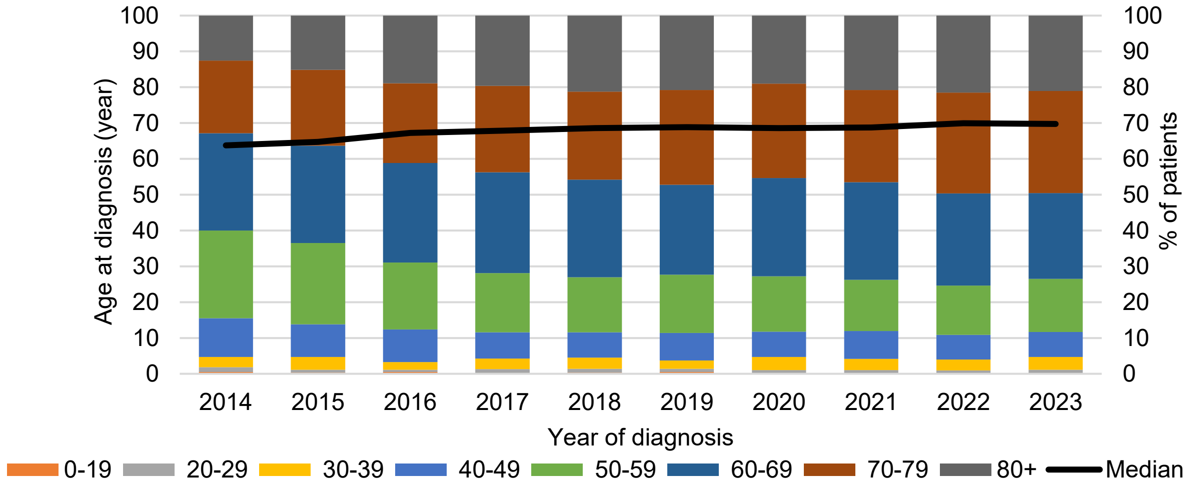
Year of diagnosis	Age 0-19			Age 20-29			Age 30-39			Age 40-49		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2014	9	0.5	10.5	24	1.3	45.3	51	2.9	85.8	194	10.8	310.6
2015	5	0.3	5.9	14	0.8	26.2	62	3.6	104.8	156	9.1	251.5
2016	10	0.5	12.0	12	0.6	22.2	41	2.1	69.8	176	9.1	286.4
2017	4	0.2	4.8	22	1.1	40.1	61	3.0	105.1	147	7.3	239.0
2018	7	0.3	8.6	21	1.0	38.4	64	3.1	109.4	146	7.1	238.8
2019	11	0.5	13.5	18	0.9	33.5	50	2.4	84.1	163	7.7	266.1
2020	5	0.2	6.2	18	0.8	33.9	85	3.7	142.3	162	7.1	265.1
2021	4	0.2	5.1	19	0.8	36.8	71	3.2	120.3	174	7.7	293.5
2022	1	0.0	1.3	22	0.9	42.9	71	3.0	116.8	162	6.9	268.1
2023	4	0.2	5.1	22	1.0	43.4	79	3.5	126.7	156	7.0	254.6
P for trend	-	-	0.095	-	-	0.258	-	-	0.041*	-	-	0.639
Year of diagnosis	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2014	437	24.4	723.6	487	27.2	1240.1	363	20.3	1982.4	224	12.5	2566.0
2015	388	22.7	635.9	464	27.1	1097.1	363	21.2	1974.5	259	15.1	2771.6
2016	359	18.6	583.6	536	27.8	1191.4	428	22.2	2232.1	364	18.9	3721.9
2017	335	16.6	545.2	570	28.2	1221.6	488	24.1	2307.9	397	19.6	3920.0
2018	314	15.3	511.9	560	27.3	1157.5	502	24.5	2193.4	436	21.3	4079.3
2019	343	16.2	563.7	533	25.2	1065.7	559	26.4	2284.2	440	20.8	3804.4
2020	354	15.4	588.1	630	27.5	1225.6	604	26.3	2314.2	435	19.0	3508.8
2021	322	14.3	551.2	612	27.2	1181.5	577	25.7	2119.0	467	20.8	3556.4

[11] GBD results. Institute for Health Metrics and Evaluation. https://vizhub.healthdata.org/gbd-results/. Accessed on 18 November 2025.

2022	325	13.8	548.2	608	25.7	1134.5	667	28.2	2265.8	507	21.5	3732.7
2023	332	14.8	550.5	535	23.9	967.7	637	28.5	1997.5	471	21.1	3366.5
P for trend	-	-	0.042*	-	-	0.137	-	-	0.518	-	-	0.164

The median age at diagnosis of CKD5 increased from 63.8 years in 2014 to 69.8 years in 2023 ($p<0.001$); the percentage of CKD5 patients aged 60 years and above also increased from 60.0% in 2014 to 73.5% in 2023 (Figure 5.2.2a).

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



The age-specific incidence rate of CKD5 increased with age, with those aged 80 years and above having the highest incidence rate (Figure 5.2.2b, Figure 5.2.3).

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

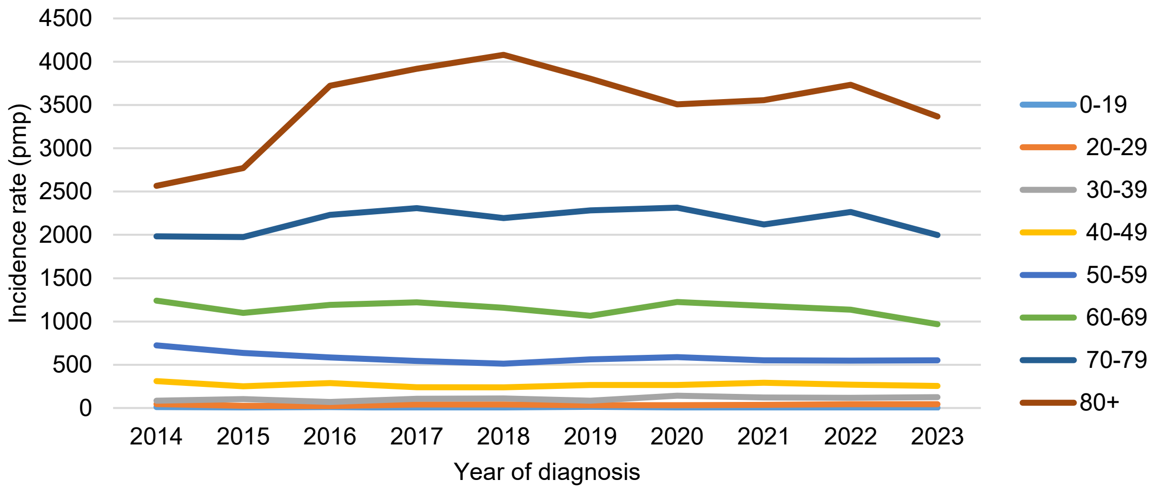
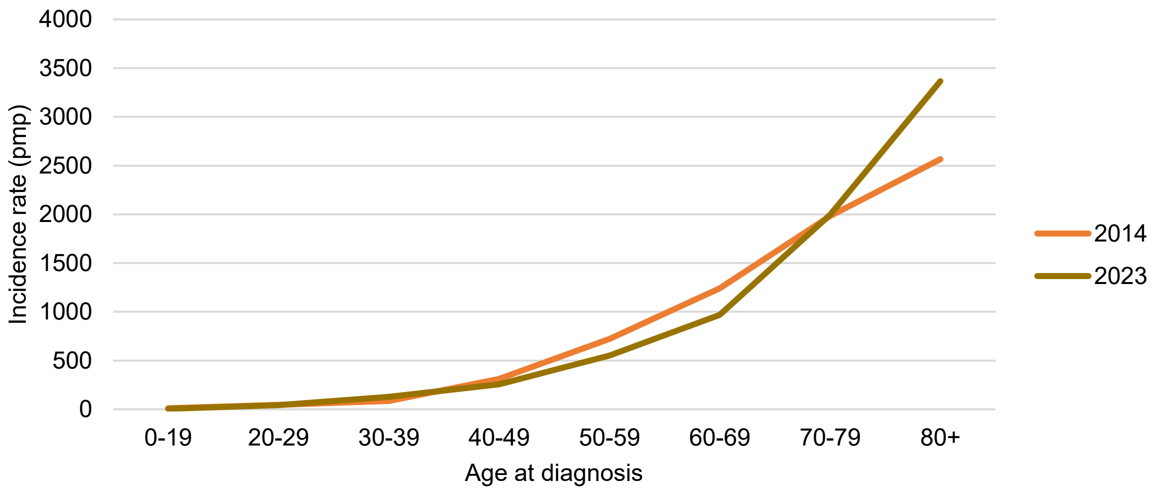


Figure 5.2.3: Age-specific incidence rate (pmp) of CKD5 across age groups



Across the past decade, males consistently accounted for a slightly higher percentage of individuals suffering from CKD5 compared to females. The ASIRs of CKD5 were consistently higher among males than females across the years (Table 5.2.3, Figure 5.2.4). In 2023, the ASIR was 320.2 pmp and 215.7 pmp for males and females respectively. The ASIR of CKD5 among both males and females remained relatively unchanged over the years (p=0.143 and p=0.058 respectively). This could be due to the higher prevalence of risk factors of CKD5 such as diabetes and hypertension in males compared to females, as consistently observed in the National Population Health Survey series, including the latest survey cycle with health examination in 2023-2024[12].

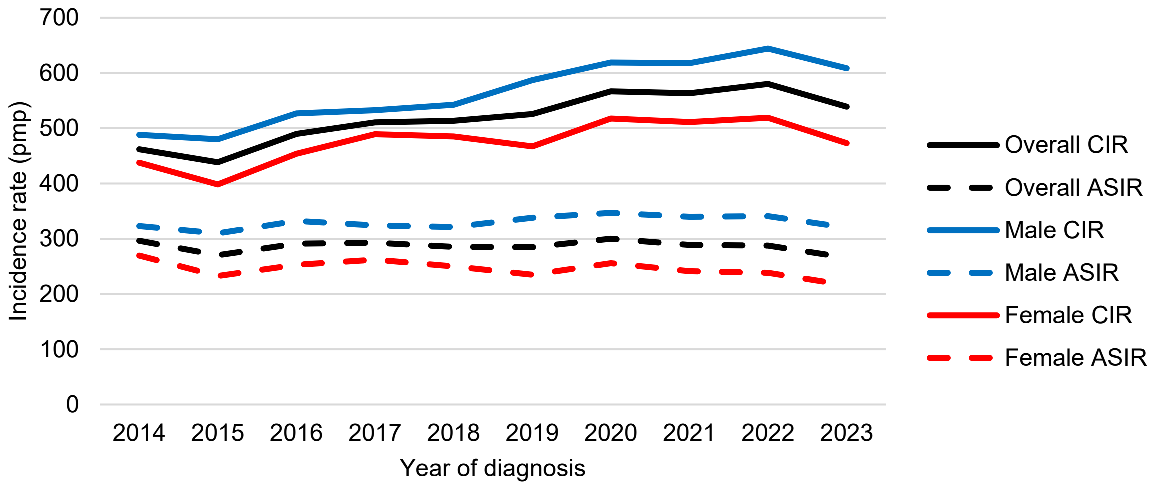
Table 5.2.3: Incidence number and rate (pmp) of CKD5 by sex

Male				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2014	928	51.9	487.8	322.8
2015	920	53.8	480.0	309.8
2016	1016	52.8	526.6	332.0
2017	1035	51.1	532.5	324.2
2018	1061	51.8	542.5	321.3
2019	1156	54.6	587.0	338.2
2020	1224	53.4	618.9	346.8
2021	1206	53.7	617.5	339.8
2022	1282	54.3	644.2	340.8
2023	1230	55.0	608.3	320.2
P for trend	-	-	<0.001**	0.143
Female				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2014	861	48.1	437.4	269.5

[12] National Population Health Survey 2024 (Household Interview and Health Examination). Ministry of Health, Singapore. https:// www.moh.gov.sg/others/resources-and-statistics/national-population-health-survey--nphs--2024-report/ Accessed on 18 November 2025.

2015	791	46.2	398.3	232.4
2016	910	47.2	454.1	252.8
2017	989	48.9	489.1	261.9
2018	989	48.2	485.2	249.9
2019	961	45.4	467.2	235.1
2020	1069	46.6	517.3	255.5
2021	1040	46.3	511.4	241.3
2022	1081	45.7	519.0	238.6
2023	1006	45.0	472.9	215.7
P for trend	-	-	0.018*	0.058

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



Over the past decade, the ASIRs of CKD5 were consistently higher among Malays than Chinese and Indians (Table 5.2.4, Figure 5.2.5). This could be attributed to the higher metabolic disease burden, poorer diabetes control, greater number of comorbidities, and poor appointment adherence among Malays[13]. In 2023, the ASIR among Malays was 623.3 pmp, which was almost threefold higher compared to Chinese (214.2 pmp) and more than twofold higher compared to Indians (269.9 pmp). While significant rises were observed in the CIR of CKD5 among all three ethnicities, no significant changes in ASIR were observed for all three groups, suggesting that the increase in CKD5 incidence was mainly driven by population ageing.

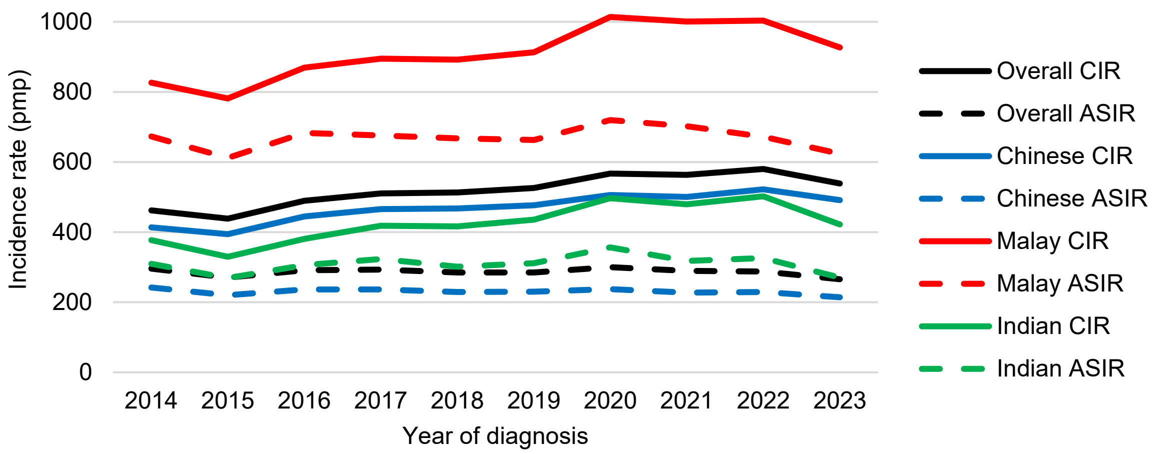
Table 5.2.4: Incidence number and rate (pmp) of CKD5 by ethnicity

Chinese				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2014	1189	66.5	413.7	242.0
2015	1143	66.8	394.1	220.5
2016	1299	67.4	444.4	236.7
2017	1372	67.8	465.4	236.7
2018	1389	67.8	467.8	229.4

[13] Chua, Y. T., Leo, C. H., Chua, H. R., Wong, W. K., Chan, G. C., Vathsala, A., Gan, Y. L. M., & Teo, B. W. (2025). Disparities in ethnicity and metabolic disease burden in referrals to nephrology. Singapore Medical Journal, 66(6), 301-306. https://doi.org/10.4103/singaporemedj.SMJ-2022-193

2019	1426	67.4	476.3	230.5
2020	1520	66.3	505.5	237.6
2021	1481	65.9	500.3	227.5
2022	1576	66.7	522.0	229.6
2023	1508	67.4	490.8	214.2
P for trend	-	-	<0.001**	0.143
Malay				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2014	427	23.9	826.5	672.8
2015	407	23.8	781.3	611.7
2016	457	23.7	869.0	682.5
2017	475	23.5	895.0	675.9
2018	478	23.3	892.1	667.2
2019	494	23.3	913.5	662.7
2020	553	24.1	1013.8	719.5
2021	545	24.3	1001.0	702.1
2022	556	23.5	1003.4	672.2
2023	520	23.3	926.4	623.3
P for trend	-	-	0.003**	0.760
Indian				
Year of diagnosis	**Number**	**%**	**CIR**	**ASIR**
2014	133	7.4	376.7	309.1
2015	117	6.8	329.6	268.9
2016	136	7.1	381.1	305.5
2017	150	7.4	418.0	322.9
2018	150	7.3	416.1	301.1
2019	158	7.5	435.7	311.1
2020	180	7.8	496.9	356.5
2021	170	7.6	479.0	317.5
2022	184	7.8	502.2	326.2
2023	158	7.1	421.5	269.9
P for trend	-	-	0.007**	0.696

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



DN was the major cause of CKD5 among new CKD5 patients, accounting for about 2 in 3 new CKD5 patients every year, followed by HYP and GN (Table 5.2.5). This aligns with the National Institute of Diabetes and Digestive and Kidney Diseases in the USA, which identifies diabetes and hypertension as the two most common causes of CKD5 in adults[14]. In 2023, 66.0% of the new CKD5 patients had DN, 17.5% had HYP and 9.6% had GN. According to data collected by the USRDS, in 2022, Singapore had the third highest proportion of incident treated CKD5[15] attributed to diabetes in the world[16].

Table 5.2.5: Incidence number of CKD5 by etiology

Year of diagnosis	DN		GN		HYP		AD	
	Number	%	Number	%	Number	%	Number	%
2014	1189	66.5	249	13.9	218	12.2	22	1.2
2015	1113	65.0	216	12.6	265	15.5	17	1.0
2016	1274	66.1	199	10.3	336	17.4	12	0.6
2017	1339	66.2	219	10.8	349	17.2	15	0.7
2018	1369	66.8	227	11.1	328	16.0	19	0.9
2019	1421	67.1	208	9.8	356	16.8	20	0.9
2020	1539	67.1	226	9.9	383	16.7	23	1.0
2021	1496	66.6	232	10.3	403	17.9	16	0.7
2022	1515	64.1	244	10.3	455	19.3	24	1.0
2023	1476	66.0	215	9.6	391	17.5	28	1.3

Year of diagnosis	OBS		PKD		Others	
	Number	%	Number	%	Number	%
2014	25	1.4	39	2.2	47	2.6

[14] National Institute of Diabetes and Digestive and Kidney Diseases. (2016, October). Causes of Chronic Kidney Disease. National Institute of Diabetes and Digestive and Kidney Diseases. https://www.niddk.nih.gov/health-information/kidney-disease/chronic-kidney-disease-ckd/causes

[15] Refers to CKD5 treated with either dialysis or kidney transplant, with the former as the predominant form of treatment

[16] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 18 November 2025.

2015	16	0.9	31	1.8	53	3.1
2016	27	1.4	30	1.6	48	2.5
2017	30	1.5	40	2.0	32	1.6
2018	26	1.3	35	1.7	46	2.2
2019	39	1.8	29	1.4	44	2.1
2020	24	1.0	54	2.4	44	1.9
2021	20	0.9	36	1.6	43	1.9
2022	34	1.4	41	1.7	50	2.1
2023	28	1.3	45	2.0	53	2.4

DN: Diabetic Nephropathy
GN: Primary Glomerulonephritis
HYP: Hypertension and Renovascular Disease
AD: Autoimmune Disease/GN with Systemic Manifestations
OBS: Obstruction
PKD: Polycystic Kidney Disease/Other Cystic Diseases

5.3 Incidence of ever-started dialysis

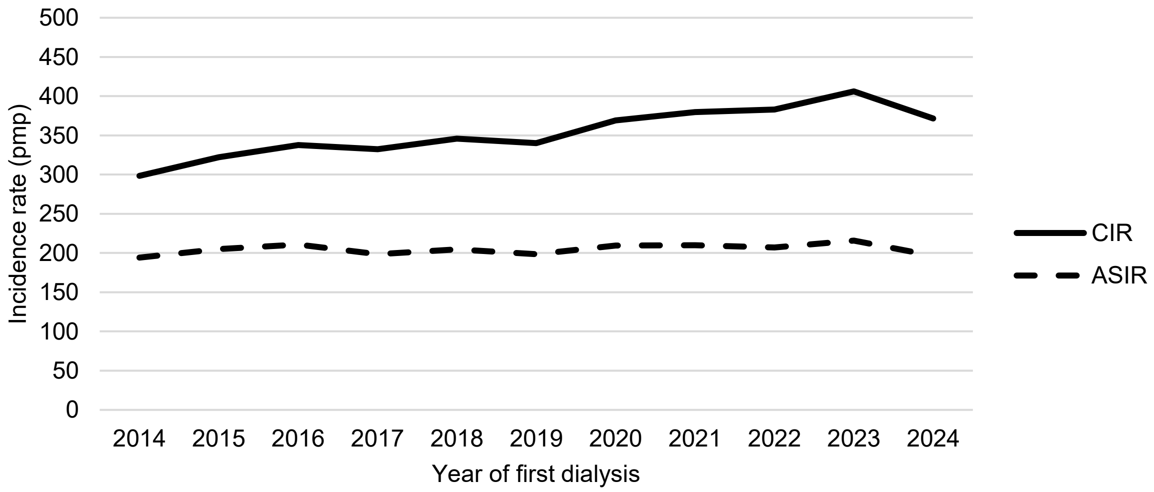
The incidence rate of ever-started dialysis[17] in each year was calculated by taking the number of new patients who ever-started dialysis in a year, divided by the number of Singapore residents in the same year. The modality was based on the first dialysis. Patients were categorised into 10-year age 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 1,155 in 2014 to 1,553 in 2024, a 35% increase in 10 years (Table 5.3.1, Figure 5.3.1). Correspondingly, the CIR increased significantly from 298.4 pmp in 2014 to 371.5 pmp in 2024 (p<0.001). However, the ASIR remained stable and ranged between 194.1 pmp and 215.8 pmp during the same period (p=0.366).

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

Year of first dialysis	Number	CIR	ASIR
2014	1155	298.4	194.1
2015	1258	322.3	205.2
2016	1328	337.6	210.9
2017	1318	332.3	198.5
2018	1381	345.7	204.5
2019	1370	340.3	198.6
2020	1492	368.9	209.6
2021	1514	379.7	209.8
2022	1560	383.0	207.0
2023	1685	406.1	215.8
2024	1553	371.5	196.4
P for trend	-	<0.001**	0.366

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



The age-specific incidence rate of ever-started dialysis increased significantly for those aged 30-39 years (p=0.004) and 40-49 years (p=0.049) (Table 5.3.2).

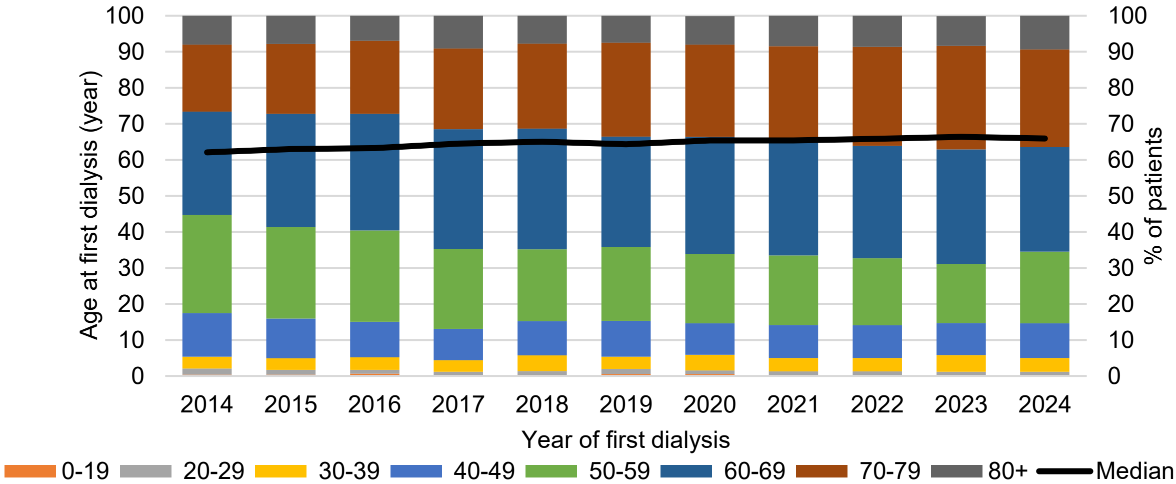
[17] Refers to CKD5 patients who had ever initiated dialysis, including those who did not survive beyond 90 days after first dialysis

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
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	137	10.0	223.7
2020	8	0.5	10.0	15	1.0	28.2	65	4.4	108.8	130	8.7	212.8
2021	4	0.3	5.1	15	1.0	29.1	57	3.8	96.6	138	9.1	232.8
2022	0	0.0	0.0	20	1.3	39.0	58	3.7	95.4	141	9.0	233.4
2023	3	0.2	3.8	17	1.0	33.5	77	4.6	123.5	150	8.9	244.8
2024	4	0.3	5.1	14	0.9	28.3	59	3.8	92.9	150	9.7	245.3
P for trend	-	-	0.728	-	-	0.782	-	-	0.004**	-	-	0.049*
Year of first dialysis	**Age 50-59**			**Age 60-69**			**Age 70-79**			**Age 80+**		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
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	269	20.3	1402.9	92	6.9	940.7
2017	292	22.2	475.2	438	33.2	938.7	295	22.4	1395.1	120	9.1	1184.9
2018	275	19.9	448.4	464	33.6	959.1	325	23.5	1420.0	107	7.7	1001.1
2019	281	20.5	461.8	420	30.7	839.8	356	26.0	1454.7	103	7.5	890.6
2020	287	19.2	476.8	485	32.5	943.5	383	25.7	1467.4	118	7.9	951.8
2021	292	19.3	499.8	476	31.4	918.9	404	26.7	1483.6	128	8.5	974.8
2022	291	18.7	490.9	486	31.2	906.8	429	27.5	1457.3	135	8.7	993.9
2023	276	16.4	457.7	537	31.9	971.4	484	28.7	1517.8	140	8.3	1000.7
2024	309	19.9	513.7	451	29.0	801.3	421	27.1	1234.1	145	9.3	989.1
P for trend	-	-	0.268	-	-	0.646	-	-	0.217	-	-	0.289

The median age at first dialysis increased from 62.1 years in 2014 to 65.9 years in 2024 (p<0.001), while the percentage of ever-started dialysis patients aged 60 years and above increased from 55.2% to 65.5% (Figure 5.3.2a).

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



The age-specific incidence rates of ever-started dialysis increased with age, and it was the highest for those aged 70-79 years. Among the older age group of >= 50 years old, the age-specific incidence rates remained stable over the years (Figure 5.3.2b, Figure 5.3.3). Similarly, in Australia and New Zealand, the proportion of patients aged >= 75 years initiating dialysis increased from 1999-2003 but has remained stable in recent years from 2004-2018[18]. Dialysis initiation rates may not have increased among the elderly CKD5 patients, as it may not be the best treatment option for elderly CKD5 patients due to multiple age-related comorbidities, geriatric syndromes, and functional impairment[19].

[18] Ethier, I., Campbell, S., Cho, Y., Hawley, C., Isbel, N., Krishnasamy, R., Roberts, M., Semple, D., Sypek, M., Viecelli, A., & Johnson, D. (2021). Dialysis initiation in older persons across centres and over time in Australia and New Zealand. *Nephrology*, *26*, Article 13873. https://doi.org/10.1111/nep.13873

[19] Ahmed, F.A and Catic, A. G. Decision-Making in Geriatric Patients with End-Stage Renal Disease: Thinking Beyond Nephrology. J Clin Med. 2018; 8(1)

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

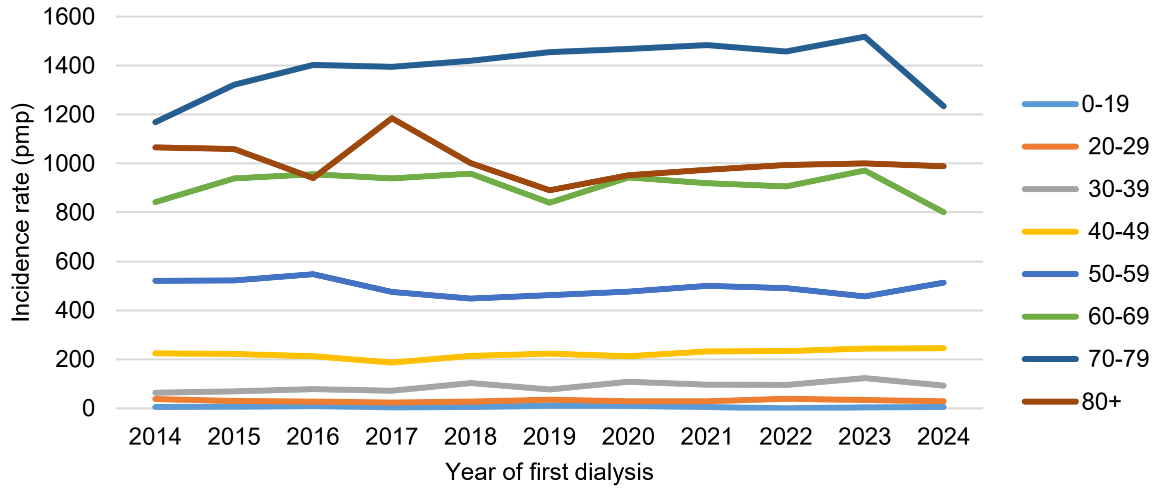
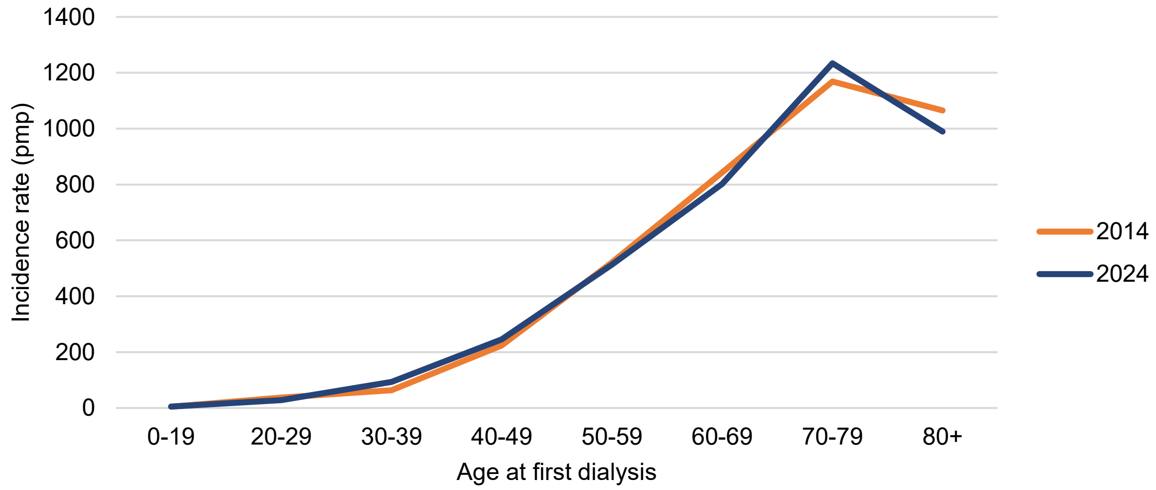


Figure 5.3.3: Age-specific incidence rate (pmp) of ever-started dialysis across age groups



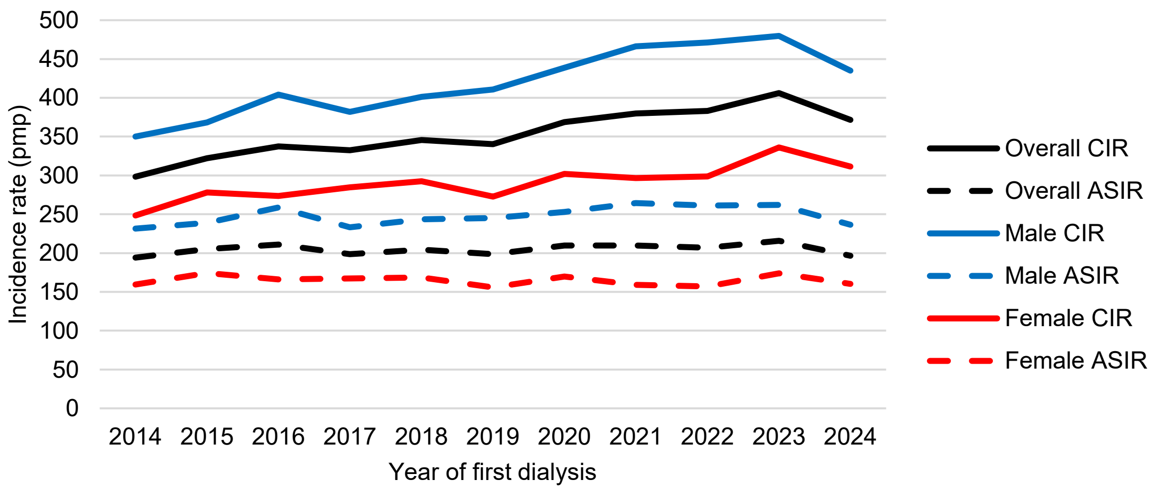
The ASIRs of ever-started dialysis were consistently higher among males than females across the years (Table 5.3.3, Figure 5.3.4). In 2024, the ASIR was 236.4 pmp and 160.3 pmp for males and females respectively. Similar to the sex trends of CKD5 incidence (Table 5.2.3), no significant changes were observed in the ASIR of dialysis initiation among males (p=0.137) and females (p=0.585).

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

	Male			
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	666	57.7	350.1	231.6
2015	706	56.1	368.4	239.1
2016	780	58.7	404.2	258.7
2017	742	56.3	381.8	233.2
2018	785	56.8	401.4	243.3

2019	809	59.1	410.8	245.3
2020	868	58.2	438.9	253.0
2021	911	60.2	466.4	264.4
2022	938	60.1	471.3	261.2
2023	970	57.6	479.7	261.9
2024	885	57.0	434.9	236.4
P for trend	-	-	<0.001**	0.137
Female				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	489	42.3	248.4	159.6
2015	552	43.9	277.9	174.3
2016	548	41.3	273.4	166.2
2017	576	43.7	284.8	167.5
2018	596	43.2	292.4	168.4
2019	561	40.9	272.8	155.8
2020	624	41.8	301.9	169.9
2021	603	39.8	296.5	159.0
2022	622	39.9	298.6	157.2
2023	715	42.4	336.1	173.9
2024	668	43.0	311.3	160.3
P for trend	-	-	<0.001**	0.585

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

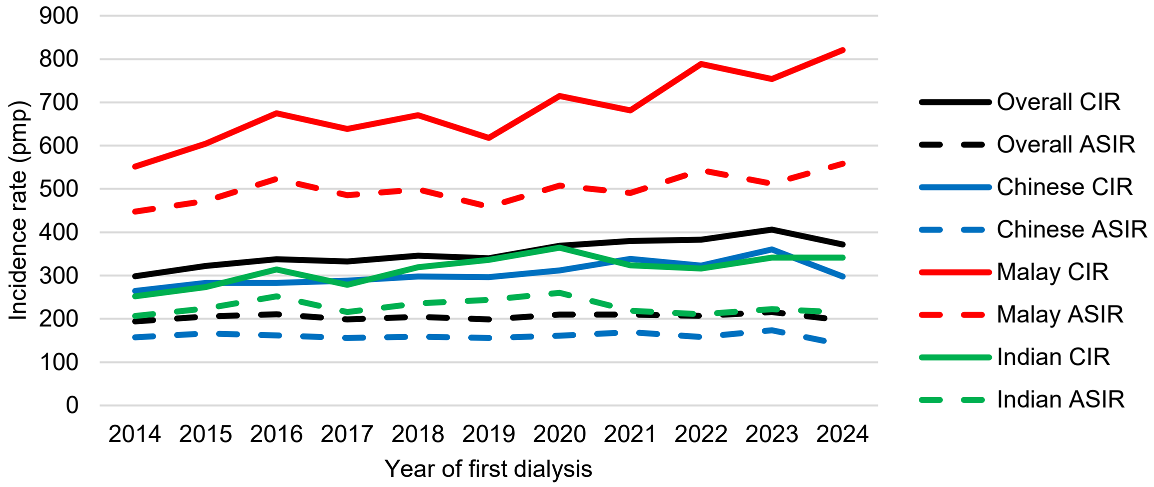


The ASIRs of ever-started dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.3.4, Figure 5.3.5). In 2024, the ASIRs were 140.5 pmp, 558.2 pmp and 215.2 pmp for Chinese, Malays and Indians respectively. Malays had a significant increase in the ASIR of ever-started dialysis (p=0.016) in the past decade.

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

Chinese				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	760	65.8	264.4	157.6
2015	820	65.2	282.8	166.5
2016	828	62.3	283.3	161.6
2017	850	64.5	288.3	155.9
2018	884	64.0	297.7	158.6
2019	887	64.7	296.3	155.9
2020	937	62.8	311.6	161.1
2021	1002	66.2	338.5	168.9
2022	976	62.6	323.3	158.4
2023	1107	65.7	360.3	173.7
2024	922	59.4	298.1	140.5
P for trend	-	-	0.004**	0.64
Malay				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	285	24.7	551.6	447.7
2015	315	25.0	604.7	472.2
2016	355	26.7	675.0	523.5
2017	339	25.7	638.8	485.4
2018	359	26.0	670.0	498.8
2019	334	24.4	617.6	459.0
2020	390	26.1	714.9	508.0
2021	371	24.5	681.4	490.5
2022	437	28.0	788.7	543.1
2023	423	25.1	753.6	512.3
2024	464	29.9	820.7	558.2
P for trend	-	-	<0.001**	0.016*
Indian				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	89	7.7	252.1	206.6
2015	97	7.7	273.3	224.1
2016	112	8.4	313.8	251.7
2017	100	7.6	278.7	216.0
2018	115	8.3	319.0	235.7
2019	122	8.9	336.4	244.2
2020	132	8.8	364.4	260.1
2021	115	7.6	324.0	219.1
2022	116	7.4	316.6	210.5
2023	128	7.6	341.5	222.3
2024	129	8.3	341.3	215.2
P for trend	-	-	0.005**	0.783

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



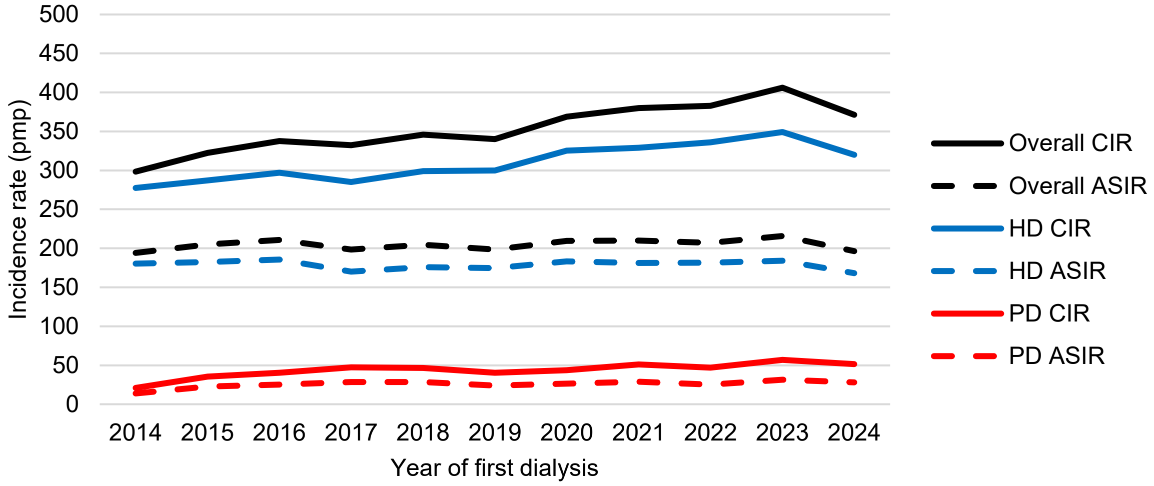
The ASIRs of ever-started dialysis were consistently higher among HD than PD, as about 90% of those who initiated dialysis did so with HD every year (Table 5.3.5, Figure 5.3.6). In 2024, the ASIR was 168.1 pmp and 28.1 pmp for HD and PD respectively. The Ministry of Health (MOH) has been working with the public healthcare institutions and dialysis service providers to promote the uptake of PD among local dialysis patients, and the proportion of those opting for PD has been moving upwards over the years. While the ASIR for PD increased significantly over the years (p=0.029), the ASIR for HD remained stable (p=0.571).

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

	HD			
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	1074	93.0	277.5	180.3
2015	1120	89.0	287.0	182.3
2016	1169	88.0	297.2	185.6
2017	1131	85.8	285.2	170.1
2018	1195	86.5	299.2	176.1
2019	1208	88.2	300.0	174.6
2020	1316	88.2	325.4	183.3
2021	1311	86.6	328.8	181.1
2022	1369	87.8	336.1	181.4
2023	1449	86.0	349.2	184.2
2024	1338	86.2	320.0	168.1
P for trend	-	-	<0.001**	0.571

PD				
Year of first dialysis	**Number**	**%**	**CIR**	**ASIR**
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	162	11.8	40.2	24.0
2020	176	11.8	43.5	26.3
2021	203	13.4	50.9	28.7
2022	191	12.2	46.9	25.3
2023	236	14.0	56.9	31.4
2024	215	13.8	51.4	28.1
P for trend	-	-	0.005**	0.029*

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



5.4 Incidence of definitive dialysis

The incidence rate of definitive dialysis 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 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 by 36% from 1,042 in 2014 to 1,419 in 2024 (Table 5.4.1, Figure 5.4.1). Correspondingly, the CIR increased significantly from 269.2 pmp in 2014 to 339.4 pmp in 2024 ($p<0.001$). The rise in ASIR from 176.1 pmp in 2014 to 181.8 pmp in 2024 was also significant ($p=0.048$), suggesting that there were other factors besides population ageing that may account for the increase in dialysis incidence in Singapore.

According to the Global Burden of Disease (GBD), in 2023, developed high-income countries had a higher incidence of CKD5, as well as a higher prevalence of CKD5-associated risk factors such as diabetes and hypertension[20].Therefore, the elevated incidence of treated CKD5[21] in developed countries may be attributed to the greater prevalence of these risk factors.

Likewise, according to data collected by the United States Renal Data System (USRDS), the incidence of treated CKD5 in Asia was noted to be comparatively higher than other parts of the world. In 2022, Singapore had the fifth highest incidence of treated CKD5 in the world among countries included in the analysis, after countries like Taiwan, Mexico, Brunei, and the United States[22].

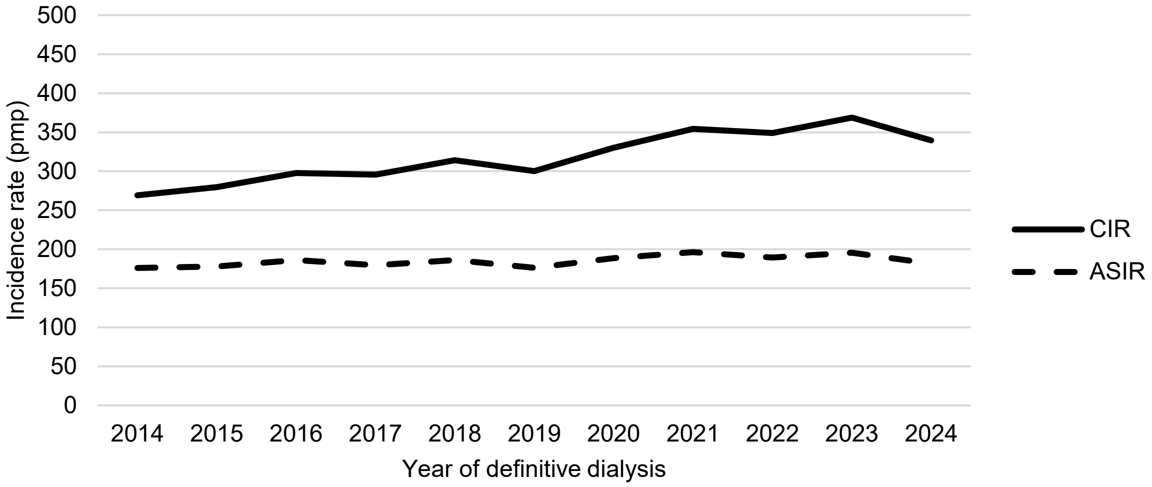
Table 5.4.1: Incidence number and rate (pmp) of definitive dialysis

Year of definitive dialysis	Number	CIR	ASIR
2014	1042	269.2	176.1
2015	1091	279.6	177.8
2016	1171	297.7	186.4
2017	1173	295.8	179.5
2018	1254	313.9	186.3
2019	1208	300.0	176.5
2020	1335	330.1	188.5
2021	1412	354.2	196.4
2022	1422	349.1	189.5
2023	1530	368.7	195.6

[20] GBD results. Institute for Health Metrics and Evaluation. https://vizhub.healthdata.org/gbd-results/. Accessed on 11 December 2025.
[21] Refers to CKD5 treated with dialysis or kidney transplant, with the former as the predominant form of treatment
[22] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 18 November 2025.

2024	1419	339.4	181.8
P for trend	-	<0.001**	0.048*

Figure 5.4.1: Incidence rate (pmp) of definitive dialysis



The age-specific incidence rate of definitive dialysis increased significantly for those aged 30-39 years (p=0.002) and 40-49 years (p=0.03) (Table 5.4.2). The majority of incident definitive dialysis patients were found among the older age bands, especially those 60 years and above – increasing from 52.9% in 2014 to 65.8% in 2024. Data from the USRDS also showed that the growth of incident treated CKD5 patients[23] was highest among the older age bands (65-74 years, 75 years and above) across different countries[24]. The observed increase in age-specific incidence of dialysis among older age groups could be related to increasing polypharmacy among the elderly, where the high risk of exposure to the adverse effects from medications and procedures increases the risk of acute kidney injury and CKD progression to dialysis[25].

[23] Refers to CKD5 treated with either dialysis or kidney transplant, with the former as the predominant form of treatment

[24] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 18 November 2025.

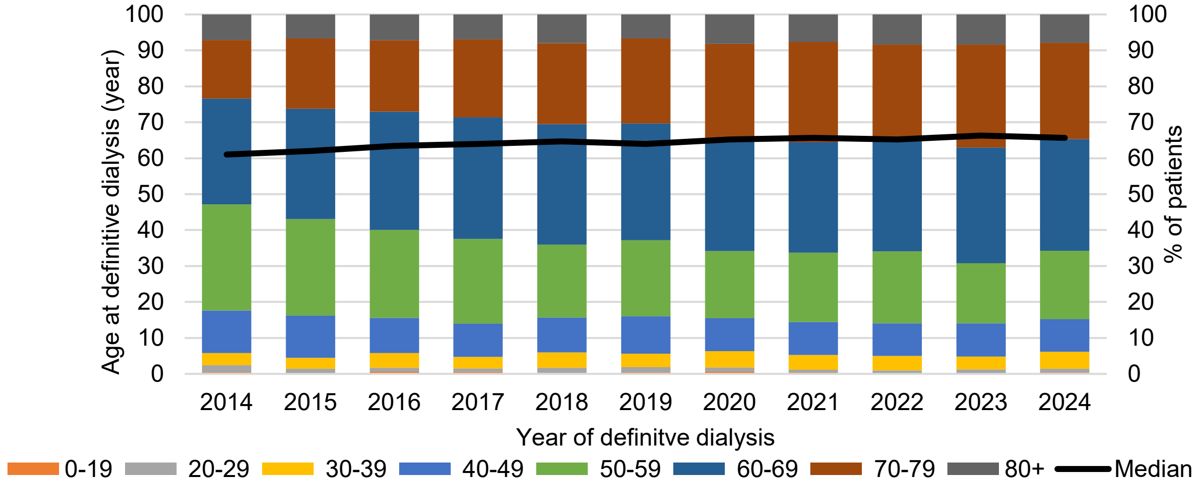
[25] Lai et al. Trends in the incidence and prevalence of end-stage kidney disease requiring dialysis in Taiwan: 2010-2018. Journal of the Formosan Medical Association 2022; 121: S5-S11

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
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	108	9.2	175.6
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	60	4.5	100.4	123	9.2	201.3
2021	5	0.4	6.4	12	0.8	23.3	57	4.0	96.6	130	9.2	219.3
2022	0	0.0	0.0	14	1.0	27.3	57	4.0	93.7	129	9.1	213.5
2023	2	0.1	2.5	17	1.1	33.5	55	3.6	88.2	141	9.2	230.1
2024	5	0.4	6.3	16	1.1	32.4	66	4.7	103.9	129	9.1	211.0
P for trend	-	-	0.937	-	-	0.647	-	-	0.002**	-	-	0.03*
Year of definitive dialysis	**Age 50-59**			**Age 60-69**			**Age 70-79**			**Age 80+**		
	Number	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**	**Number**	**%**	**CIR**
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	213	19.5	1158.6	73	6.7	781.2
2016	287	24.5	466.5	385	32.9	855.8	233	19.9	1215.1	84	7.2	858.9
2017	276	23.5	449.2	397	33.8	850.8	255	21.7	1206.0	81	6.9	799.8
2018	255	20.3	415.7	420	33.5	868.1	282	22.5	1232.1	101	8.1	945.0
2019	255	21.1	419.1	393	32.5	785.8	285	23.6	1164.6	81	6.7	700.3
2020	249	18.7	413.7	420	31.5	817.1	350	26.2	1341.0	109	8.2	879.2
2021	272	19.3	465.6	434	30.7	837.8	394	27.9	1446.9	108	7.6	822.5
2022	285	20.0	480.8	447	31.4	834.1	371	26.1	1260.3	119	8.4	876.1
2023	256	16.7	424.5	493	32.2	891.8	438	28.6	1373.5	128	8.4	914.9
2024	270	19.0	448.8	441	31.1	783.6	380	26.8	1113.9	112	7.9	764.0
P for trend	-	-	0.2	-	-	0.538	-	-	0.082	-	-	0.875

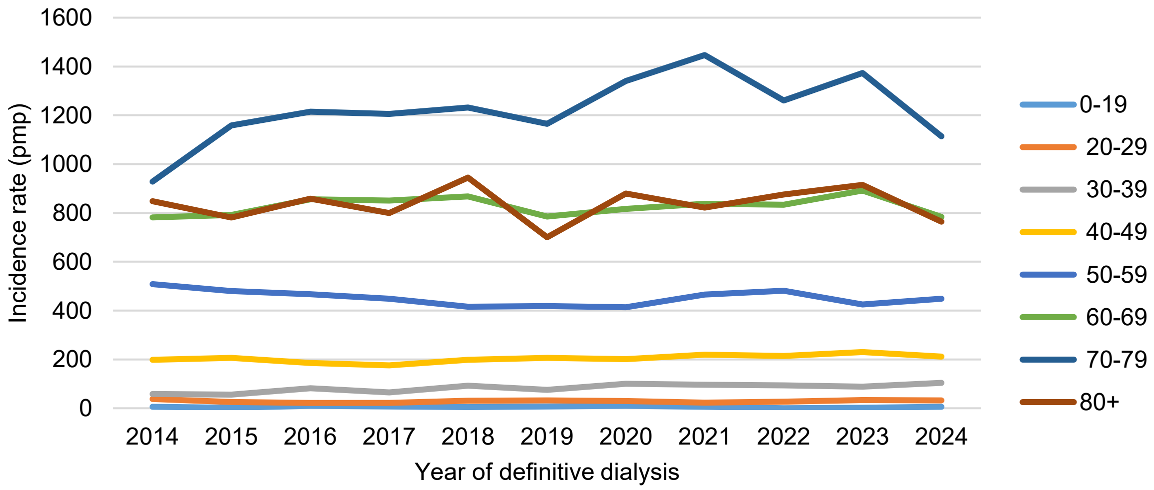
The median age at definitive dialysis increased from 61.0 years in 2014 to 65.7 years in 2024 ($p<0.001$) (Figure 5.4.2a).

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



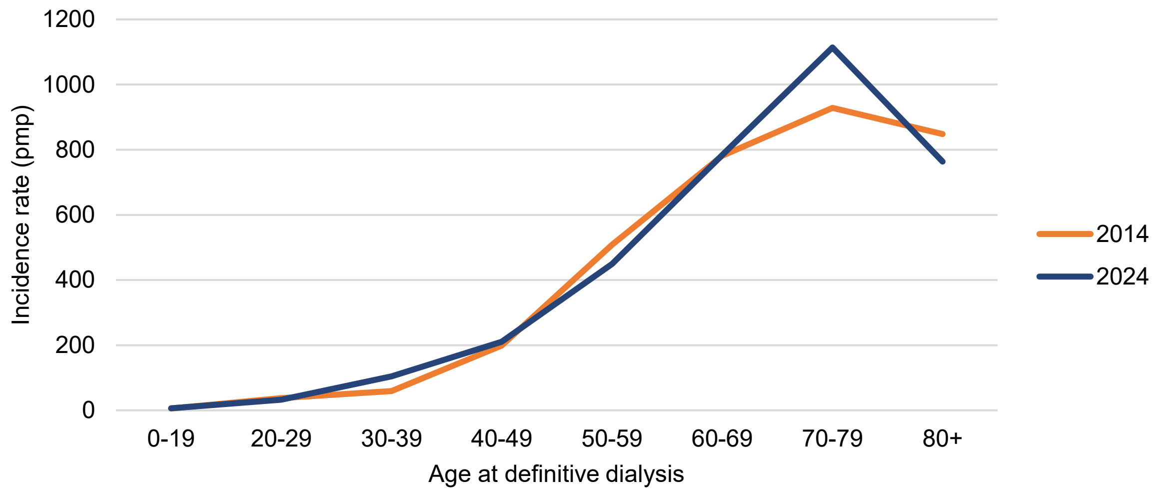
Similar to the trends for ever-started dialysis incidence (Table 5.3.1, Figure 5.3.1), the age-specific incidence rates of definitive dialysis increased with age (Figure 5.4.2b, Figure 5.4.3) It peaked for those aged 70 to 79 years, and then declined for those aged 80 years or older as studies have shown that dialysis offers little advantage in improving survival, especially among elderly patients with pre-existing co-morbidities[26].

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



[26] 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



Definitive dialysis was more common among males than females, with males accounting for close to 60% of definitive dialysis patients every year from 2014-2024. The ASIRs of definitive dialysis were consistently higher among males than females across the years (Table 5.4.3, Figure 5.4.4). In 2024, the ASIR was 222.0 pmp and 145.4 pmp for males and females respectively. The ASIR increased significantly over the years for males (p=0.009), but not for females (p=0.877). Similar to trends found in other high-income countries, males had a 1.2- to 1.5-fold higher incidence of dialysis across the years[27]. This could be due to higher prevalence of risk factors for CKD5 among males. For example, males are known to be at higher risk for developing diabetic kidney failure[28]. Hypertension also is a major risk factor for CKD5. The ASIR of hypertension-related CKD5 is higher in males than in females, both globally and in high-income countries[29].

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

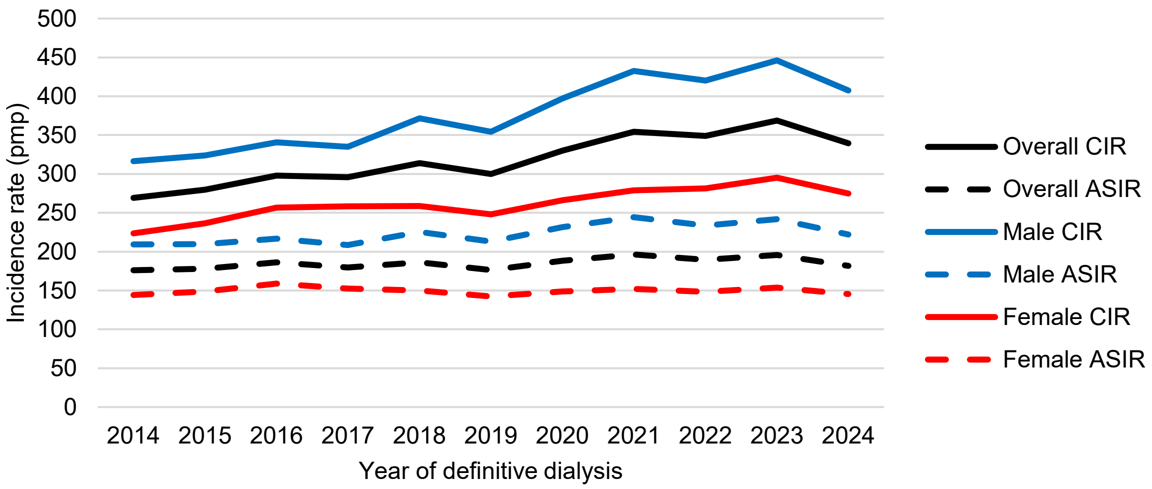
	Male			
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	602	57.8	316.4	209.2
2015	621	56.9	324.0	209.6
2016	657	56.1	340.5	216.6
2017	651	55.5	335.0	208.5
2018	727	58.0	371.7	225.5
2019	698	57.8	354.4	213.0
2020	785	58.8	397.0	231.7
2021	845	59.8	432.6	244.4
2022	836	58.8	420.1	233.8

[27] Himmelfarb J, Vanholder R, Mehrotra R, and Tonelli M. The current and future landscape of dialysis. Nephrology. 2020;16.
[28] Hoogeveen E. K. The Epidemiology of Diabetic Kidney Disease. Kidney Dial. 2022, 2(3), 433-442
[29] Liu, Y., He, Q., Li, Q., & others. (2023). Global incidence and death estimates of chronic kidney disease due to hypertension from 1990 to 2019: An ecological analysis of the global burden of diseases 2019 study. *BMC Nephrology, 24*(352). https://doi.org/10.1186/s12882-023-03391-z

2023	902	59.0	446.1	241.7
2024	829	58.4	407.4	222.0
P for trend	-	-	<0.001**	0.009**

	Female			
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	440	42.2	223.5	144.4
2015	470	43.1	236.6	148.6
2016	514	43.9	256.5	158.9
2017	522	44.5	258.1	152.3
2018	527	42.0	258.5	150.1
2019	510	42.2	248.0	142.4
2020	550	41.2	266.1	148.8
2021	567	40.2	278.8	152.0
2022	586	41.2	281.3	148.2
2023	628	41.0	295.2	153.5
2024	590	41.6	274.9	145.4
P for trend	-	-	<0.001**	0.877

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

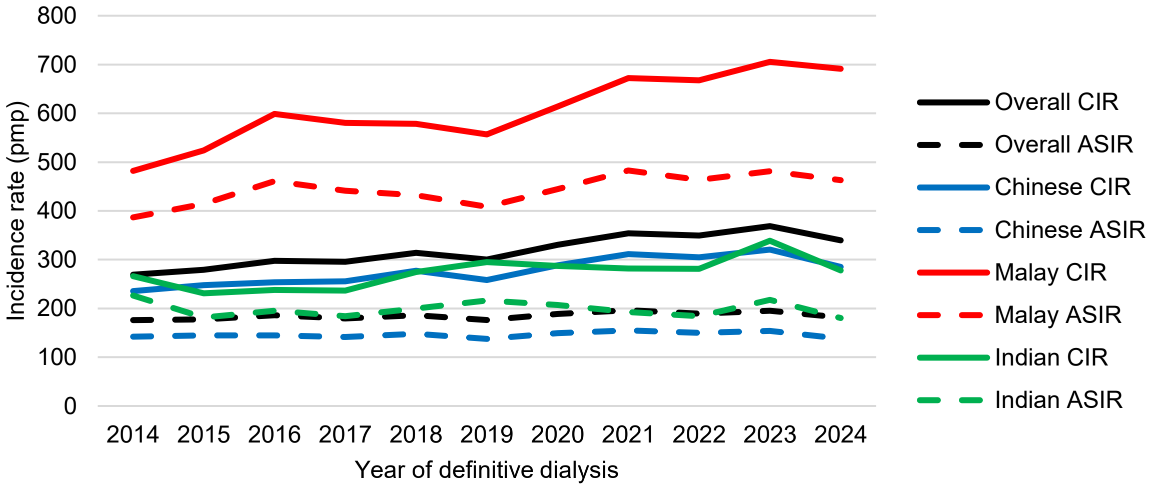


The ASIRs of definitive dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.4.4, Figure 5.4.5). In 2024, the ASIR was 138.5 pmp, 462.8 pmp and 180.4 pmp for Chinese, Malays and Indians respectively. While the ASIRs for Malays (p=0.01) increased significantly over the years, the ASIR for Chinese and Indians remained stable.

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

Chinese				
Year of definitive dialysis	Number	%	CIR	ASIR
2014	677	65.0	235.5	141.9
2015	718	65.8	247.6	144.8
2016	741	63.3	253.5	144.4
2017	754	64.3	255.7	141.7
2018	824	65.7	277.5	148.3
2019	774	64.1	258.5	137.6
2020	867	64.9	288.3	149.6
2021	921	65.2	311.1	154.9
2022	920	64.7	304.7	149.8
2023	985	64.4	320.6	154.2
2024	882	62.2	285.1	138.5
P for trend	-	-	<0.001**	0.341
Malay				
Year of definitive dialysis	Number	%	CIR	ASIR
2014	249	23.9	481.9	386.6
2015	273	25.0	524.1	414.1
2016	315	26.9	599.0	460.8
2017	308	26.3	580.4	441.0
2018	310	24.7	578.5	432.2
2019	301	24.9	556.6	408.8
2020	335	25.1	614.1	444.7
2021	366	25.9	672.2	482.8
2022	370	26.0	667.7	463.5
2023	396	25.9	705.5	481.0
2024	391	27.6	691.5	462.8
P for trend	-	-	<0.001**	0.01**
Indian				
Year of definitive dialysis	Number	%	CIR	ASIR
2014	94	9.0	266.3	226.4
2015	82	7.5	231.0	181.4
2016	85	7.3	238.2	195.1
2017	85	7.2	236.9	184.2
2018	99	7.9	274.6	200.2
2019	107	8.9	295.1	216.5
2020	104	7.8	287.1	207.2
2021	100	7.1	281.8	193.0
2022	103	7.2	281.1	184.1
2023	127	8.3	338.8	217.3
2024	105	7.4	277.8	180.4
P for trend	-	-	0.014*	0.611

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



HD was the primary modality undertaken by individuals on dialysis in Singapore, ranging from 77.1% to 86.9% from 2014 to 2024 (Table 5.4.5). In Singapore, the MOH has been working with public hospitals and the social service sector to encourage PD utilisation among patients requiring dialysis by providing stakeholders with training to enable patients to independently perform PD at home[30]. The percentage of patients on definitive dialysis utilising HD has fallen over years, while that of PD has increased correspondingly. Nevertheless, the ASIRs of definitive dialysis remained consistently higher among HD than PD patients across the years (Table 5.4.5, Figure 5.4.6). In 2024, the ASIR was 144.6 pmp and 37.3 pmp for HD and PD patients respectively. For both modalities, no significant changes in ASIR were observed (HD: p=0.407; PD: p=0.136).

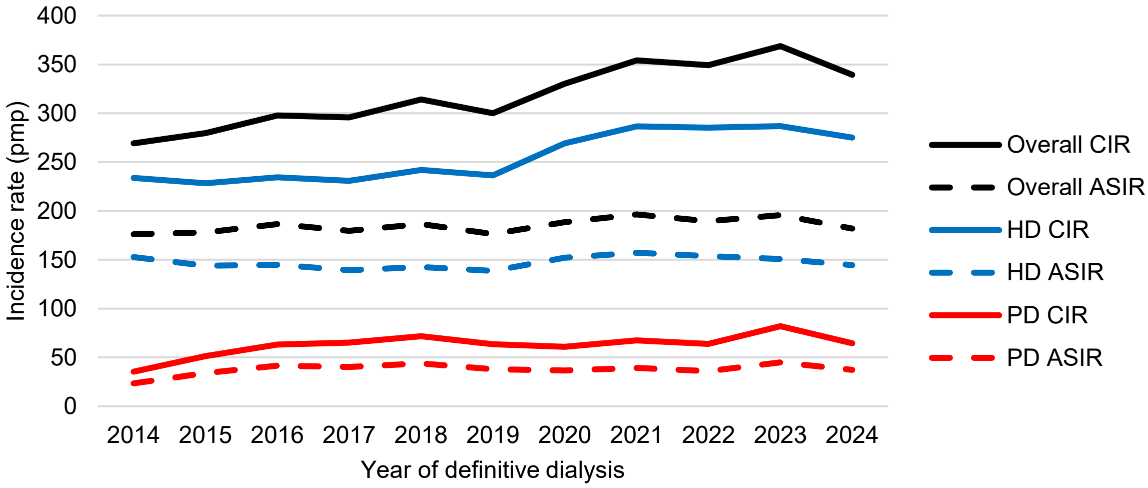
Table 5.4.5: Incidence number and rate (pmp) of definitive dialysis by modality

	HD			
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
2014	905	86.9	233.8	152.7
2015	891	81.7	228.3	143.9
2016	922	78.7	234.4	144.9
2017	915	78.0	230.7	139.4
2018	967	77.1	242.1	142.6
2019	952	78.8	236.5	138.6
2020	1089	81.6	269.3	151.9
2021	1143	80.9	286.7	157.2
2022	1162	81.7	285.3	153.6
2023	1190	77.8	286.8	150.6
2024	1150	81.0	275.1	144.6
P for trend	-	-	<0.001**	0.407

[30] Speech By Mr Ong Ye Kung, Minister For Health, At The 19th International Society For Peritoneal Dialysis Congress 2022 Opening Ceremony. Ministry of Health, Singapore. https://www.moh.gov.sg/news-highlights/details/speech-by-mr-ong-ye-kung-minister-for-health-at-the-19th-international-society-for-peritoneal-dialysis-congress-2022-opening-ceremony Accessed on 24 October 2023.

PD				
Year of definitive dialysis	**Number**	**%**	**CIR**	**ASIR**
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	256	21.2	63.6	37.9
2020	246	18.4	60.8	36.5
2021	269	19.1	67.5	39.2
2022	260	18.3	63.8	35.8
2023	340	22.2	81.9	44.9
2024	269	19.0	64.3	37.3
P for trend	-	-	0.023*	0.136

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



Among new patients on definitive dialysis, DN was the major cause of CKD5, accounting for about 2 in 3 new dialysis patients every year. GN was the second highest cause from 2014-2018 and was overtaken by HYP from 2019-2024 (Table 5.4.6). In 2024, 67.0% of the new definitive dialysis patients had DN, 15.4% had HYP while 10.9% had GN. According to data collected by the USRDS, in 2022, Singapore had the third highest proportion of incident treated CKD5[31] attributed to diabetes in the world[32].

[31] Refers to CKD5 treated with either dialysis or kidney transplant, with the former as the predominant form of treatment

[32] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 18 November 2025.

Table 5.4.6: Incidence number of definitive dialysis by etiology

Year of definitive dialysis	DN		GN		HYP		AD	
	Number	%	Number	%	Number	%	Number	%
2014	673	64.6	166	15.9	123	11.8	17	1.6
2015	727	66.6	177	16.2	118	10.8	15	1.4
2016	780	66.6	169	14.4	135	11.5	12	1
2017	790	67.3	173	14.7	142	12.1	8	0.7
2018	831	66.3	175	14	171	13.6	9	0.7
2019	825	68.3	139	11.5	156	12.9	15	1.2
2020	905	67.8	164	12.3	188	14.1	14	1
2021	944	66.9	179	12.7	205	14.5	13	0.9
2022	918	64.6	183	12.9	209	14.7	18	1.3
2023	962	62.9	197	12.9	259	16.9	19	1.2
2024	951	67	155	10.9	218	15.4	22	1.6

Year of definitive dialysis	OBS		PKD		Others	
	Number	%	Number	%	Number	%
2014	8	0.8	29	2.8	26	2.5
2015	11	1	16	1.5	27	2.5
2016	10	0.9	30	2.6	35	3
2017	10	0.9	19	1.6	31	2.6
2018	18	1.4	23	1.8	27	2.2
2019	14	1.2	31	2.6	28	2.3
2020	9	0.7	29	2.2	26	1.9
2021	6	0.4	32	2.3	33	2.3
2022	18	1.3	46	3.2	30	2.1
2023	20	1.3	25	1.6	48	3.1
2024	10	0.7	34	2.4	29	2

DN: Diabetic Nephropathy
GN: Primary Glomerulonephritis
HYP: Hypertension and Renovascular Disease
AD: Autoimmune Disease/GN with Systemic Manifestations
OBS: Obstruction
PKD: Polycystic Kidney Disease/Other Cystic Diseases

5.5 Prevalence of definitive dialysis

The prevalence rate of definitive dialysis 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.

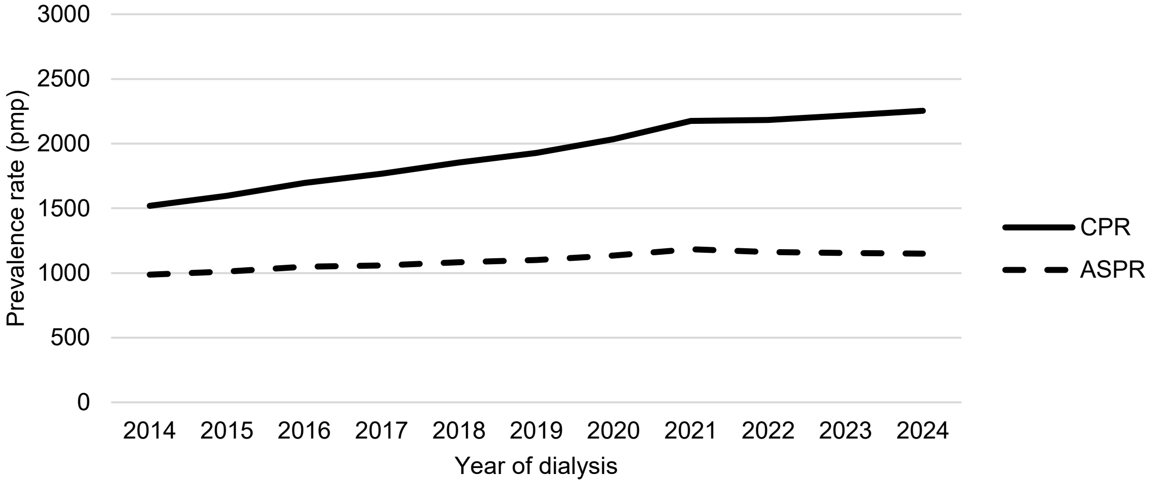
Like the incidence trends of definitive dialysis (Table 5.4.1, Figure 5.4.1), the number of prevalent patients on definitive dialysis increased since 2014 (Table 5.5.1, Figure 5.5.1). Correspondingly, both the crude prevalence rate (CPR, p<0.001) and ASPR (p<0.001) increased significantly over the years. At the end of 2024, there were a total of 9,422 surviving dialysis patients, a 60% increase compared to 5,880 dialysis patients a decade ago. The CPR of definitive dialysis was 2,253.6 pmp and ASPR was 1,148.8 pmp in 2024. 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. Data from USRDS indicated that in 2022, Singapore had the third highest prevalence of dialysis, as well as the second highest average yearly rate of change in dialysis prevalence from 2012 to 2022[33].

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

Year of dialysis	Number	CPR	ASPR
2014	5880	1519.1	987.1
2015	6232	1596.8	1012.4
2016	6675	1696.9	1048.7
2017	7009	1767.4	1059.2
2018	7408	1854.7	1082.0
2019	7767	1929.1	1101.4
2020	8223	2033.3	1134.0
2021	8674	2175.7	1183.3
2022	8886	2181.6	1163.2
2023	9202	2217.7	1155.3
2024	9422	2253.6	1148.8
P for trend	-	<0.001**	<0.001**

[33] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 18 November 2025.

Figure 5.5.1: Prevalence rate (pmp) of definitive dialysis



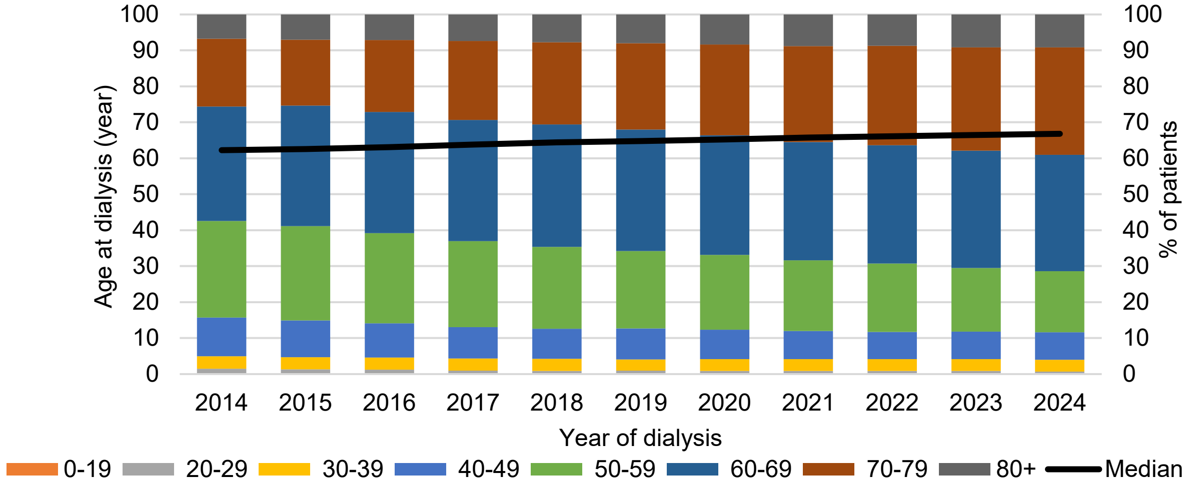
The age-specific prevalence rate of definitive dialysis increased significantly for those aged 30-39 years (p<0.001), 40-49 years (p<0.001), 60 years and above (p<0.001). Those aged 30-39 had the largest percentage change in the age-specific prevalence (Table 5.5.2). Nevertheless, older individuals continued to comprise the majority of prevalent dialysis patients. In 2024, 71.4% of prevalent dialysis patients were aged 60 years and above.

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
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	225	3.4	383.0	637	9.5	1036.4
2017	12	0.2	14.5	55	0.8	100.1	235	3.4	405.0	612	8.7	995.2
2018	13	0.2	15.9	51	0.7	93.2	250	3.4	427.3	621	8.4	1015.6
2019	14	0.2	17.2	59	0.8	109.8	242	3.1	407.2	668	8.6	1090.7
2020	19	0.2	23.6	55	0.7	103.5	267	3.2	447.0	674	8.2	1103.1
2021	18	0.2	23.0	54	0.6	104.7	291	3.4	493.0	679	7.8	1145.2
2022	13	0.1	16.5	62	0.7	120.8	293	3.3	481.8	674	7.6	1115.5
2023	12	0.1	15.2	65	0.7	128.2	309	3.4	495.5	701	7.6	1144.1
2024	13	0.1	16.5	56	0.6	113.3	304	3.2	478.7	719	7.6	1175.8
P for trend	-	-	0.182	-	-	0.453	-	-	<0.001**	-	-	<0.001**
Year of dialysis	**Age 50-59**			**Age 60-69**			**Age 70-79**			**Age 80+**		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2014	1578	26.8	2613.0	1871	31.8	4764.5	1110	18.9	6062.0	398	6.8	4559.3
2015	1635	26.2	2679.7	2085	33.5	4930.0	1141	18.3	6206.4	440	7.1	4708.5
2016	1673	25.1	2719.5	2250	33.7	5001.4	1336	20.0	6967.4	474	7.1	4846.7
2017	1674	23.9	2724.2	2362	33.7	5061.9	1542	22.0	7292.6	517	7.4	5104.9
2018	1685	22.7	2747.2	2520	34.0	5208.9	1693	22.9	7397.1	575	7.8	5379.9
2019	1677	21.6	2756.2	2624	33.8	5246.7	1860	23.9	7600.3	623	8.0	5386.6
2020	1707	20.8	2836.0	2735	33.3	5320.8	2077	25.3	7957.9	689	8.4	5557.6
2021	1699	19.6	2908.3	2858	32.9	5517.3	2312	26.7	8490.5	763	8.8	5810.5
2022	1690	19.0	2850.8	2921	32.9	5450.3	2456	27.6	8343.1	777	8.7	5720.5
2023	1627	17.7	2698.0	3003	32.6	5432.1	2645	28.7	8294.3	840	9.1	6003.9
2024	1605	17.0	2668.1	3048	32.3	5415.7	2813	29.9	8246.1	864	9.2	5893.5
P for trend	-	-	0.207	-	-	<0.001**	-	-	<0.001**	-	-	<0.001**

The median age among prevalent definitive dialysis patients increased from 62.3 years in 2014 to 66.8 years in 2024 (p<0.001) (Figure 5.5.2a).

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



Similar to the trends observed for incident definitive dialysis patients (Figure 5.4.2b, Figure 5.4.3), the age-specific prevalence rate of definitive dialysis increased with age, and it peaked for those aged 70 to 79 years (Figure 5.5.2b, Figure 5.5.3).

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

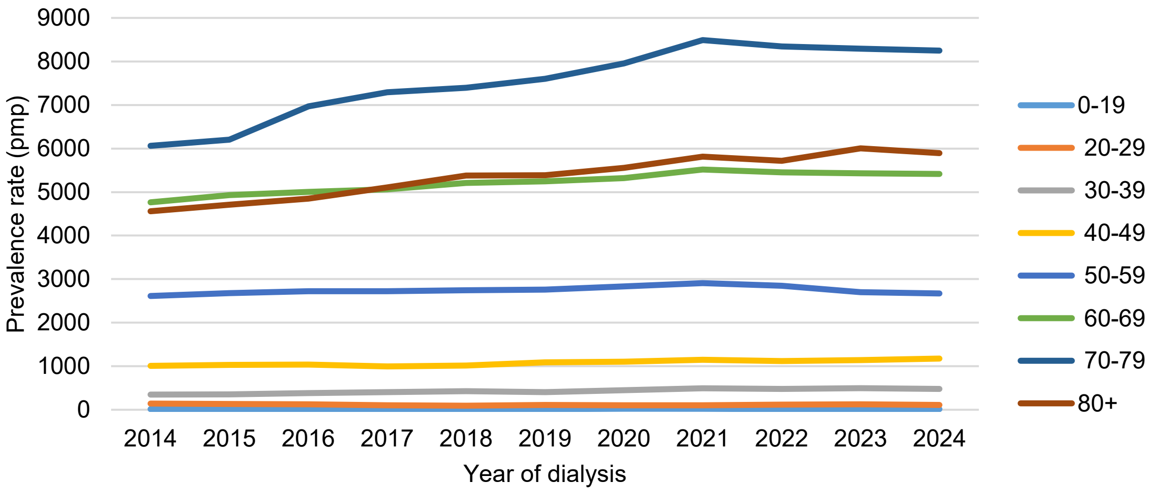
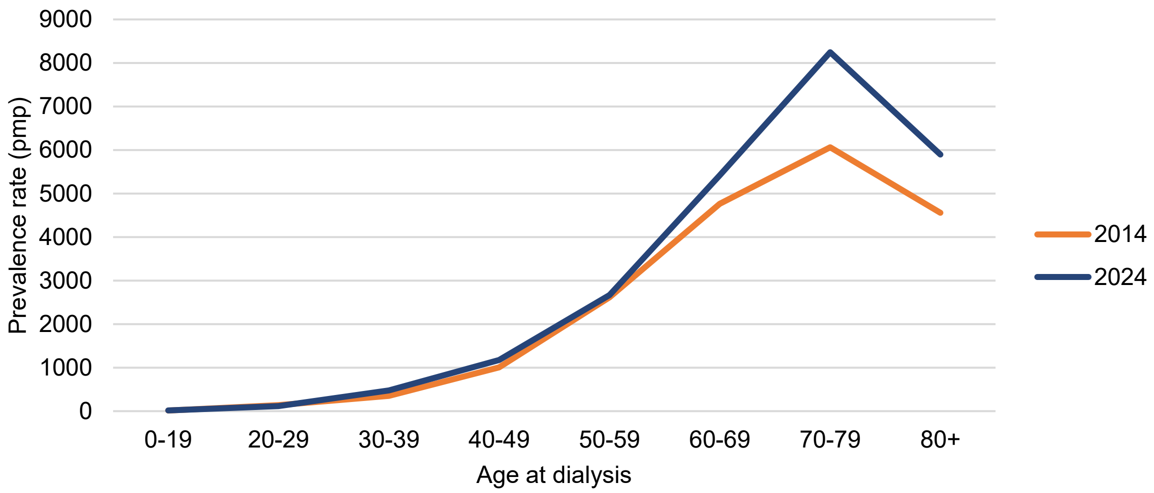


Figure 5.5.3: Age-specific prevalence rate (pmp) of definitive dialysis across age groups



Akin to the trends for definitive dialysis incidence (Table 5.4.3, Figure 5.4.4), males comprised a higher percentage of prevalent definitive dialysis patients, and the ASPRs of definitive dialysis were consistently higher among males than females across the years (Table 5.5.3, Figure 5.5.4). In 2024, the ASPR was 1,360.3 pmp and 956.8 pmp for males and females respectively. The ASPRs for both sexes increased significantly over the years ($p<0.001$), with a larger rise for males. Globally, more males receive kidney replacement therapy compared to females, partly due to underlying biological factors and faster CKD progression in men[34].

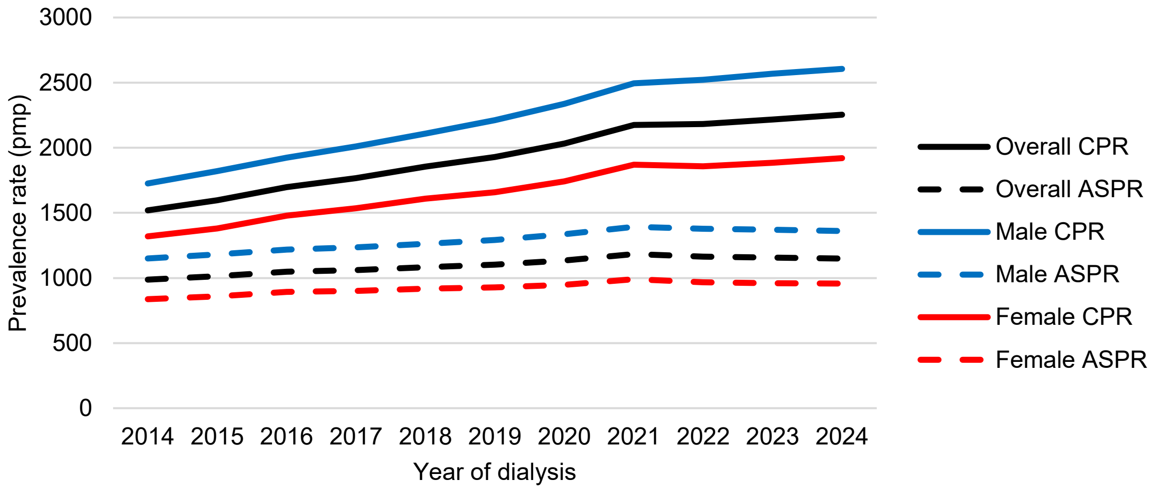
Table 5.5.3: Prevalence number and rate (pmp) of definitive dialysis by sex

Male				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	3283	55.8	1725.7	1149.8
2015	3490	56.0	1820.9	1180.3
2016	3714	55.6	1924.8	1217.7
2017	3906	55.7	2009.7	1234.5
2018	4126	55.7	2109.6	1261.0
2019	4355	56.1	2211.4	1290.9
2020	4623	56.2	2337.7	1336.2
2021	4872	56.2	2494.5	1392.4
2022	5019	56.5	2521.8	1376.6
2023	5191	56.4	2567.4	1370.0
2024	5302	56.3	2605.5	1360.3
P for trend	-	-	<0.001**	<0.001**

[34] García García, G., Iyengar, A., Kaze, F., Kierans, C., Padilla-Altamira, C., & Luyckx, V. A. (2022). Sex and gender differences in chronic kidney disease and access to care around the globe. Seminars in Nephrology, 42(2), 101-113. https://doi.org/10.1016/j.semnephrol.2022.04.001

Female				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	2597	44.2	1319.4	837.1
2015	2742	44.0	1380.6	857.4
2016	2961	44.4	1477.5	893.9
2017	3103	44.3	1534.4	899.3
2018	3282	44.3	1610.1	918.4
2019	3412	43.9	1658.9	928.7
2020	3600	43.8	1741.9	948.2
2021	3802	43.8	1869.5	990.4
2022	3867	43.5	1856.4	966.6
2023	4011	43.6	1885.4	959.2
2024	4120	43.7	1919.9	956.8
P for trend	-	-	<0.001**	<0.001**

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

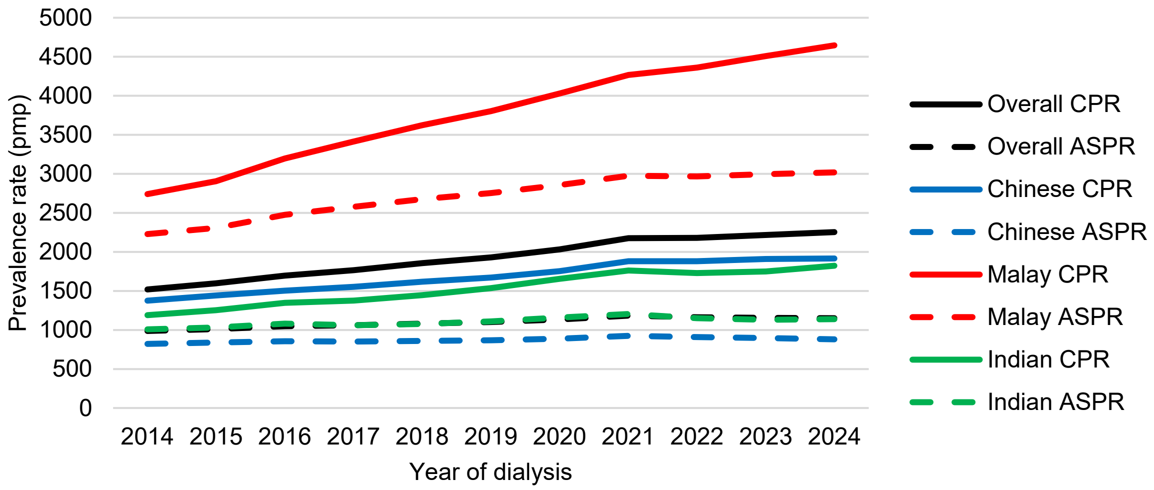


The ASPRs of definitive dialysis were consistently higher among Malays than Chinese and Indians across the years (Table 5.5.4, Figure 5.5.5). In 2024, the ASPR was 878.9 pmp, 3018.8 pmp and 1,140.2 pmp for Chinese, Malays and Indians respectively. While the ASPRs for all the three ethnic groups increased significantly over the years ($p<0.001$), the increment for Malays was higher than those for Chinese and Indians.

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

Chinese				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	3954	67.2	1375.6	821.1
2015	4179	67.1	1441.0	840.4
2016	4398	65.9	1504.5	853.6
2017	4573	65.2	1551.1	849.6
2018	4805	64.9	1618.2	860.2
2019	5005	64.4	1671.8	868.4
2020	5267	64.1	1751.7	888.3
2021	5570	64.2	1881.7	924.6
2022	5682	63.9	1882.1	906.9
2023	5867	63.8	1909.6	897.3
2024	5926	62.9	1915.7	878.9
P for trend	-	-	<0.001**	0.001**
Malay				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	1416	24.1	2740.7	2228.4
2015	1513	24.3	2904.5	2305.1
2016	1681	25.2	3196.5	2473.9
2017	1811	25.8	3412.4	2578.5
2018	1941	26.2	3622.5	2674.1
2019	2058	26.5	3805.6	2753.7
2020	2199	26.7	4031.2	2858.5
2021	2323	26.8	4266.7	2975.6
2022	2417	27.2	4361.9	2968.5
2023	2530	27.5	4507.1	2997.8
2024	2627	27.9	4646.2	3018.8
P for trend	-	-	<0.001**	<0.001**
Indian				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	420	7.1	1189.7	1007.8
2015	445	7.1	1253.7	1031.9
2016	481	7.2	1347.8	1079.8
2017	494	7.0	1376.7	1061.6
2018	522	7.0	1447.9	1075.4
2019	557	7.2	1536.0	1109.9
2020	600	7.3	1656.2	1158.7
2021	625	7.2	1761.1	1204.3
2022	633	7.1	1727.6	1150.1
2023	655	7.1	1747.3	1128.2
2024	689	7.3	1822.9	1140.2
P for trend	-	-	<0.001**	0.001**

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



HD was the predominant dialysis modality utilised by prevalent dialysis patients in Singapore, with almost 9 in 10 prevalent dialysis patients on HD every year (Table 5.5.5). This is similar to most countries worldwide, with HD accounting for the bulk of the dialysis undertaken[35]. Among countries with more than 95% of prevalent dialysis patients on HD were Greece, Poland, and Bangladesh[36], with Hong Kong offering an interesting contrast – its "PD-first" approach meant that about two-thirds of prevalent CKD5 patients were on PD in 2021 – the highest PD uptake rate in the world among countries included in the USRDS data[37,38]. Overall, HD is the most common form of renal replacement therapy (RRT) in the world, accounting for about 69% of all RRT and 89% of dialysis[39].

The ASPRs of definitive dialysis were consistently higher among HD than PD patients across the years (Table 5.5.5, Figure 5.5.6). In 2024, the ASPR was 988.7 pmp and 160.1 pmp for HD and PD respectively. The ASPRs for both HD and PD increased significantly over the years ($p<0.001$).

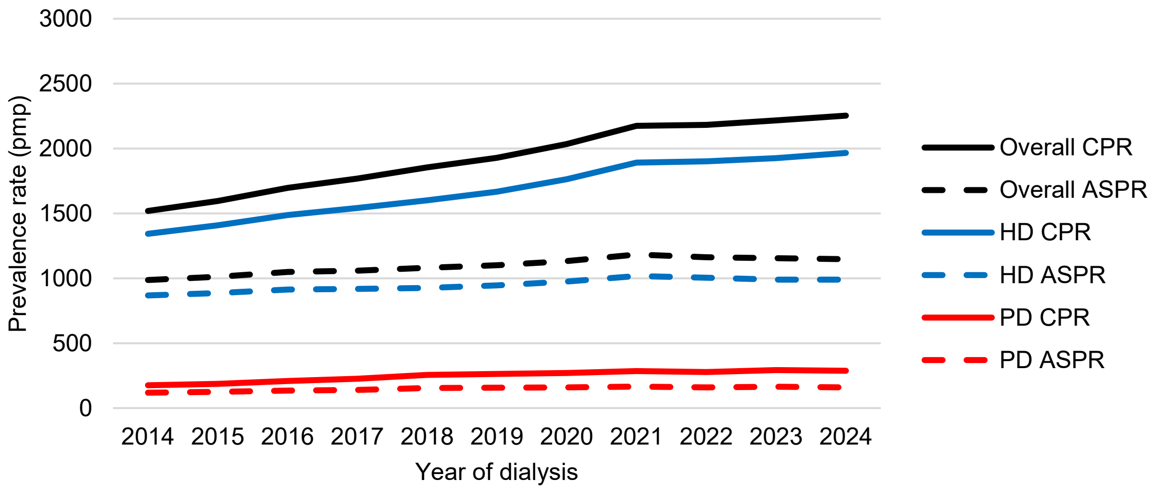
[35] Filipska A, Bohdan B, Wieczorek P and Hudz N. Chronic kidney disease and dialysis therapy: incidence and prevalence in the world. Pharmacia 68(2): 463–470.
[36] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2023/end-stage-renal-disease/11-international-comparisons. Accessed 29 September 2024.
[37] Ibid.
[38] Li KT. et al. Peritoneal dialysis first policy in Hong Kong for 35 years: Global impact. Nephrology. 2022;27:787–794.
[39] Bello AK et al. Epidemiology of haemodialysis outcomes. Nature 2022; 18.

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

HD				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
2014	5199	88.4	1343.2	868.3
2015	5499	88.2	1409.0	887.1
2016	5852	87.7	1487.7	913.4
2017	6112	87.2	1541.2	918.1
2018	6390	86.3	1599.8	927.0
2019	6711	86.4	1666.8	945.1
2020	7130	86.7	1763.0	974.7
2021	7539	86.9	1891.0	1017.6
2022	7749	87.2	1902.4	1003.5
2023	7987	86.8	1924.9	989.7
2024	8220	87.2	1966.1	988.7
P for trend	-	-	<0.001**	<0.001**

PD				
Year of dialysis	**Number**	**%**	**CPR**	**ASPR**
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	1056	13.6	262.3	156.3
2020	1093	13.3	270.3	159.3
2021	1135	13.1	284.7	165.7
2022	1137	12.8	279.1	159.7
2023	1215	13.2	292.8	165.5
2024	1202	12.8	287.5	160.1
P for trend	-	-	<0.001**	<0.001**

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



Among the prevalent definitive dialysis patients, the top conditions by etiology had consistently been DN, followed by GN and then hypertension (Table 5.5.6). While about two-thirds of incident dialysis patients each year had DN (Table 5.4.6), a lower percentage (slightly more than half) of prevalent dialysis patients had the condition, likely due to poorer survival rates among dialysis patients with DN. An Australian study found that CKD5 patients with type 2 diabetes and/or DN had higher mortality risk than patients without diabetes for both cardiovascular disease-related and all-cause mortality[40]. The proportion of prevalent definitive dialysis patients with DN increased from 51.0% in 2014 to 55.9% in 2024. Similar to the situation in Singapore, diabetes is noted to be the most common cause of CKD5 worldwide[41]. It is noteworthy that the proportion of prevalent definitive dialysis patients with GN had dropped from 27.4% in 2014 to 20.7% in 2024, while the proportion of prevalent definitive dialysis patients with hypertension rose from 11.9% to 14.8% in the same period.

Table 5.5.6: Prevalence number of definitive dialysis by etiology

Year of dialysis	DN		GN		HYP		AD	
	Number	%	Number	%	Number	%	Number	%
2014	2999	51	1613	27.4	701	11.9	109	1.9
2015	3273	52.5	1682	27	722	11.6	113	1.8
2016	3570	53.5	1726	25.9	788	11.8	114	1.7
2017	3804	54.3	1747	24.9	853	12.2	120	1.7
2018	4065	54.9	1776	24	937	12.6	125	1.7
2019	4291	55.2	1808	23.3	995	12.8	133	1.7
2020	4609	56.1	1848	22.5	1076	13.1	135	1.6
2021	4884	56.3	1911	22	1165	13.4	142	1.6
2022	4979	56	1924	21.7	1235	13.9	149	1.7
2023	5102	55.4	1968	21.4	1345	14.6	155	1.7
2024	5269	55.9	1948	20.7	1399	14.8	165	1.8

Year of dialysis	OBS		PKD		Others	
	Number	%	Number	%	Number	%
2014	56	1	201	3.4	201	3.4
2015	57	0.9	195	3.1	190	3
2016	63	0.9	210	3.1	204	3.1
2017	68	1	212	3	205	2.9
2018	76	1	219	3	210	2.8
2019	81	1	238	3.1	221	2.8
2020	79	1	249	3	227	2.8
2021	76	0.9	264	3	232	2.7
2022	83	0.9	289	3.3	227	2.6
2023	94	1	292	3.2	246	2.7
2024	95	1	303	3.2	243	2.6

[40] Lim, W. H., Johnson, D. W., Hawley, C., Lok, C., Polkinghorne, K. R., Roberts, M. A., Boudville, N., & Wong, G. (2018). Type 2 diabetes in patients with end-stage kidney disease: influence on cardiovascular disease-related mortality risk. Medical Journal of Australia, 209(10), 440-446. https://doi.org/10.5694/mja18.00195

[41] Filipska A, Bohdan B, Wieczorek P and Hudz N. Chronic kidney disease and dialysis therapy: incidence and prevalence in the world. Pharmacia 68(2): 463–470.

DN: Diabetic Nephropathy
GN: Primary Glomerulonephritis
HYP: Hypertension and Renovascular Disease
AD: Autoimmune Disease/GN with Systemic Manifestations
OBS: Obstruction
PKD: Polycystic Kidney Disease/Other Cystic Diseases

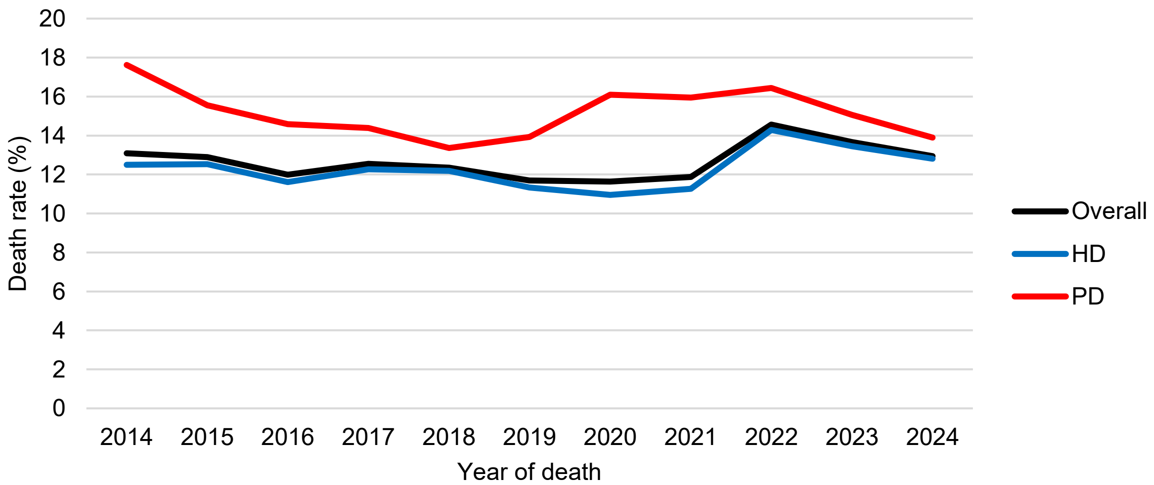
5.6 Mortality of definitive dialysis

In 2024, 12.9% of the patients on definitive dialysis died, similar to the proportion a decade ago (13.1% in 2014) (Table 5.6.1, Figure 5.6.1). Based on the last modality that the dialysis patients received before death, a greater proportion of PD patients died compared to HD over the years. 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	%
2014	770	13.1	650	12.5	120	17.6
2015	803	12.9	689	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	908	11.7	761	11.3	147	13.9
2020	957	11.6	781	11.0	176	16.1
2021	1030	11.9	849	11.3	181	15.9
2022	1294	14.6	1107	14.3	187	16.4
2023	1258	13.7	1075	13.5	183	15.1
2024	1220	12.9	1053	12.8	167	13.9

Figure 5.6.1: All-cause mortality by modality



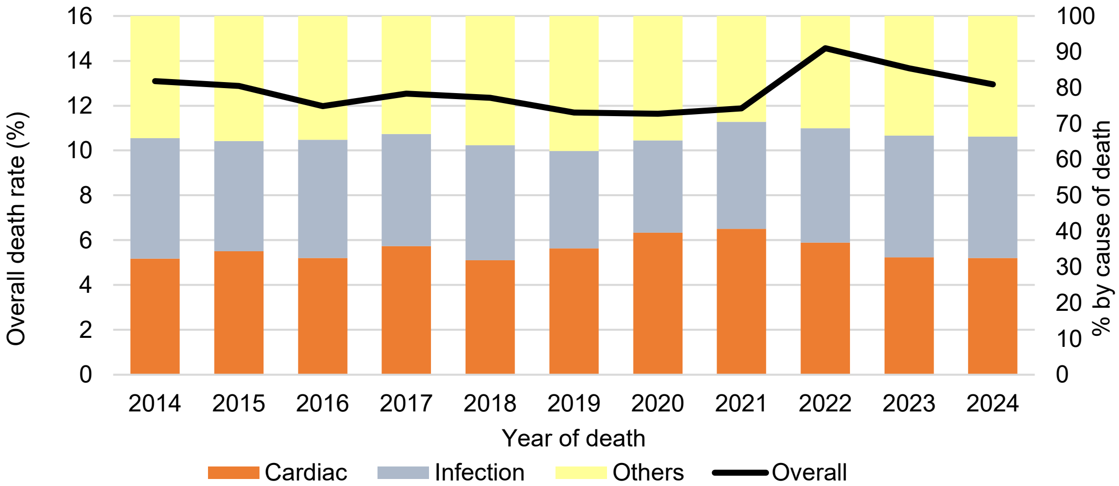
Deaths related to cardiac events and infection were the two most common causes of deaths among dialysis patients and each of them accounted for about a third of all deaths across the years (Table 5.6.2, Figure 5.6.2). The burden of cardiovascular risk factors among dialysis patients is noted to be markedly greater than that of the general population; and the risk of infection is also greater, driven in part by access-related infections in HD patients with central venous catheters as well as blood-borne virus infections such as hepatitis B and C, and peritonitis-related infections in PD patients[42,43].

Table 5.6.2: Mortality by cause of death

Year of death	Overall		Cardiac event		Infection		Others	
	Number	%*	Number	%^	Number	%^	Number	%^
2014	770	13.1	249	32.3	259	33.6	262	34.0
2015	803	12.9	276	34.4	247	30.8	280	34.9
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	908	11.7	320	35.2	246	27.1	342	37.7
2020	957	11.6	379	39.6	246	25.7	332	34.7
2021	1030	11.9	419	40.7	307	29.8	304	29.5
2022	1294	14.6	477	36.9	412	31.8	405	31.3
2023	1258	13.7	412	32.8	426	33.9	420	33.4
2024	1220	12.9	397	32.5	413	33.9	410	33.6

*Mortality among prevalent dialysis patients
^Mortality among prevalent dialysis patients who died due to specific causes (e.g. cardiac event, infection)

Figure 5.6.2: Mortality by cause of death



42 Himmelfarb J, Vanholder R, Mehrotra R, and Tonelli M. The current and future landscape of dialysis. Nephrology. 2020;16.
43 Bello AK et al. Epidemiology of haemodialysis outcomes. Nature 2022; 18.

PD patients experienced proportionally more deaths from infections and fewer from cardiac events when compared to HD patients in the past decade (Table 5.6.3) Specifically in 2024, infections caused 43.7% of deaths amongst PD patients versus 32.3% amongst HD patients, whilst cardiac-related deaths occurred in 22.8% of PD patients compared to 34.1% of HD patients. A Korean study has demonstrated that PD carries an elevated infection risk due to peritonitis, leading to higher rates of infection-related hospital readmissions and mortality compared to HD[44].

Table 5.6.3: Mortality by cause of death and modality

HD								
Year of death	Overall		Cardiac event		Infection		Others	
	Number	%*	Number	%^	Number	%^	Number	%^
2014	650	12.5	213	32.8	209	32.2	228	35.1
2015	689	12.5	242	35.1	209	30.3	238	34.5
2016	680	11.6	226	33.2	215	31.6	239	35.1
2017	750	12.3	267	35.6	226	30.1	257	34.3
2018	779	12.2	249	32.0	236	30.3	294	37.7
2019	761	11.3	274	36.0	195	25.6	292	38.4
2020	781	11.0	306	39.2	189	24.2	286	36.6
2021	849	11.3	355	41.8	233	27.4	261	30.7
2022	1107	14.3	416	37.6	337	30.4	354	32.0
2023	1075	13.5	357	33.2	354	32.9	364	33.9
2024	1053	12.8	359	34.1	340	32.3	354	33.6
PD								
Year of death	Overall		Cardiac event		Infection		Others	
	Number	%*	Number	%^	Number	%^	Number	%^
2014	120	17.6	36	30.0	50	41.7	34	28.3
2015	114	15.6	34	29.8	38	33.3	42	36.8
2016	120	14.6	34	28.3	49	40.8	37	30.8
2017	129	14.4	48	37.2	49	38.0	32	24.8
2018	136	13.4	43	31.6	57	41.9	36	26.5
2019	147	13.9	46	31.3	51	34.7	50	34.0
2020	176	16.1	73	41.5	57	32.4	46	26.1
2021	181	15.9	64	35.4	74	40.9	43	23.8
2022	187	16.4	61	32.6	75	40.1	51	27.3
2023	183	15.1	55	30.1	72	39.3	56	30.6
2024	167	13.9	38	22.8	73	43.7	56	33.5

*Mortality among prevalent dialysis patients
^Mortality among prevalent dialysis patients who died due to specific causes (e.g. cardiac event, infection)

[44] Jeon, Y., Kim, H. D., Hong, Y. A., Kim, H. W., Yang, C. W., Chang, Y. K., & Kim, Y. K. (2020). Clinical outcomes of infection-related hospitalization in incident peritoneal dialysis patients. *Kidney research and clinical practice*, *39*(4), 460–468. https://doi.org/10.23876/j.krcp.20.069

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 5.7.11. 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 30 April 2025, the date until which the death status of all patients were updated for this report). Survival at 5 or 10 years is indicated as “not applicable (NA)” if the elapsed survival time since dialysis initiation exceeds this date. Median survival duration is indicated as “not reached (NR)” if more than half of the patients were alive as of 30 April 2025. Multivariable Cox regression was used to estimate the adjusted risk of death, accounting for the effects of potential confounders in Table 5.7.12.

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, sex, ethnicity, etiology and co-morbidities in this section were based on data captured by the registry at the start of definitive dialysis.

The baseline characteristics of HD and PD patients are shown in Table 5.7.1. Compared to PD patients, the proportion of males was higher ($p<0.001$), and the proportion of Chinese was lower ($p<0.001$) among HD patients (Table 5.7.1). The proportions of those with cerebrovascular disease ($p=0.014$) were higher among PD patients. However, higher proportions of HD patients had ischemic heart disease ($p<0.001$), peripheral vascular disease ($p<0.001$) and cancer ($p<0.001$).

Table 5.7.1: Baseline characteristics by modality

	HD	PD	Overall
Age group (%)			
≥60 years	57.5	57.7	57.6
Sex (%)			
Male	57.7	51.1	56.3
Ethnicity (%)			
Chinese	65.1	71.9	66.5
Malay	25.3	20.2	24.2
Indian	7.8	6.1	7.5
Etiology (%)			
DN	63.1	62.3	62.9
Co-morbidities (%)			
Ischemic heart disease	49.0	46.2	48.4
Cerebrovascular disease	25.2	27.0	25.6
Peripheral vascular disease	15.9	13.3	15.4
Cancer	9.4	5.3	8.6

HD patients had significantly better survival than PD patients as indicated by their higher survival rates at each time-point (especially beyond the 1-year survival mark), 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 (%)	91.1	90.7	91.0
5-year survival (%)	61.0	44.0	57.4
10-year survival (%)	31.7	20.7	29.3
Median survival (years)	6.6	4.3	6.0

Although the 5- and 10-year survival were consistently better among HD than PD patients, differences in survival had narrowed over the years as the survival of HD patients were similar throughout the years ($p=0.07$), while the survival of PD patients improved over time ($p<0.001$) (Table 5.7.3). These findings mirror those found in another study which reported that long-term mortality risk was historically higher among PD patients, but over time, the reduction in mortality risk has been greater for PD compared to HD, such that the long-term survival of HD and PD patients are now similar[45].

Table 5.7.3: Survival of definitive dialysis by year and modality

	1999-2004			2005-2009		
	HD	**PD**	**Overall**	**HD**	**PD**	**Overall**
1-year survival (%)	90.7	85.4	89.0	89.2	88.7	89.1
5-year survival (%)	58.5	32.5	49.7	59.4	39.2	55.5
10-year survival (%)	33.2	15.0	27.0	30.9	18.1	28.4
Median survival (years)	6.5	3.4	5.0	6.4	3.8	5.8
	2010-2014			**2015-2019**		
	HD	**PD**	**Overall**	**HD**	**PD**	**Overall**
1-year survival (%)	90.2	89.6	90.1	91.9	93.6	92.3
5-year survival (%)	59.7	47.9	57.9	61.8	50.2	59.3
10-year survival (%)	30.1	22.8	28.9	NA	NA	NA
Median survival (years)	6.4	4.7	6.1	6.6	5.0	6.3
	2020-2024					
	HD	**PD**	**Overall**			
1-year survival (%)	92.2	94.8	92.7			
5-year survival (%)	NA	NA	NA			
10-year survival (%)	NA	NA	NA			
Median survival (years)	NR	NR	NR			

For both HD and PD, younger patients aged below 60 years had significantly better survival than older patients aged 60 years and above ($p<0.001$) (Table 5.7.4).

[45] Himmelfarb J, Vanholder R, Mehrotra R, and Tonelli M. The current and future landscape of dialysis. Nephrology. 2020;16.

Table 5.7.4: Survival of definitive dialysis by age group and modality

	Age <60 years			Age ⩾60 years		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	93.9	94.1	93.9	89.1	88.3	88.9
5-year survival (%)	72.4	60.5	69.9	52.4	32.1	48.0
10-year survival (%)	46.2	36.4	44.2	19.8	9.2	17.5
Median survival (years)	9.2	6.7	8.8	5.3	3.5	4.7

Female HD patients had significantly better survival than male HD patients (p<0.001). However, there were no significant sex differences in survival for PD (p=0.688) (Table 5.7.5). A Korean nationwide study found that females with kidney failure on HD or PD had a lower risk of death than males, which was mainly attributed to lower risk of non-cardiovascular and non-infectious death in females. The risk of mortality due to sudden death, cancer or other causes was significantly lower for females than males in their study[46].

Table 5.7.5: Survival of definitive dialysis by sex and modality

	Male			Female		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	90.7	91.1	90.8	91.7	90.4	91.4
5-year survival (%)	60.0	45.0	57.1	62.4	42.9	57.7
10-year survival (%)	30.5	19.4	28.4	33.2	22.0	30.5
Median survival (years)	6.5	4.5	6.0	6.7	4.2	6.1

Malay HD patients had significantly better survival than Chinese and Indian HD patients (p<0.001) (Table 5.7.6). However, there were no significant ethnic differences in survival among PD patients.

Table 5.7.6: Survival of definitive dialysis by ethnicity and modality

	Chinese			Malay			Indian		
	HD	PD	Overall	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	91.1	90.9	91.1	91.6	90.1	91.3	90.1	90.3	90.1
5-year survival (%)	59.8	44.1	56.2	64.7	42.2	60.7	59.0	46.1	56.8
10-year survival (%)	30.5	19.8	28.1	35.5	23.1	33.2	28.0	21.5	26.8
Median survival (years)	6.4	4.4	5.8	7.2	4.2	6.6	6.0	4.3	5.9

Patients without DN[47] had significantly better survival than those with DN regardless of modality (p<0.001) (Table 5.7.7). Population cohort studies have consistently shown

[46] Jung, H. Y., Jeon, Y., Kim, Y. S., Lee, J. P., Kim, D. K., Oh, Y. K., Joo, K. W., Kim, Y. S., & Han, S. S. (2022). Sex disparities in mortality among patients with kidney failure receiving dialysis. *Scientific Reports*, *12*, Article 18555. https://doi.org/10.1038/s41598-022-16163-w

[47] This report focuses on diabetic nephropathy as diabetic patients show poorer survival outcomes than non-diabetic patients, with this effect being more significant than in glomerulonephritis. Large cohort studies indicate that the relationship between hypertension and survival follows a reverse U-shaped or J-shaped curve, suggesting a counterintuitive association.

that the presence of type 2 diabetes is associated with an excess risk of mortality in CKD5 patients[48]. Possible reasons include metabolic factors and accelerated vascular calcification. Poor glycaemic control, xerostomia (dry mouth) and thirst can also lead to fluid overload among diabetic HD patients, resulting in high rates of haemodynamic instability[49].

Table 5.7.7: Survival of definitive dialysis by etiology and modality

	Non-DN			DN		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.6	94.3	93.0	90.3	88.6	89.9
5-year survival (%)	71.8	65.1	70.4	54.8	31.8	49.9
10-year survival (%)	48.5	39.1	46.6	21.8	10.2	19.3
Median survival (years)	9.6	7.5	9.1	5.6	3.5	5.0

Patients without ischemic heart disease (IHD) had significantly better survival than those with IHD regardless of modality ($p<0.001$) (Table 5.7.8). In a review looking at patients with both CKD5 and cardiovascular conditions like IHD, cardiovascular disease, rather than CKD5, emerged as the primary cause of death. CKD5 exacerbates IHD by promoting a systemic, chronic proinflammatory state, which contributes to vascular and myocardial remodelling. This results in atherosclerotic lesions, vascular calcification, myocardial fibrosis, etc, thereby potentially elevating mortality risk[50].

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

	No IHD			IHD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	93.0	93.9	93.2	88.9	87.4	88.6
5-year survival (%)	69.8	57.0	67.0	51.3	30.8	47.1
10-year survival (%)	42.1	31.1	39.7	19.9	10.5	17.9
Median survival (years)	8.4	6.1	7.8	5.2	3.4	4.6

Patients without cerebrovascular disease (CVD) had significantly better survival than those with CVD regardless of modality ($p<0.001$) (Table 5.7.9). A review examining patients with both CKD and stroke found that CKD significantly worsens stroke outcomes, potentially leading to functional brain damage and resulting in cognitive impairment. Cognitive dysfunction has been associated with poor medication adherence, which in turn is linked to increased morbidity and mortality [51].

[48] Phillips J, Chen J, Ooi E, Prunster J and Lim WH. Global Epidemiology, Health Outcomes, and Treatment Options for Patients With Type 2 Diabetes and Kidney Failure. Frontiers in Clinical Diabetes and Healthcare 2021; 2.
[49] Eldehni M, Crowley L, Selby N. Challenges in Management of Diabetic Patient on Dialysis. Kidney Dial. 2022; 2: 553–564.
[50] Jankowski, J., Floege, J., Fliser, D., Böhm, M., & Marx, N. (2021). Cardiovascular disease in chronic kidney disease. Circulation, 143(11), 1157–1172. https://doi.org/10.1161/circulationaha.120.050686
[51] Miglinas, M., Cesniene, U., Janusaite, M. M., & Vinikovas, A. (2020). Cerebrovascular disease and cognition in chronic kidney disease patients. *Frontiers in Cardiovascular Medicine, 7*, Article 96. https://doi.org/10.3389/fcvm.2020.00096

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

	No CVD			CVD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.0	92.9	92.2	88.0	86.6	87.7
5-year survival (%)	64.7	51.7	62.0	49.8	29.4	45.1
10-year survival (%)	35.2	25.4	33.3	19.1	11.3	17.3
Median survival (years)	7.2	5.2	6.8	5.0	3.2	4.4

Patients without peripheral vascular disease (PVD) had significantly better survival than those with PVD regardless of modality (p<0.001) (Table 5.7.10). A study revealed that the presence of PVD in CKD patients significantly increases the short-term risk of heart attack and stroke and is a major contributor to mortality[52].

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

	No PVD			PVD		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.1	92.7	92.2	85.9	83.5	85.4
5-year survival (%)	64.3	49.6	61.2	44.7	23.4	40.8
10-year survival (%)	34.6	24.5	32.5	15.1	5.6	13.4
Median survival (years)	7.1	5.0	6.6	4.4	2.8	4.0

Patients without cancer had significantly better survival than those with cancer regardless of modality (p<0.001) (Table 5.7.11). Impaired kidney function may limit the use of nephrotoxic cancer treatments as well as therapies that are cleared by the kidneys and can cause systemic toxicities, thereby contributing to increased mortality risk[53].

Table 5.7.11: Survival of definitive dialysis by presence of cancer and modality

	No cancer			Cancer		
	HD	PD	Overall	HD	PD	Overall
1-year survival (%)	92.2	92.2	92.2	84.6	89.8	85.3
5-year survival (%)	63.2	47.1	59.8	48.0	36.2	46.6
10-year survival (%)	33.2	22.5	31.0	20.1	12.1	19.2
Median survival (years)	6.9	4.7	6.4	4.8	3.5	4.6

PD, older age (60 years and above), DN, and presence of co-morbidities (IHD, CVD, PVD and cancer) remained as significant risk factors of death in the multivariable analysis (Table 5.7.12). This is reflected in a study where individuals with CKD and

[52] Garimella, P. S., & Hirsch, A. T. (2014). Peripheral artery disease and chronic kidney disease: clinical synergy to improve outcomes. *Advances in chronic kidney disease*, *21*(6), 460–471. https://doi.org/10.1053/j.ackd.2014.07.005
[53] Kitchlu, A., Reid, J., Jeyakumar, N., Dixon, S. N., Munoz, A. M., Silver, S. A., & Wald, R. (2022). Cancer risk and mortality in patients with kidney disease: A population-based cohort study. *American Journal of Kidney Diseases, 80*(4), 436-448.e1. https://doi.org/10.1053/j.ajkd.2022.02.020

multiple comorbidities had a greater risk of mortality compared to those with the same degree of comorbidities but without CKD[54].

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 other complications may be less recognised, thereby affecting the timeliness of intervention[55]. Findings of poorer outcomes for PD in Asian populations contrasts with most studies based on Western populations, which show no difference by modality, or better short-term survival for PD. This difference has been thought to be possibly a result of the higher prevalence of diabetes in Asian populations (including Singapore), as the glucose load present in PD dialysate is thought to exert a deleterious effect in diabetic patients and make them more prone to infections[56,57].

Table 5.7.12: 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	1.48	1.42-1.55	
Age group			
<60 years	1.00	Reference	<0.001**
⩾60 years	1.89	1.82-1.97	
Sex			
Male	1.00	Reference	0.064
Female	0.97	0.93-1.00	
Ethnicity			
Chinese	1.00	Reference	
Malay	0.89	0.85-0.93	<0.001**
Indian	0.98	0.92-1.05	0.530
Etiology			
Non-DN	1.00	Reference	<0.001**
DN	1.68	1.61-1.75	
IHD			
No	1.00	Reference	<0.001**
Yes	1.47	1.42-1.52	
CVD			
No	1.00	Reference	<0.001**

[54] Fraser, S. D. S., Roderick, P. J., May, C. R., & others. (2015). The burden of comorbidity in people with chronic kidney disease stage 3: A cohort study. *BMC Nephrology, 16*, Article 193. https://doi.org/10.1186/s12882-015-0189-z
[55] 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.
[56] Khoo CY et al. Death and cardiovascular outcomes in end-stage renal failure patients on different modalities of dialysis. Ann Acad Med Singap 2022;51:136-42.
[57] Ng JH, Woo KT and Tan EK. Survival outcome of haemodialysis and peritoneal dialysis. Ann Acad Med Singap 2022;51:132-3

Yes	1.30	1.25-1.36	
PVD			
No	1.00	Reference	<0.001**
Yes	1.52	1.45-1.59	
Cancer			
No	1.00	Reference	<0.001**
Yes	1.42	1.34-1.51	

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 shown in the table below and they follow as closely to international guidelines[58,59,60,61] as possible.

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 >=1.7
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

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[62].

About 7 in 10 prevalent HD patients were dialysed in centres run by the VWOs, about 3 in 10 in the private sector, and the remaining in the public sector. In 2024, the proportions of prevalent HD patients under the care of the VWOs, private sector and public sector were 69.4%, 29.2% and 1.4% respectively (Table 5.1.2). Compared to the VWOs and private sector in the past decade, the number of HD patients from the public sector was smaller, resulting in less stable trends.

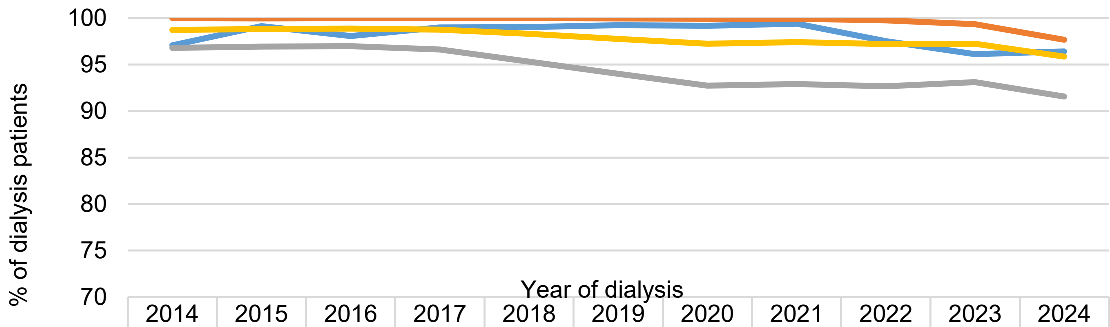
[58] National Kidney Foundation: K/DOQI clinical practice guidelines for hemodialysis adequacy, 2000. American Journal of Kidney Disease. 2001; 37 (suppl 1): S7-S64.
[59] NKF KDOQI Guidelines. National Kidney Foundation, New York. http://kidneyfoundation.cachefly.net/professionals/KDOQI/guideline_upHD_PD_VA/pd_guide2.htm Accessed on 1 Mar 2021.
[60] Mimura I, Tanaka T, Nangaku M. How the target hemoglobin of renal anemia should be? Nephron. 2015; 131: 202-209.
[61] NKF KDOQI Guidelines. National Kidney Foundation, New York. http://kidneyfoundation.cachefly.net/professionals/KDOQI/guidelines_bone/guidestate.htm Accessed on 1 Mar 2021.
[62] The registry captures the absolute value but not the reference range (which differ from each healthcare institution) of each biomarker for each patient.

On the other hand, almost all the prevalent PD patients were cared for by the public sector. In 2024, 97.9% of the PD patients fell under the care of the public sector, with no patients 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 from the VWOs since 2017 were not shown in the figures though they were included in the overall statistics.

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). In 2024, 96.4%, 97.7% and 91.6% of the patients from the public sector, VWOs and private sector underwent thrice weekly dialysis respectively.

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

*x-axis starts from 70

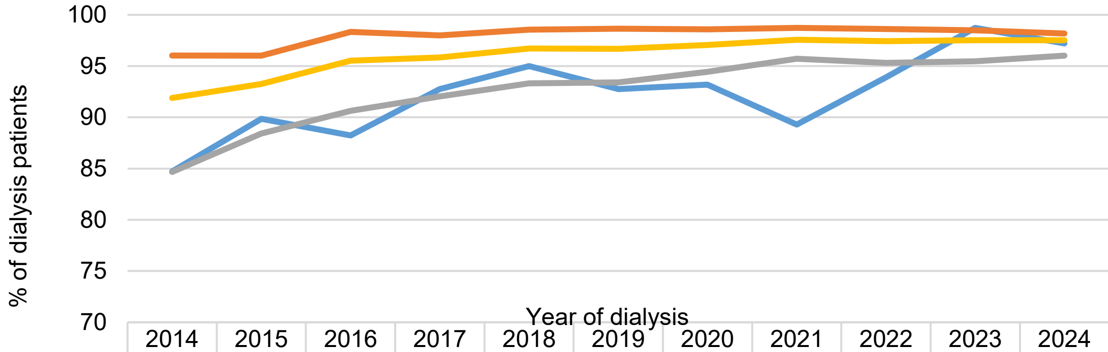


	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	97.1	99.1	98.1	99.0	99.0	99.2	99.2	99.4	97.5	96.1	96.4
VWO	100.0	100.0	100.0	100.0	100.0	100.0	99.9	99.9	99.8	99.3	97.7
Private	96.8	96.9	97.0	96.6	95.3	94.0	92.7	92.9	92.7	93.1	91.6
Overall	98.7	98.8	98.9	98.8	98.3	97.8	97.3	97.4	97.2	97.3	95.9

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, exceeding 95% every year, and standing at 98.2% in 2024 (Figure 5.8.1b). Progress has been observed in this area as both the public and private sectors were catching up, with the respective proportions rising from 84.7% to 97.2%, and 84.7% to 96.0% from 2014 to 2024.

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

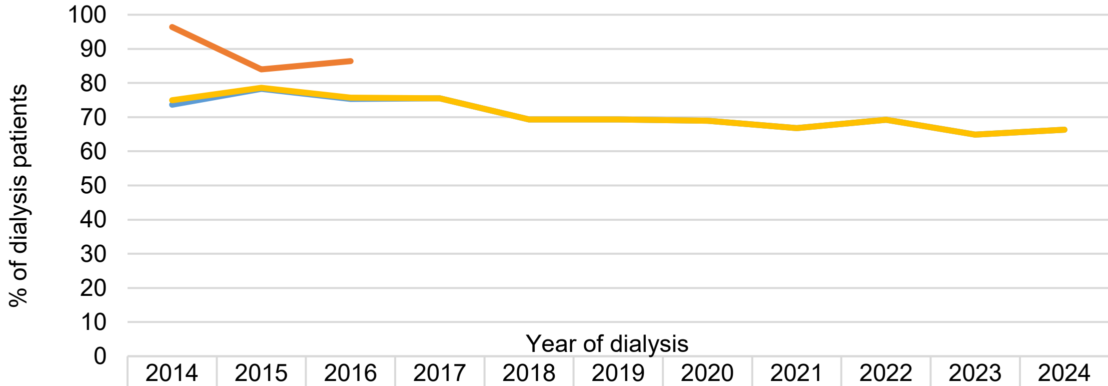
*x-axis starts from 70



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	84.7	89.9	88.2	92.8	95.0	92.8	93.2	89.3	93.9	98.7	97.2
VWO	96.0	96.0	98.3	98.0	98.6	98.7	98.6	98.7	98.6	98.5	98.2
Private	84.7	88.4	90.6	92.0	93.3	93.4	94.4	95.7	95.3	95.5	96.0
Overall	91.9	93.3	95.5	95.8	96.7	96.7	97.1	97.6	97.4	97.5	97.5

The proportion of prevalent PD patients who met the adequate management of urea criteria of Kt/V >=1.7 dropped from 75.0% in 2014 to 66.3% in 2024 (Figure 5.8.2). Aside from Kt/V, the International Society for Peritoneal Dialysis recommends using other measures to concurrently assess the quality of dialysis, such as anaemia management and bone and mineral management[63].

Figure 5.8.2: Proportion of PD patients with adequate management of urea (Kt/V >=1.7)



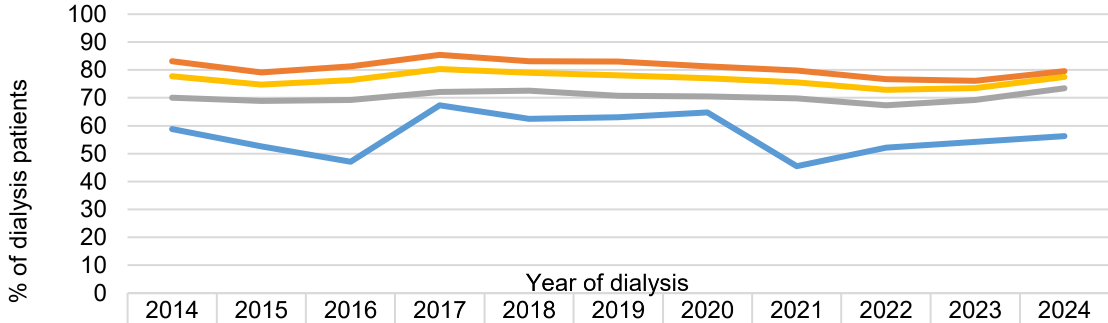
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	73.7	78.3	75.3	75.5	69.3	69.3	69.0	66.8	69.2	64.9	66.3
VWO	96.4	84.0	86.4								
Overall	75.0	78.6	75.7	75.5	69.3	69.3	69.0	66.8	69.2	64.9	66.3

[63] Brown EA, Blake PG, Boudville N, et al. International Society for Peritoneal Dialysis practice recommendations: prescribing high-quality goal-directed peritoneal dialysis. Journal of the International Society for Peritoneal Dialysis. 2020; 40: 244-253.

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). In 2024, 56.3%, 79.6% and 73.4% of the patients from the public sector, VWOs and private sector fulfilled the criteria respectively. Overall, more than three-quarters of HD patients had adequate management of anaemia.

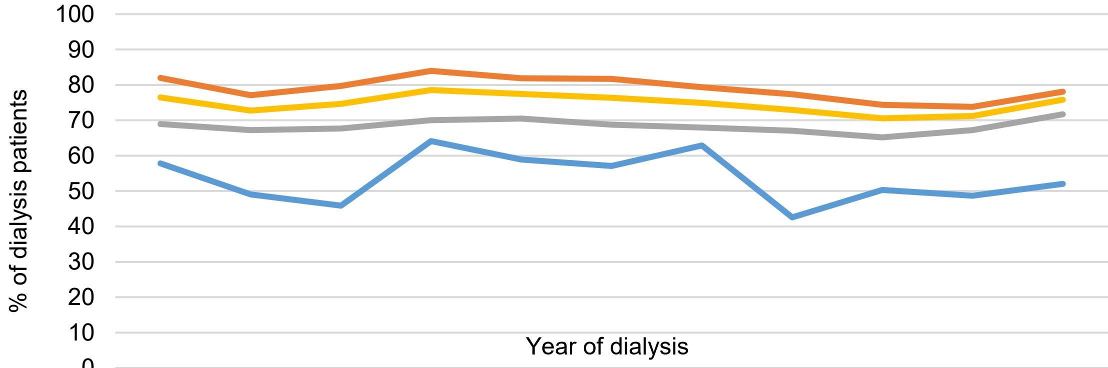
Similar trends were observed after stratification by ESA, a drug that stimulates the production of erythropoietin, a hormone produced primarily by the kidneys and plays a key role in the production of red blood cells (Figures 5.8.3b and 5.8.3c). In addition, regardless of service provider, the proportion of prevalent HD patients not on ESA who had adequate management of anaemia criteria was consistently higher than those on ESA (Figure 5.8.3b, 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)



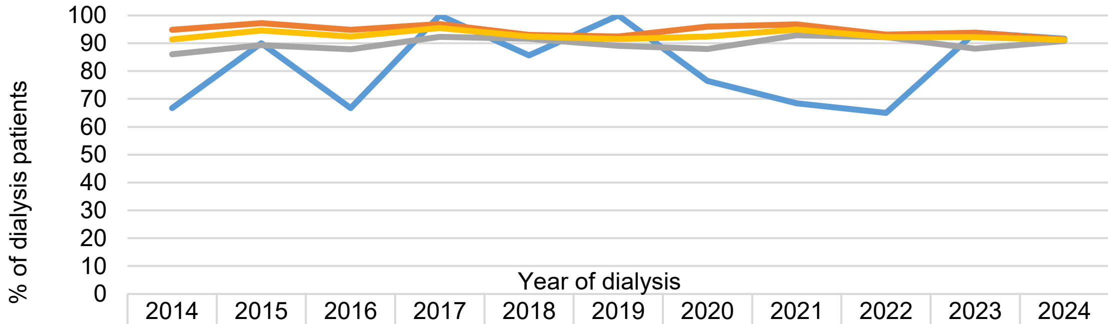
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	58.8	52.6	47.1	67.3	62.5	63.1	64.8	45.5	52.2	54.3	56.3
VWO	83.2	79.1	81.3	85.4	83.1	83.0	81.3	79.8	76.7	76.1	79.6
Private	70.1	68.9	69.3	72.1	72.6	70.7	70.5	69.8	67.3	69.2	73.4
Overall	77.7	74.8	76.4	80.3	79.0	78.1	77.1	75.5	72.9	73.5	77.5

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



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	57.8	49.0	45.9	64.1	58.9	57.1	62.9	42.6	50.3	48.7	52.0
VWO	81.9	77.1	79.7	84.0	81.9	81.7	79.4	77.4	74.4	73.8	78.0
Private	69.0	67.2	67.7	70.0	70.5	68.8	67.9	67.1	65.2	67.3	71.7
Overall	76.5	72.8	74.7	78.6	77.4	76.3	74.9	72.9	70.6	71.3	75.8

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

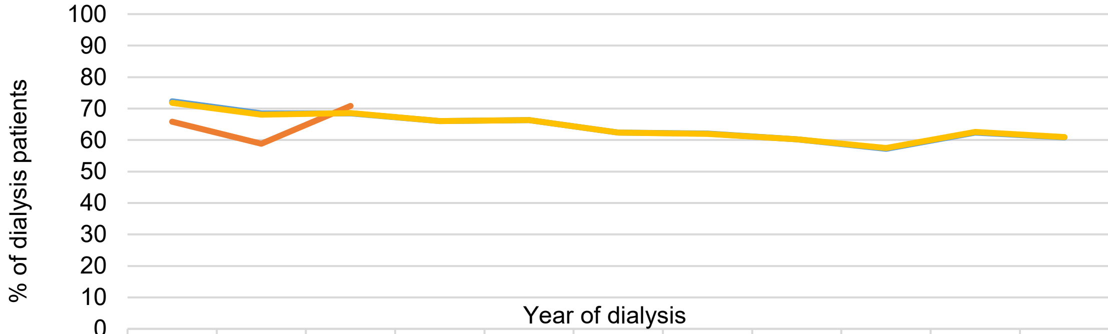


	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	66.7	90.0	66.7	100.0	85.7	100.0	76.5	68.4	65.0	93.8	91.7
VWO	94.8	97.2	94.8	96.9	93.0	92.4	95.9	96.8	93.2	93.8	91.4
Private	86.1	89.4	87.8	92.3	91.7	89.1	87.9	92.9	92.2	88.1	90.8
Overall	91.4	94.6	92.5	95.5	92.4	91.6	92.4	95.0	92.2	92.2	91.2

The proportion of prevalent PD patients who fulfilled the adequate management of anaemia criteria of Hb >=10 g/dL dropped from 71.8% in 2014 to 57.5% in 2022, then remained stable between 60.9% and 62.5% from 2023 to 2024 (Figure 5.8.4a).

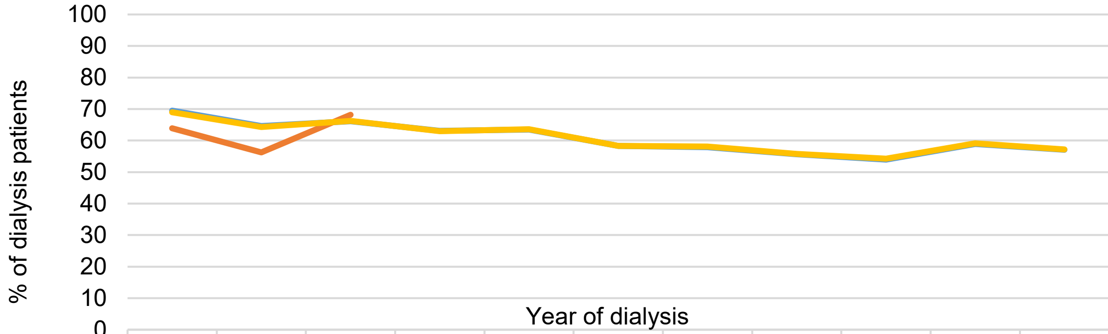
Similar decreasing trend was observed among PD patients taking ESA (Figure 5.8.4b), but the trend since 2017 was relatively stable among those not on ESA (Figure 5.8.4c). Like HD patients, the proportion of PD patients fulfilling the criteria was consistently higher among those who were not taking ESA than those on ESA.

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



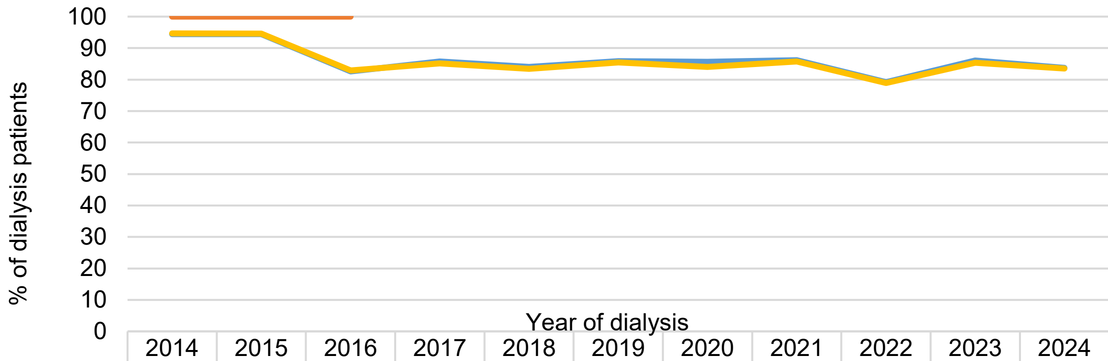
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	72.3	68.4	68.5	66.1	66.3	62.4	62.0	60.2	57.2	62.4	60.8
VWO	65.8	58.8	70.8								
Overall	71.8	68.1	68.6	66.0	66.3	62.4	62.0	60.2	57.5	62.5	60.9

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



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	69.5	64.6	66.1	63.0	63.5	58.3	58.0	55.7	54.0	58.9	57.1
VWO	63.9	56.3	68.2								
Overall	69.0	64.3	66.2	63.0	63.6	58.3	58.1	55.8	54.3	59.2	57.2

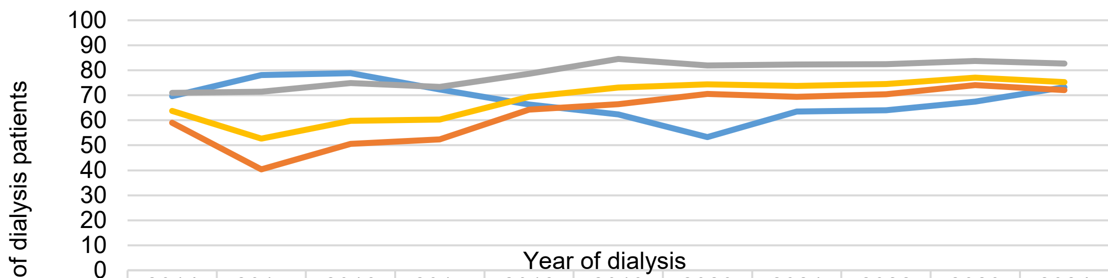
Figure 5.8.4c: Proportion of PD patients not on ESA with adequate management of anaemia (Hb >=10 g/dL)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	94.4	94.4	82.6	85.7	84.1	85.8	85.6	86.1	79.2	86.1	83.7
VWO	100.0	100.0	100.0								
Overall	94.7	94.6	82.9	85.1	83.4	85.4	84.1	85.7	78.9	85.3	83.5

Improvement was observed for the proportion of prevalent HD patients meeting the criteria for adequate management of mineral and bone disease, from 63.7% to 75.2% from 2014 to 2024; and the improvement was seen across the three broad service providers (Figure 5.8.5). For the public sector, 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, while an upward trend was found for both VWOs and the private sector. In recent years, compared to the public sector and VWOs, more HD patients in the private sector met the guidelines for corrected serum Ca, exceeding 80% every year since 2019. In 2024, 73.2%, 72.1%, and 82.7% of the patients from the public sector, VWOs and private sector met the criteria respectively.

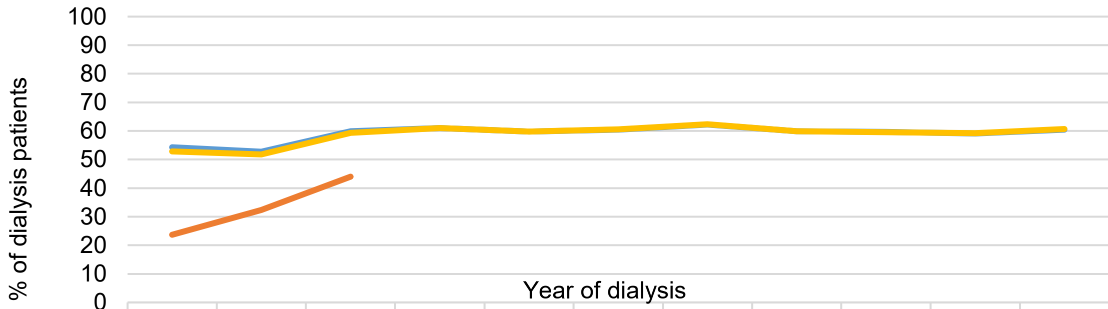
Figure 5.8.5: Proportion of HD patients with adequate management of mineral and bone disease (corrected serum Ca <2.37 mmol/L)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	69.6	78.1	78.8	72.3	66.3	62.3	53.3	63.5	64.0	67.4	73.2
VWO	59.0	40.4	50.6	52.3	64.3	66.4	70.5	69.4	70.4	74.1	72.1
Private	71.0	71.4	74.8	73.3	78.6	84.5	82.0	82.3	82.4	83.7	82.7
Overall	63.7	52.7	59.8	60.2	69.4	73.0	74.4	73.7	74.5	77.1	75.2

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 increased from 52.8% in 2014 to 60.6% in 2024 (Figure 5.8.6).

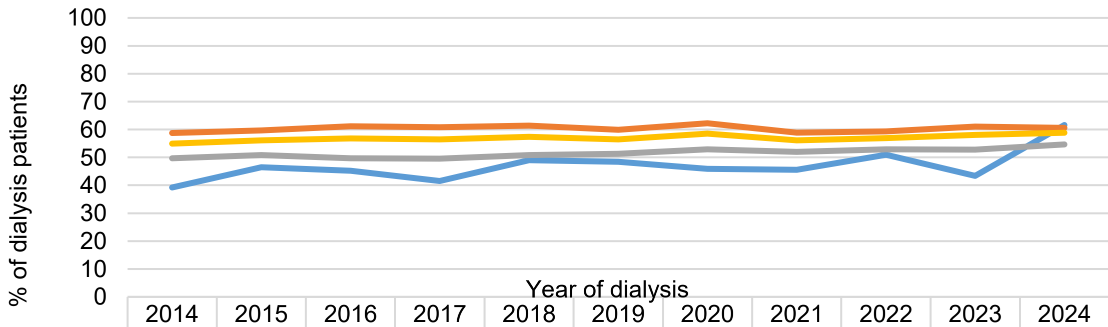
Figure 5.8.6: Proportion of PD patients with adequate management of mineral and bone disease (corrected serum Ca <2.37 mmol/L)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	54.3	52.7	59.9	61.0	59.8	60.4	62.2	59.9	59.6	59.2	60.5
VWO	23.7	32.3	44.0								
Overall	52.8	51.8	59.3	61.0	59.8	60.6	62.3	59.9	59.6	59.3	60.6

The proportion of prevalent HD patients who had adequate management of mineral and bone disease criteria with 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 2024, 61.6%, 60.5%, and 54.7% of HD patients from the public sector, VWOs and private sector met the criteria respectively.

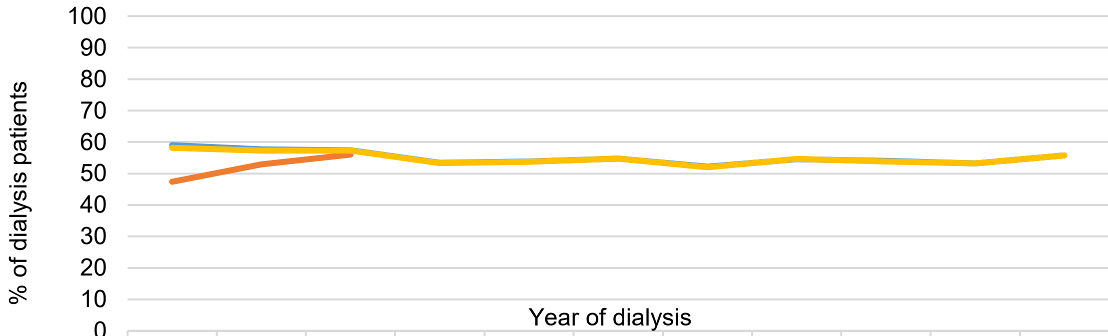
Figure 5.8.7: Proportion of HD patients with adequate management of mineral and bone disease (serum PO_4 >1.13 mmol/L and <1.78 mmol/L)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	39.2	46.5	45.2	41.6	49.0	48.5	45.9	45.5	50.9	43.4	61.6
VWO	58.7	59.7	61.2	60.9	61.4	59.9	62.2	58.9	59.3	61.0	60.5
Private	49.7	50.8	49.7	49.5	50.8	51.3	52.8	52.0	53.0	52.8	54.7
Overall	54.9	56.1	56.8	56.5	57.4	56.5	58.5	56.2	56.9	58.1	58.8

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 remained stable and ranged between 52.0% and 58.2% from 2014 to 2024 (Figure 5.8.8).

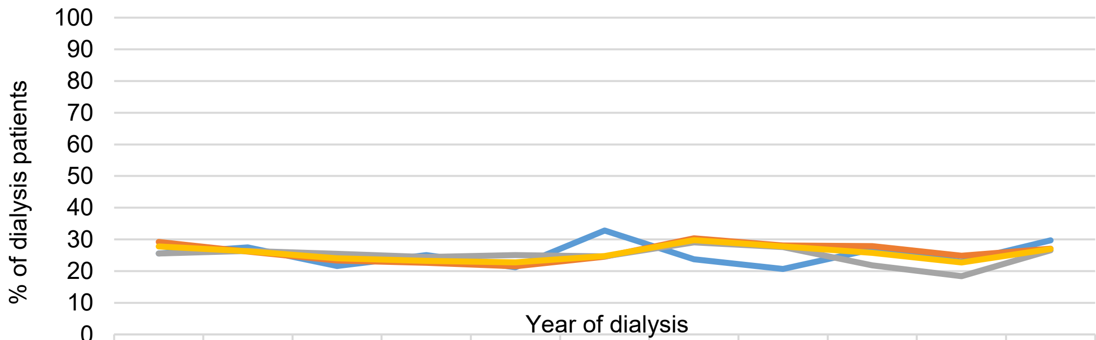
Figure 5.8.8: Proportion of PD patients with adequate management of mineral and bone disease (serum PO_4 >1.13 mmol/L and <1.78 mmol/L)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	59.0	57.7	57.4	53.4	53.8	54.8	52.2	54.5	54.1	53.2	55.7
VWO	47.4	52.9	56.0								
Overall	58.2	57.3	57.3	53.3	53.7	54.7	52.0	54.6	53.8	53.2	55.8

The proportion of prevalent HD patients who had adequate management of mineral and bone disease with serum iPTH >16.3 pmol/L and <33.0 pmol/L was fairly similar across the three broad service providers for most years (Figure 5.8.9). In 2024, 29.7%, 27.1%, and 26.6% of the patients from the public sector, VWOs and private sector passed the criteria respectively.

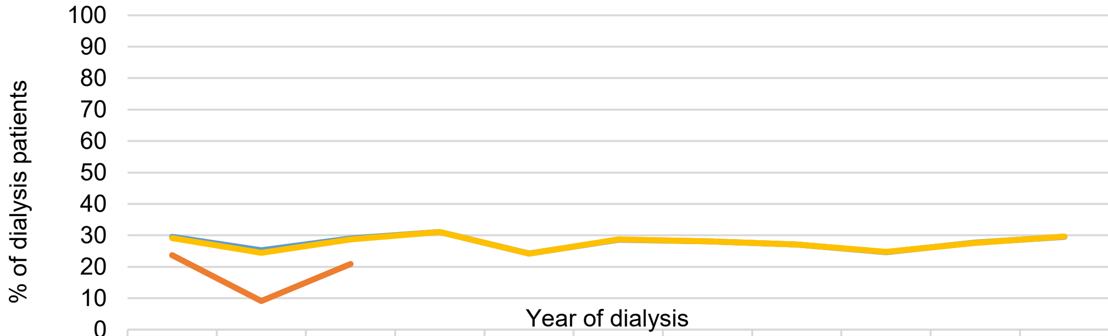
Figure 5.8.9: Proportion of HD patients with adequate management of mineral and bone disease (serum iPTH >16.3 pmol/L and <33.0 pmol/L)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	25.5	27.4	21.6	25.0	21.2	32.8	23.7	20.7	26.9	23.0	29.7
VWO	29.2	26.1	23.3	22.6	21.5	24.5	30.3	28.0	27.9	24.9	27.1
Private	25.6	26.3	25.5	24.4	25.1	24.6	29.1	27.6	21.8	18.4	26.6
Overall	27.8	26.2	24.0	23.3	22.8	24.7	29.8	27.7	25.8	22.8	27.0

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 remained stable and ranged between 24.2% and 31.0% from 2014 to 2024 (Figure 5.8.10).

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)



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Public	29.5	25.3	29.0	31.0	24.2	28.6	28.1	27.1	24.7	27.6	29.5
VWO	23.7	9.1	20.8								
Overall	29.1	24.4	28.7	31.0	24.2	28.7	28.1	27.1	24.7	27.6	29.6

5.9 Incidence of kidney transplant

The incidence rate of kidney transplant in each year was calculated by taking the number of new kidney transplant patients 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.

Due to the small number of kidney transplants done each year, the CIR and ASIR of transplant fluctuated year-on-year (Table 5.9.1, Figure 5.9.1). In 2020, the number of kidney transplants hit the lowest point in the past decade, likely due to COVID-19. But numbers increased from 2021, as hospitals resumed transplant services when Singapore moved on to living with COVID-19. In 2024, 124 patients received kidney transplant, the highest in the decade. The CIR of kidney transplant was 29.7 pmp and ASIR was 24.2 pmp. Neither the CIR (p=0.941) nor ASIR of kidney transplant (p=0.961) showed significant changes in incidence over time.

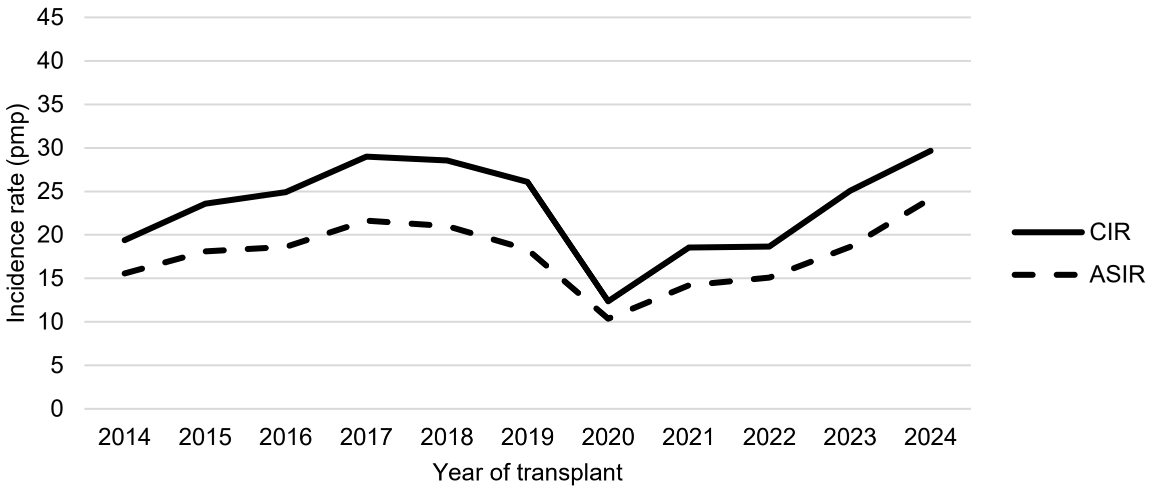
Based on data collected from the USRDS, Asian countries had lower rates of kidney transplant among dialysis patients. In contrast, European countries had the highest rates of kidney transplantation among dialysis patients[64].

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

Year of transplant	Number	CIR	ASIR
2014	75	19.4	15.6
2015	92	23.6	18.1
2016	98	24.9	18.6
2017	115	29.0	21.6
2018	114	28.5	21.0
2019	105	26.1	18.3
2020	50	12.4	10.4
2021	74	18.6	14.2
2022	76	18.7	15.1
2023	104	25.1	18.6
2024	124	29.7	24.2
P for trend	-	0.941	0.961

[64] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 19 November 2025.

Figure 5.9.1: Incidence rate (pmp) of kidney transplant



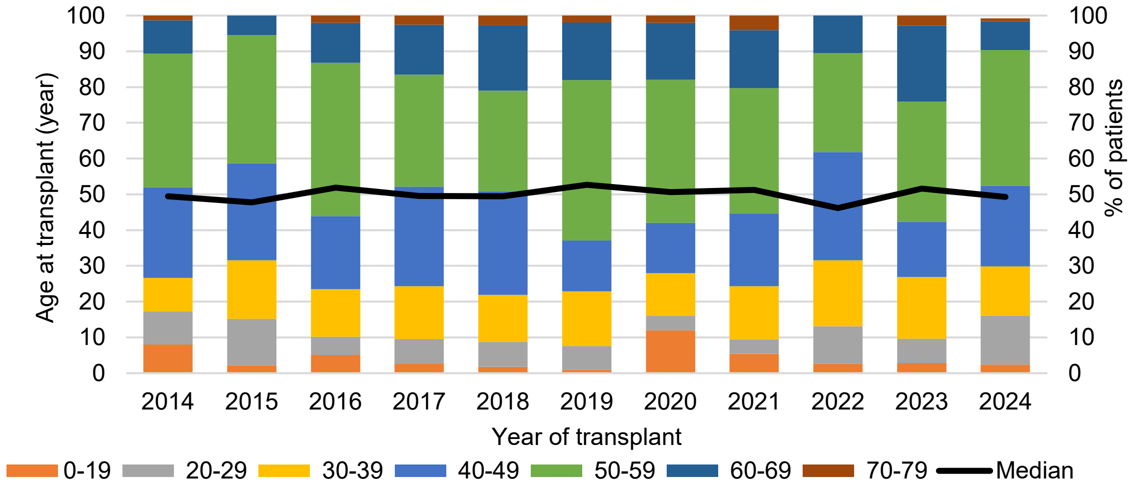
The age-specific incidence rate of kidney transplant fluctuated for all age groups due to the small number of transplants done each year, and there were no significant changes in the age-specific incidence of kidney transplant across all age groups (Table 5.9.2).

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
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	13.0	22.4	15	16.3	25.4	25	27.2	40.3
2016	5	5.1	6.0	5	5.1	9.2	13	13.3	22.1	20	20.4	32.5
2017	3	2.6	3.6	8	7.0	14.6	17	14.8	29.3	32	27.8	52.0
2018	2	1.8	2.4	8	7.0	14.6	15	13.2	25.6	33	28.9	54.0
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
2021	4	5.4	5.1	3	4.1	5.8	11	14.9	18.6	15	20.3	25.3
2022	2	2.6	2.5	8	10.5	15.6	14	18.4	23.0	23	30.3	38.1
2023	3	2.9	3.8	7	6.7	13.8	18	17.3	28.9	16	15.4	26.1
2024	3	2.4	3.8	17	13.7	34.4	17	13.7	26.8	28	22.6	45.8
P for trend	-	-	0.753	-	-	0.858	-	-	0.473	-	-	0.657
Year of transplant	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CIR	Number	%	CIR	Number	%	CIR	Number	%	CIR
2014	28	37.3	46.4	7	9.3	17.8	1	1.3	5.5	0	0.0	0.0
2015	33	35.9	54.1	5	5.4	11.8	0	0.0	0.0	0	0.0	0.0
2016	42	42.9	68.3	11	11.2	24.5	2	2.0	10.4	0	0.0	0.0
2017	36	31.3	58.6	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
2021	26	35.1	44.5	12	16.2	23.2	3	4.1	11.0	0	0.0	0.0
2022	21	27.6	35.4	8	10.5	14.9	0	0.0	0.0	0	0.0	0.0
2023	35	33.7	58.0	22	21.2	39.8	3	2.9	9.4	0	0.0	0.0
2024	47	37.9	78.1	10	8.1	17.8	1	0.8	2.9	1	0.8	6.8
P for trend	-	-	0.981	-	-	0.756	-	-	0.365	-	-	-

The median age at kidney transplant ranged between 46.2 and 52.7 years in the past decade (p=0.936), and the majority of transplant patients each year were aged between 40-59 years (Figure 5.9.2a).

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



The age-specific incidence rate of kidney transplants was highest for those aged 50 to 59 years (Figure 5.9.2b, Figure 5.9.3).

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

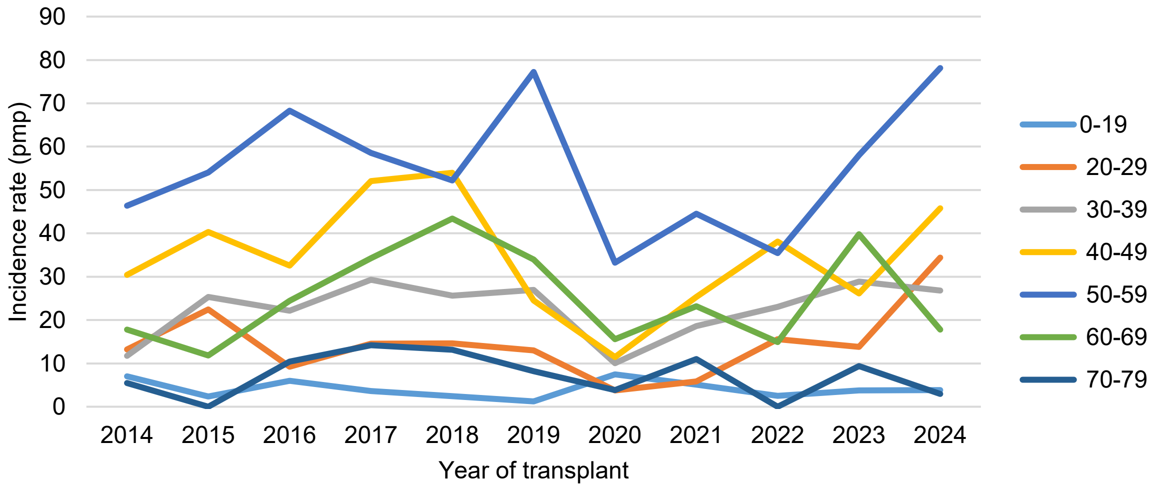
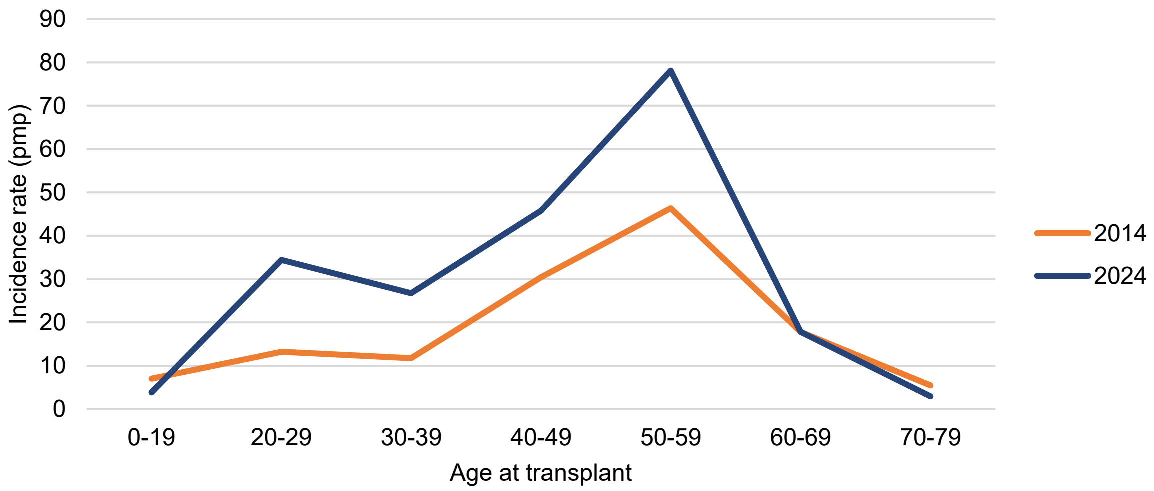


Figure 5.9.3: Age-specific incidence rate (pmp) of kidney transplant across age groups



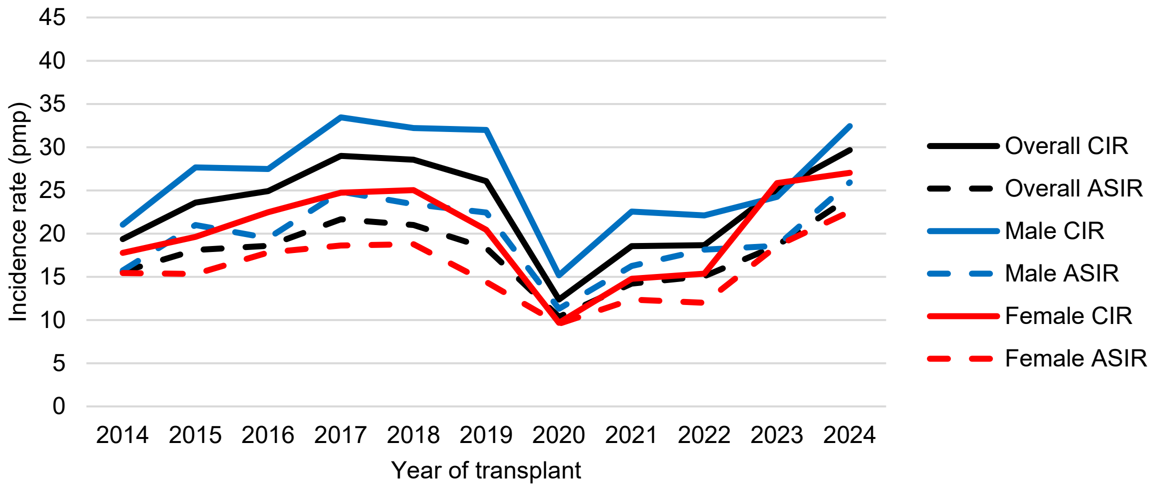
Males accounted for a higher percentage of kidney transplant patients every year except 2023, and the ASIRs of kidney transplant were generally higher among males than females for most of the years (Table 5.9.3, Figure 5.9.4). In 2024, the ASIR was 25.9 pmp and 22.5 pmp for males and females respectively. The ASIRs for both sexes fluctuated over the years due to the small number of transplants done each year; no significant changes in transplant incidence were observed for either.

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

	Male			
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2014	40	53.3	21.0	15.7
2015	53	57.6	27.7	21.0
2016	53	54.1	27.5	19.5
2017	65	56.5	33.4	24.8
2018	63	55.3	32.2	23.4
2019	63	60.0	32.0	22.4
2020	30	60.0	15.2	11.3
2021	44	59.5	22.5	16.2
2022	44	57.9	22.1	18.2
2023	49	47.1	24.2	18.6
2024	66	53.2	32.4	25.9
P for trend	-	-	0.841	0.935

Year of transplant	Female			
	Number	%	CIR	ASIR
2014	35	46.7	17.8	15.4
2015	39	42.4	19.6	15.3
2016	45	45.9	22.5	17.8
2017	50	43.5	24.7	18.6
2018	51	44.7	25.0	18.8
2019	42	40.0	20.4	14.4
2020	20	40.0	9.7	9.6
2021	30	40.5	14.8	12.4
2022	32	42.1	15.4	12.0
2023	55	52.9	25.9	18.6
2024	58	46.8	27.0	22.5
P for trend	-	-	0.984	0.993

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

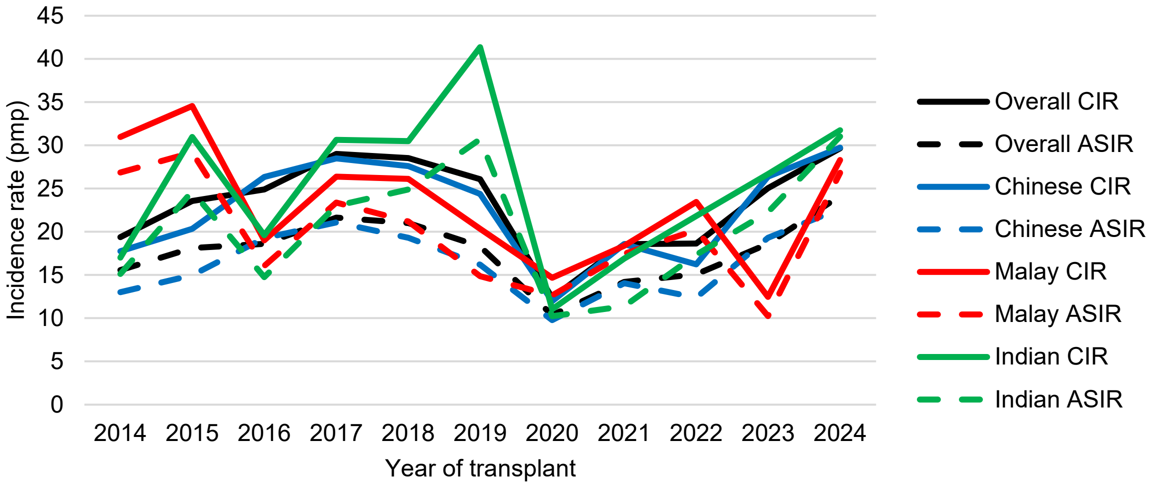


There was no ethnic group with consistently higher or lower incidence rates of kidney transplant across the years (Table 5.9.4, Figure 5.9.5). In 2024, the ASIR was 22.7 pmp, 26.8 pmp and 31.0 pmp for Chinese, Malays and Indians respectively. No significant changes in the ASIR of kidney transplant were observed for the Chinese (p=0.74), Malays (p=0.206) and Indians (p=0.751).

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

Chinese				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2014	51	68.0	17.7	13.0
2015	59	64.1	20.3	15.0
2016	77	78.6	26.3	19.3
2017	84	73.0	28.5	21.1
2018	82	71.9	27.6	19.3
2019	73	69.5	24.4	16.2
2020	36	72.0	12.0	9.8
2021	55	74.3	18.6	14.1
2022	49	64.5	16.2	12.4
2023	81	77.9	26.4	19.3
2024	92	74.2	29.7	22.7
P for trend	-	-	0.884	0.74
Malay				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2014	16	21.3	31.0	26.9
2015	18	19.6	34.6	29.2
2016	10	10.2	19.0	16.0
2017	14	12.2	26.4	23.4
2018	14	12.3	26.1	21.2
2019	11	10.5	20.3	14.9
2020	8	16.0	14.7	12.6
2021	10	13.5	18.4	17.4
2022	13	17.1	23.5	20.2
2023	7	6.7	12.5	10.2
2024	16	12.9	28.3	26.8
P for trend	-	-	0.12	0.206
Indian				
Year of transplant	**Number**	**%**	**CIR**	**ASIR**
2014	6	8.0	17.0	15.1
2015	11	12.0	31.0	24.7
2016	7	7.1	19.6	14.8
2017	11	9.6	30.7	23.0
2018	11	9.6	30.5	24.9
2019	15	14.3	41.4	30.7
2020	4	8.0	11.0	10.2
2021	6	8.1	16.9	11.4
2022	8	10.5	21.8	17.3
2023	10	9.6	26.7	22.3
2024	12	9.7	31.7	31.0
P for trend	-	-	0.883	0.751

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



Most of the new kidney transplants were done locally, with 83.1% being local transplants in 2024 (Table 5.9.5). The percentage of living donors among local transplants has increased steadily from about 43% in 2017 to 69.4% in 2022, before dipping to 55.3% in 2024. Transplants done overseas were not further stratified by donor status as the registry does not have the data.

Transplants from living donors offer better outcomes[65]. Worldwide, the proportions of transplants coming from living donors in 2022 differ, ranging from about 22% (1 in 4) in the United States to about 80% (4 in 5) in Malaysia. In Taiwan, which has the world's highest incidence and prevalence of CKD5, about 47% (1 in 2) kidney transplants in 2022 were from living donors[66].

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

Year of transplant	Local transplant						Overseas transplant	
	Living donor		Deceased donor		Total			
	Number	%*	Number	%*	Number	%^	Number	%^
2014	40	70.2	17	29.8	57	76.0	18	24.0
2015	40	55.6	32	44.4	72	78.3	20	21.7
2016	32	44.4	40	55.6	72	73.5	26	26.5
2017	40	43.0	53	57.0	93	80.9	22	19.1
2018	43	53.1	38	46.9	81	71.1	33	29.0
2019	56	62.9	33	37.1	89	84.8	16	15.2
2020	31	67.4	15	32.6	46	92.0	4	8.0
2021	47	66.2	24	33.8	71	95.9	3	4.1
2022	50	69.4	22	30.6	72	94.7	4	5.3
2023	49	55.7	39	44.3	88	84.6	16	15.4
2024	57	55.3	46	44.7	103	83.1	21	16.9

* Among local transplants; ^ Among all transplants

65 Hariharan S, Israni AK, Danovitch G. Long-Term Survival after Kidney Transplantation. N Engl J Med 2021;385:729-43.
66 End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System (USRDS). https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 19 November 2024.

Among incident kidney transplant patients, the top three conditions in terms of etiology were consistently GN, followed by DN and hypertension (Table 5.9.6), GN was the main cause of CKD5 among new kidney transplant patients. The proportion of new transplant patients with GN was 50.8% in 2024, while the proportion with DN was 18.5% and the proportion with hypertension was 12.9%. In contrast to trends for dialysis incidence, where about two-thirds of incident dialysis case were due to DN (Table 5.4.6), there were more patients with GN undergoing transplant than those with DN / hypertension, as patients with DN tend to have more co-morbidities and higher risk of post-transplant complications[67,68], while patients with hypertension tend to have higher risk of graft failure[69].

Table 5.9.6: Incidence number of kidney transplant by etiology

Year of transplant	DN		GN		HYP		AD	
	Number	%	Number	%	Number	%	Number	%
2014	11	14.7	42	56	6	8	6	8
2015	18	19.6	50	54.3	9	9.8	4	4.3
2016	17	17.3	54	55.1	10	10.2	5	5.1
2017	19	16.5	70	60.9	7	6.1	0	0
2018	18	15.8	68	59.6	12	10.5	3	2.6
2019	24	22.9	50	47.6	13	12.4	4	3.8
2020	9	18	23	46	4	8	4	8
2021	13	17.6	39	52.7	8	10.8	2	2.7
2022	17	22.4	40	52.6	6	7.9	0	0
2023	22	21.2	47	45.2	15	14.4	4	3.8
2024	23	18.5	63	50.8	16	12.9	3	2.4

Year of transplant	OBS		PKD		Others	
	Number	%	Number	%	Number	%
2014	1	1.3	4	5.3	5	6.7
2015	0	0	5	5.4	6	6.5
2016	0	0	7	7.1	5	5.1
2017	2	1.7	8	7	9	7.8
2018	0	0	9	7.9	4	3.5
2019	1	1	9	8.6	4	3.8
2020	1	2	5	10	4	8
2021	0	0	7	9.5	5	6.8
2022	0	0	8	10.5	5	6.6
2023	2	1.9	4	3.8	10	9.6
2024	0	0	9	7.3	10	8.1

DN: Diabetic Nephropathy
GN: Primary Glomerulonephritis
HYP: Hypertension and Renovascular Disease
AD: Autoimmune Disease/GN with Systemic Manifestations
OBS: Obstruction
PKD: Polycystic Kidney Disease/Other Cystic Diseases

[67] Chantrel F et al. Abysmal prognosis of patients with type 2 diabetes entering dialysis. Nephrology Dialysis Transplant 1999; 14: 129-136.
[68] Hashmi S et al. Overview of renal transplantation. Minerva Med 2007. 98(6): 713-729.
[69] Speer, C., et al. (2025). Blood pressure goals and outcomes in kidney transplant recipients in an analysis of the Collaborative Transplant Study. *Kidney International Reports*, *10*(3), 780–790.

5.10 Prevalence of kidney transplant

The prevalence rate of kidney transplant 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.

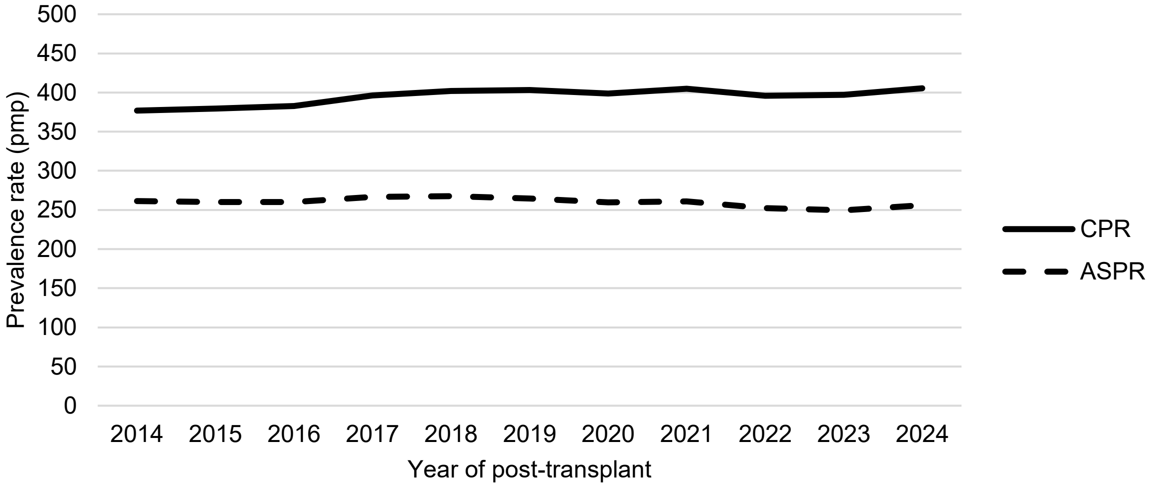
Unlike the incidence trend of kidney transplant which rose and dropped between 2014 and 2024 (Table 5.9.1, Figure 5.9.1), the number of prevalent patients with kidney transplant generally increased since 2014 (Table 5.10.1, Figure 5.10.1). There was a significant rise in CPR from 376.9 pmp in 2014 to 405.4 pmp in 2024 (p=0.004). The ASPR remained largely stable over the years, standing at 255.9 pmp in 2024. Among countries included in USRDS data, in 2022, the developed countries in the West (e.g. the United States, Canada and various European countries) had comparatively higher CPRs for kidney transplant exceeding 600 pmp compared to 396.0 pmp in Singapore[70].

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

Year of post-transplant	Number	CPR	ASPR
2014	1459	376.9	261.5
2015	1481	379.5	260.0
2016	1506	382.9	260.0
2017	1571	396.1	266.7
2018	1605	401.8	267.6
2019	1623	403.1	264.4
2020	1613	398.8	259.7
2021	1614	404.8	261.0
2022	1613	396.0	252.2
2023	1647	396.9	249.6
2024	1695	405.4	255.9
P for trend	-	0.004**	0.046*

[70] End Stage Renal Disease: Chapter 11 - International Comparisons. United States Renal Data System. https://usrds-adr.niddk.nih.gov/2024/end-stage-renal-disease/11-international-comparisons. Accessed 19 September 2025.

Figure 5.10.1: Prevalence rate (pmp) of kidney transplant



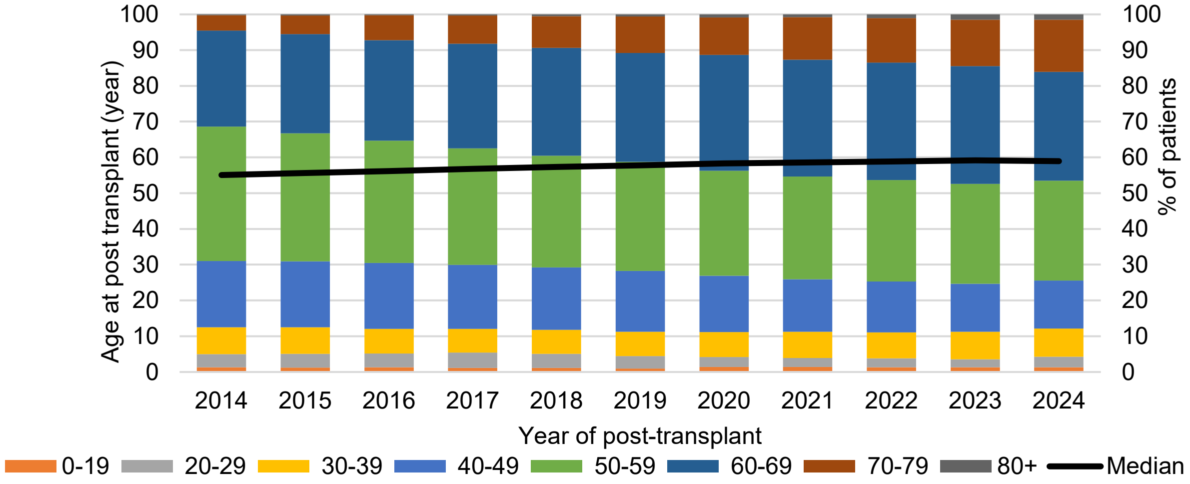
The CPR of kidney transplant increased for those aged 0 to 19 years (p=0.009), 30 to 39 years (p<0.001), 70 to 79 years (p<0.001) and 80 years and above (p<0.001), but it dropped for those aged 40-49 years (p=0.001) and 50-59 years (p<0.001) (Table 5.10.2).

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
2014	19	1.3	22.2	54	3.7	102.0	109	7.5	183.4	271	18.6	433.9
2015	18	1.2	21.3	57	3.8	106.5	110	7.4	185.9	273	18.4	440.2
2016	20	1.3	23.9	58	3.9	107.2	104	6.9	177.0	277	18.4	450.7
2017	18	1.1	21.8	68	4.3	123.8	104	6.6	179.2	280	17.8	455.3
2018	19	1.2	23.2	63	3.9	115.1	107	6.7	182.9	280	17.4	457.9
2019	16	1.0	19.7	56	3.5	104.2	111	6.8	186.8	275	16.9	449.0
2020	22	1.4	27.4	46	2.9	86.5	112	6.9	187.5	254	15.7	415.7
2021	23	1.4	29.4	40	2.5	77.6	118	7.3	199.9	238	14.7	401.4
2022	21	1.3	26.6	40	2.5	77.9	118	7.3	194.0	229	14.2	379.0
2023	22	1.3	27.8	37	2.2	73.0	126	7.7	202.0	222	13.5	362.3
2024	22	1.3	27.9	51	3.0	103.2	133	7.8	209.4	227	13.4	371.2
P for trend	-	-	0.009**	-	-	0.042*	-	-	<0.001**	-	-	0.001**
Year of post-transplant	Age 50-59			Age 60-69			Age 70-79			Age 80+		
	Number	%	CPR	Number	%	CPR	Number	%	CPR	Number	%	CPR
2014	548	37.6	907.4	392	26.9	998.2	63	4.3	344.1	3	0.2	34.4
2015	530	35.8	868.6	411	27.8	971.8	77	5.2	418.8	5	0.3	53.5
2016	515	34.2	837.1	423	28.1	940.3	105	7.0	547.6	4	0.3	40.9
2017	512	32.6	833.2	460	29.3	985.8	123	7.8	581.7	6	0.4	59.2
2018	501	31.2	816.8	484	30.2	1000.4	143	8.9	624.8	8	0.5	74.9
2019	496	30.6	815.2	494	30.4	987.8	165	10.2	674.2	10	0.6	86.5
2020	474	29.4	787.5	522	32.4	1015.5	169	10.5	647.5	14	0.9	112.9
2021	463	28.7	792.6	527	32.7	1017.4	192	11.9	705.1	13	0.8	99.0
2022	458	28.4	772.6	529	32.8	987.1	201	12.5	682.8	17	1.1	125.2
2023	459	27.9	761.1	542	32.9	980.4	214	13.0	671.1	25	1.5	178.7
2024	474	28.0	788.0	516	30.4	916.8	247	14.6	724.1	25	1.5	170.5
P for trend	-	-	<0.001**	-	-	0.637	-	-	<0.001**	-	-	<0.001**

The median age among prevalent kidney transplant patients increased from 55.1 years in 2014 to 59.0 years in 2024 (p<0.001); the percentage of kidney transplant patients aged 60 years and above also rose from 31.4% in 2014 to 46.5% in 2024 (Figure 5.10.2a).

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



Every year, the age-specific prevalence rate of kidney transplant was highest for those aged 60 to 69 years (Figure 5.10.2b, Figure 5.10.3).

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

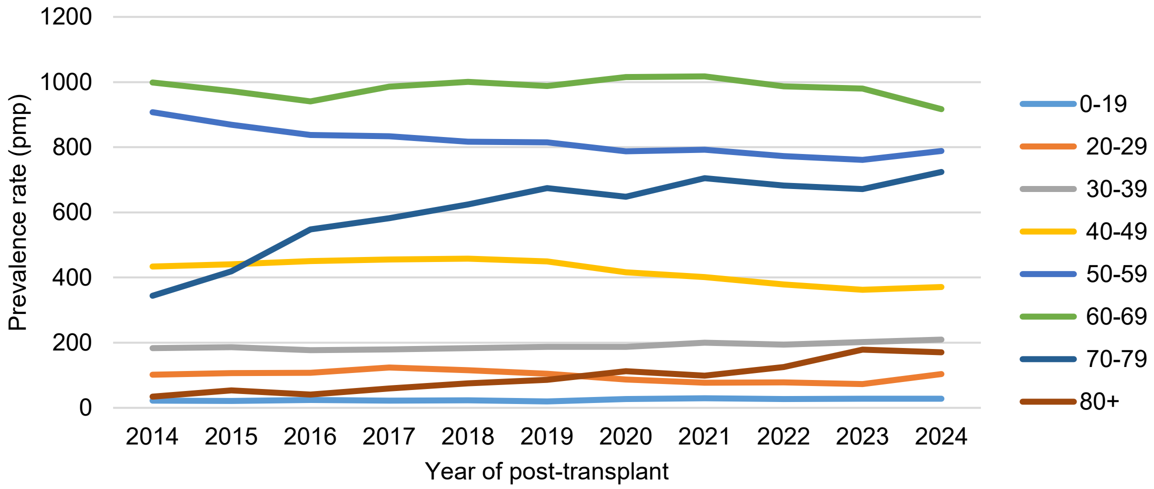
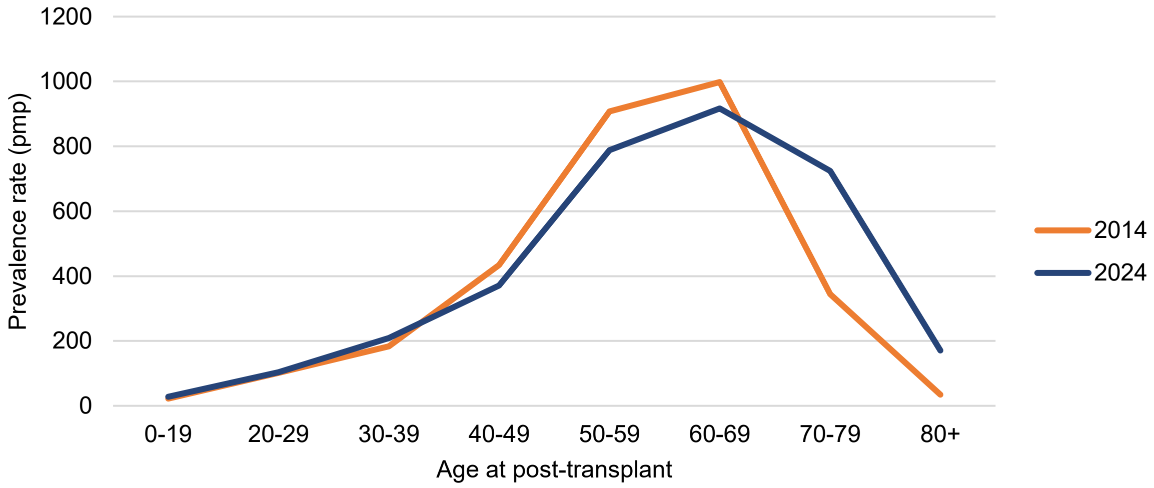


Figure 5.10.3: Age-specific prevalence rate (pmp) of kidney transplant across age groups



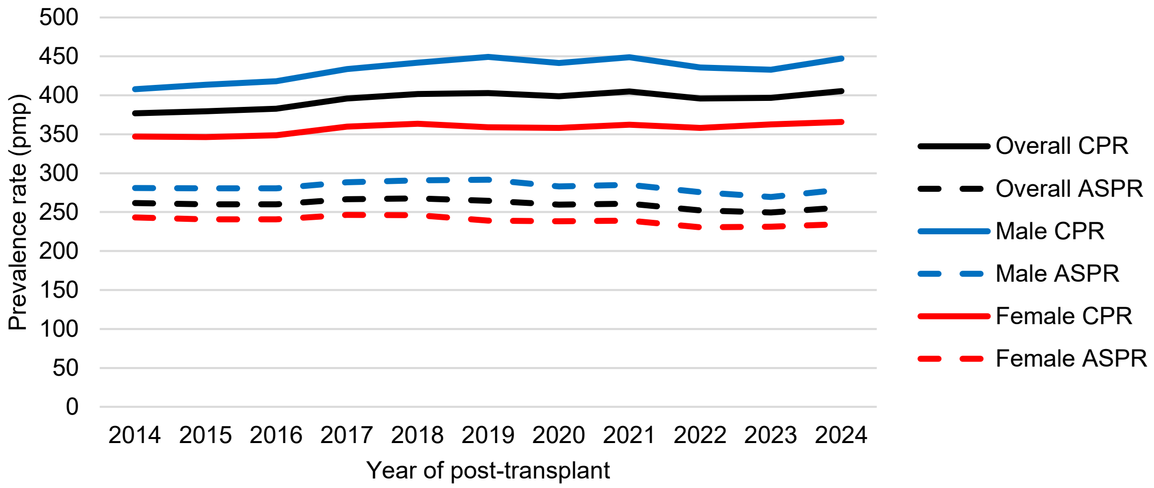
Every year, males accounted for slightly more than half of the prevalent kidney transplant patients (Table 5.10.3). The ASPRs of kidney transplant were consistently higher among males than females across the years (Figure 5.10.4). In 2024, the ASPR was 279.0 pmp and 234.5 pmp for males and females respectively. The ASPR for males remained stable (p=0.242), while that for females dropped significantly over the years (p=0.006).

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

	Male			
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2014	776	53.2	407.9	281.0
2015	793	53.5	413.7	280.6
2016	807	53.6	418.2	280.5
2017	843	53.7	433.7	288.4
2018	864	53.8	441.8	290.8
2019	885	54.5	449.4	291.6
2020	873	54.1	441.5	283.2
2021	877	54.3	449.0	285.0
2022	867	53.8	435.6	275.7
2023	875	53.1	432.8	269.4
2024	910	53.7	447.2	279.0
P for trend	-	-	0.009**	0.242

Year of post-transplant	Female			
	Number	%	CPR	ASPR
2014	683	46.8	347.0	243.3
2015	688	46.5	346.4	240.6
2016	699	46.4	348.8	240.8
2017	728	46.3	360.0	246.5
2018	741	46.2	363.5	246.1
2019	738	45.5	358.8	239.2
2020	740	45.9	358.1	238.1
2021	737	45.7	362.4	239.0
2022	746	46.2	358.1	230.6
2023	772	46.9	362.9	231.3
2024	785	46.3	365.8	234.5
P for trend	-	-	0.002**	0.006**

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

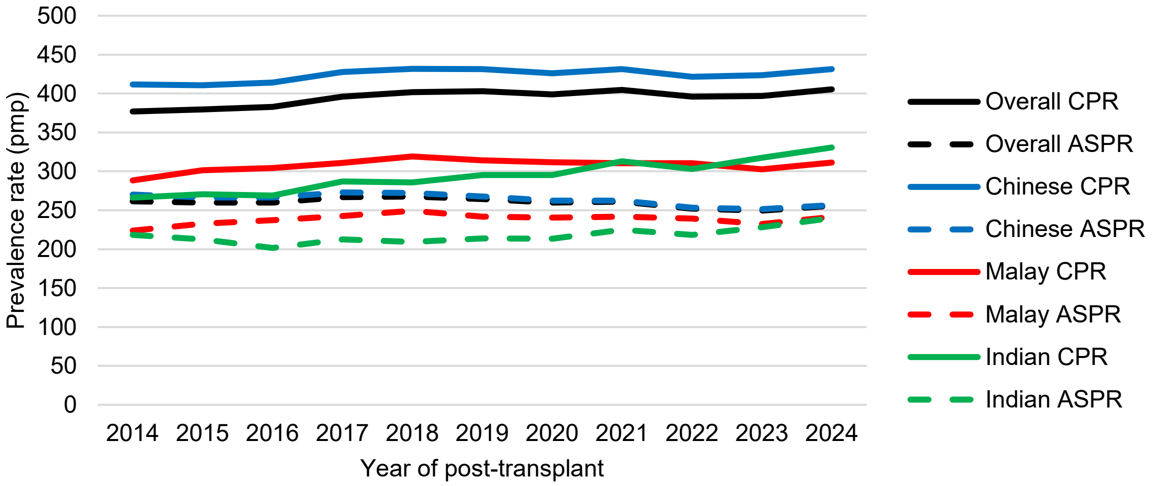


The ASPRs of kidney transplant were consistently higher among Chinese than Malays and Indians across the years (Table 5.10.4, Figure 5.10.5). While the ASPR for Chinese dropped significantly from 270.1 pmp in 2014 to 256.7 pmp in 2024 (p=0.003) and the ASPR for Indians rose significantly from 218.2 pmp in 2014 to 239.9 pmp in 2024 (p=0.012), no significant changes in the trends of kidney transplant prevalence were observed among the Malays (p=0.264).

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

Chinese				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2014	1183	81.1	411.6	270.1
2015	1191	80.4	410.7	266.4
2016	1211	80.4	414.3	266.4
2017	1261	80.3	427.7	273.0
2018	1282	79.9	431.8	272.3
2019	1292	79.6	431.6	267.5
2020	1281	79.4	426.0	262.5
2021	1277	79.1	431.4	262.4
2022	1273	78.9	421.7	253.4
2023	1301	79.0	423.5	251.5
2024	1335	78.8	431.6	256.7
P for trend	-	-	0.033*	0.003**
Malay				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2014	149	10.2	288.4	223.8
2015	157	10.6	301.4	232.5
2016	160	10.6	304.2	237.4
2017	165	10.5	310.9	242.7
2018	171	10.7	319.1	249.3
2019	170	10.5	314.4	241.6
2020	170	10.5	311.6	240.4
2021	169	10.5	310.4	241.7
2022	172	10.7	310.4	239.5
2023	170	10.3	302.9	232.3
2024	176	10.4	311.3	241.3
P for trend	-	-	0.132	0.264
Indian				
Year of post-transplant	**Number**	**%**	**CPR**	**ASPR**
2014	94	6.4	266.3	218.2
2015	96	6.5	270.5	212.7
2016	96	6.4	269.0	201.6
2017	103	6.6	287.1	212.6
2018	103	6.4	285.7	209.5
2019	107	6.6	295.1	213.9
2020	107	6.6	295.4	213.6
2021	111	6.9	312.8	225.1
2022	111	6.9	302.9	218.2
2023	119	7.2	317.4	228.0
2024	125	7.4	330.7	239.9
P for trend	-	-	<0.001**	0.012*

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



Most of the prevalent kidney transplants were done locally, with 76.4% (about 3 in 4) being local transplants in 2024 (Table 5.10.5). Among the prevalent local transplants, the difference in proportion of transplants between living and deceased donors narrowed over the years, whereby the proportion of transplants from living donors increased and exceeded the proportion from deceased donors from 2021. Transplants done overseas were not further stratified by donor status 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		Total			
	Number	%	Number	%	Number	%	Number	%
2014	454	31.1	571	39.1	1025	70.3	434	29.7
2015	479	32.3	570	38.5	1049	70.8	432	29.2
2016	485	32.2	585	38.8	1070	71.0	436	29.0
2017	507	32.3	616	39.2	1123	71.5	448	28.5
2018	527	32.8	629	39.2	1156	72.0	449	28.0
2019	563	34.7	624	38.5	1187	73.1	436	26.9
2020	575	35.7	611	37.9	1186	73.5	427	26.5
2021	606	37.5	588	36.4	1194	74.0	420	26.0
2022	638	39.5	574	35.6	1212	75.1	401	24.9
2023	669	40.6	583	35.4	1252	76.0	395	24.0
2024	700	41.3	595	35.1	1295	76.4	400	23.6

Among the prevalent kidney transplant patients, the top three conditions in terms of etiology were consistently GN, followed by DN and hypertension (Table 5.10.6). GN accounted for approximately two-thirds of prevalent transplant patients every year, with a decrease observed from 70.0% to 62.8% in the past decade. The proportion of prevalent transplant patients with DN increased from 8.4% in 2014 to 12.4% in 2024, and those with hypertension increased from 6.3% to 8% during the same period.

Table 5.10.6: Prevalence number of kidney transplant by etiology

Year of post-transplant	DN		GN		HYP		AD	
	Number	%	Number	%	Number	%	Number	%
2014	122	8.4	1021	70	92	6.3	68	4.7
2015	134	9	1025	69.2	96	6.5	69	4.7
2016	141	9.4	1036	68.8	97	6.4	72	4.8
2017	151	9.6	1075	68.4	99	6.3	70	4.5
2018	155	9.7	1093	68.1	105	6.5	71	4.4
2019	171	10.5	1085	66.9	110	6.8	74	4.6
2020	168	10.4	1074	66.6	109	6.8	73	4.5
2021	174	10.8	1058	65.6	114	7.1	71	4.4
2022	181	11.2	1055	65.4	111	6.9	68	4.2
2023	196	11.9	1052	63.9	122	7.4	68	4.1
2024	211	12.4	1064	62.8	135	8	66	3.9

Year of post-transplant	OBS		PKD		Others	
	Number	%	Number	%	Number	%
2014	4	0.3	58	4	94	6.4
2015	3	0.2	61	4.1	93	6.3
2016	3	0.2	66	4.4	91	6
2017	5	0.3	74	4.7	97	6.2
2018	4	0.2	83	5.2	94	5.9
2019	5	0.3	86	5.3	92	5.7
2020	5	0.3	91	5.6	93	5.8
2021	5	0.3	94	5.8	98	6.1
2022	4	0.2	95	5.9	99	6.1
2023	6	0.4	97	5.9	106	6.4
2024	5	0.3	104	6.1	110	6.5

DN: Diabetic Nephropathy
GN: Primary Glomerulonephritis
HYP: Hypertension and Renovascular Disease
AD: Autoimmune Disease/GN with Systemic Manifestations
OBS: Obstruction
PKD: Polycystic Kidney Disease/Other Cystic Diseases

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. 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 30 April 2025. Median survival duration is indicated as “not reached (NR)” if more than half of the patients did not suffer from graft loss or were still alive as of 30 April 2025. 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. Event was defined as all-cause death. Patients were censored if they were alive as of 30 April 2025. Median survival duration is indicated as “not reached (NR)” if more than half of the patients were alive as of 30 April 2025. Multivariable Cox regression was used to estimate the adjusted risk of death among patients with transplant done locally, accounting for the effects of potential confounders in Table 5.11.11.

The age, sex, 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.

Multivariable Cox regression was used to estimate the adjusted risk of death among patients on dialysis and those with transplant done locally, accounting for the effects of potential confounders in Table 5.11.12. For patients who underwent dialysis prior to 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 30 April 2025 (whichever earlier), and the potential confounders were based on data captured by the registry around the date of transplant.

1-, 5- and 10-year graft survival were high at 97.7%, 89.9% and 76.6% respectively (Table 5.11.1). 1-, 5- and 10-year patient survival were also high at 98.4%, 93.7% and 85.2% respectively and outperformed patients on dialysis (91.0%, 57.4% and 29.3% 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 (%)	97.7	98.4
5-year survival (%)	89.9	93.7
10-year survival (%)	76.6	85.2
Median survival (years)	19.5	25.6

Among patients with transplants done locally, those who received kidneys from living donors had significantly better graft (p<0.001) and patient (p<0.001) survival than those who received a kidney from deceased donors (Table 5.11.2), a pattern that is generally observed globally. For instance, in the United States, for transplants performed between 2002 to 2018, allografts from living donors had better survival rates of 99%, 94%, and 84% respectively, while allograft survival from deceased donors were 97%, 90%, and 77% at 1, 5, and 10 years[71]. As of 2019, 1- and 5-year year graft survival in Australia were 98% and 91% for living donors, and 96% and 83% for deceased donors; patient survival was 100% and 96% for living donor transplants, and 98% and 89% at 1 and 5 years respectively for transplants from deceased donors[72].

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

	Living		Deceased	
	Graft	Patient	Graft	Patient
1-year survival (%)	99.3	99.4	96.5	97.7
5-year survival (%)	93.9	96.1	86.3	91.4
10-year survival (%)	83.2	89.7	68.7	81.5
Median survival (years)	21.5	NR	15.7	22.2

Younger patients aged below 60 years had significantly better graft (p<0.001) 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 (%)	98.0	98.7	95.3	96.1
5-year survival (%)	90.7	94.7	83.5	85.2
10-year survival (%)	77.8	87.3	64.9	66.1
Median survival (years)	19.9	NR	14.4	14.4

Female patients had better patient (p=0.05) survival compared to males, while the graft survival difference was insignificant (p=0.118) (Table 5.11.4).

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

	Male		Female	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.6	98.4	97.9	98.5
5-year survival (%)	89.7	93.8	90.2	93.4
10-year survival (%)	75.8	85.1	77.5	85.5
Median survival (years)	18.3	22.7	20.1	NR

[71] Wang JH and Hart A. Global Perspective on Kidney Transplantation: United States. KIDNEY360 2; 2021. 1836–1839.
[72] Wyld M, Wyburn K, Chadban S. Global Perspective on Kidney Transplantation: United States. KIDNEY360 2: 1641–1644, 2021.

Chinese had significantly better graft survival than Malays (p<0.001) and Indians (p<0.001) (Table 5.11.5). However, there were no significant differences in patient survival 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 (%)	97.8	98.5	96.8	97.5	98.4	98.9
5-year survival (%)	91.1	94.2	85.8	92.5	84.9	91.0
10-year survival (%)	78.3	85.4	69.7	86.4	67.0	80.6
Median survival (years)	20.2	25.6	15.3	22.1	15.0	24.0

Patients without DN had significantly better graft (p<0.001) and patient (p<0.001) survival than those with DN (Table 5.11.6). While studies have found that the projected survival gain from transplant among diabetic CKD patients can outstrip that in non-diabetic patients, their long-term survival post-transplant nevertheless remains inferior to that of non-diabetic transplant recipients[73]. This is consistent with data seen in Singapore.

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

	Non-DN		DN	
	Graft	Patient	Graft	Patient
1-year survival (%)	97.9	98.6	96.7	97.6
5-year survival (%)	90.8	94.5	84.8	88.2
10-year survival (%)	77.7	86.8	69.0	74.6
Median survival (years)	20.2	NR	14.0	15.4

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 (%)	97.8	98.6	97.8	98.2
5-year survival (%)	91.2	95.1	87.4	89.2
10-year survival (%)	78.4	87.4	70.7	76.2
Median survival (years)	20.0	NR	14.8	16.8

Graft survival was not significantly different between patients without CVD and those with CVD (p=0.291), but patient survival was comparatively better among kidney transplant patients without CVD (p=0.026) (Table 5.11.8).

[73] Phillips J, Chen J, Ooi E, Prunster J and Lim WH. Global Epidemiology, Health Outcomes, and Treatment Options for Patients With Type 2 Diabetes and Kidney Failure. Frontiers in Clinical Diabetes and Healthcare 2021; 2.

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 (%)	98.1	98.7	91.4	95.2
5-year survival (%)	90.6	94.1	88.1	91.9
10-year survival (%)	77.0	85.7	79.7	80.1
Median survival (years)	19.4	NR	15.0	NR

Graft survival did not differ significantly between patients with and without PVD (p=0.269); however, patients without PVD had significantly better patient (p=0.029) 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 (%)	97.8	98.5	95.3	97.7
5-year survival (%)	90.4	94.0	87.3	89.7
10-year survival (%)	77.0	85.5	78.1	79.3
Median survival (years)	19.2	NR	12.9	NR

There were no significant differences in graft (p=0.949) and patient (p=0.441) survival among those with cancer compared to those without cancer (Table 5.11.10). In contrast, a study conducted in the USA found lower graft and patient survival among those with cancer compared to those without cancer, partially due to higher post-transplant cancer risk among those with pre-transplant cancer history[74].

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 (%)	98.0	98.8	95.9	95.9
5-year survival (%)	90.8	94.5	82.0	87.8
10-year survival (%)	77.3	86.1	70.3	75.6
Median survival (years)	19.5	25.6	NR	NR

Among patients with transplants done locally, transplant from deceased donor (p<0.001), older age (60 years and above) (p<0.001), presence of DN and IHD (p<0.001, p=0.008 respectively) remained as significant risk factors of death in the multivariable analysis (Table 5.11.11).

[74] Livingston-Rosanoff, D., Foley, D. P., Leverson, G., & Wilke, L. G. (2019). Impact of pre-transplant malignancy on outcomes after kidney transplantation: United Network for Organ Sharing database analysis. *Journal of the American College of Surgeons*, *229*(6), 568–579. https://doi.org/10.1016/j.jamcollsurg.2019.06.001

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	2.21	1.71-2.85	
Age group			
<60 years	1.00	Reference	<0.001**
⩾60 years	3.32	2.28-4.84	
Sex			
Male	1.00	Reference	0.758
Female	0.96	0.77-1.21	
Ethnicity			
Chinese	1.00	Reference	
Malay	1.08	0.79-1.47	0.648
Indian	1.52	1.03-2.25	0.037
Etiology			
Non-DN	1.00	Reference	<0.001**
DN	2.26	1.53-3.35	
IHD			
No	1.00	Reference	0.008**
Yes	1.51	1.11-2.05	
CVD			
No	1.00	Reference	0.790
Yes	1.09	0.58-2.04	
PVD			
No	1.00	Reference	0.451
Yes	1.32	0.64-2.68	
Cancer			
No	1.00	Reference	0.938
Yes	0.97	0.46-2.07	

Aside from transplant patients, Table 5.11.12 also included dialysis patients without transplant. Patients with kidney transplant, regardless of donor type, had significantly lower risk of death than dialysis patients without transplant. Older age (60 years and above), DN, and presence of co-morbidities (IHD, CVD, PVD and cancer) were also 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	0.22	0.18-0.26	<0.001**
Transplant from deceased donor	0.47	0.41-0.54	<0.001**
Age group			
<60 years	1.00	Reference	
≥60 years	1.86	1.79-1.94	<0.001**
Sex			
Male	1.00	Reference	
Female	0.98	0.94-1.01	0.201
Ethnicity			
Chinese	1.00	Reference	
Malay	0.87	0.84-0.91	<0.001**
Indian	0.97	0.91-1.04	0.446
Etiology			
Non-DN	1.00	Reference	
DN	1.64	1.58-1.71	<0.001**
IHD			
No	1.00	Reference	
Yes	1.45	1.4-1.51	<0.001**
CVD			
No	1.00	Reference	
Yes	1.30	1.25-1.36	<0.001**
PVD			
No	1.00	Reference	
Yes	1.50	1.43-1.57	<0.001**
Cancer			
No	1.00	Reference	
Yes	1.36	1.29-1.45	<0.001**

6. CONCLUSION

Although survival among dialysis patients has improved over the years, on top of the direct costs from medical expenses, lifestyle changes are also required to accommodate the treatment. Studies have indicated that 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[75,76]. However, the incidence rate of CKD5 is rising faster than the incidence rate of transplant. Moreover, the incidence rate of CKD5 is expected to further accelerate in future with an ageing population and concomitant increase in chronic disease 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 having a balanced diet and opting for healthier food options, exercising and maintaining a healthy weight, not smoking and going for regular screening for diabetes, hypertension, and hyperlipidaemia. 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 behaviours.

[75] Tonelli M. et al. Systematic Review: Kidney Transplantation Compared With Dialysis in Clinically Relevant Outcomes. American Journal of Transplantation 2011; 11: 2093–2109.
[76] Iqbal M. et al. Quality of Life Is Improved in Renal Transplant Recipients Versus That Shown in Patients With Chronic Kidney Disease With or Without Dialysis. Experimental and Clinical Transplantation 2020; Suppl 1: 64-67.

Annex

Prevalent patients by service providers as of 31 December 2024

Public hospitals and affiliated dialysis centres	HD	PD	Transplant
SINGAPORE GENERAL HOSPITAL	17	449	855
ALEXANDRA HOSPITAL (SINCE 01/06/2018)	0	4	0
TAN TOCK SENG RENAL CENTRE	5	147	40
CHANGI GENERAL HOSPITAL	2	122	0
KHOO TECK PUAT HOSPITAL	4	131	0
NG TENG FONG GENERAL HOSPITAL	2	62	1
SENGKANG GENERAL HOSPITAL	4	76	0
NATIONAL UNIVERSITY HOSPITAL	4	171	612
NUH DIALYSIS CENTRE	55	0	0
NUH RENAL CENTRE	17	0	0
SHAW NKF - NUH CHILDREN'S KIDNEY CENTRE	2	15	43
Subtotal	**112**	**1177**	**1551**
Voluntary Welfare Organisations	**HD**	**PD**	**Transplant**
ANG MO KIO THYE HUA KWAN HOSPITAL DIALYSIS CENTRE	113	0	0
FOO HAI - NKF DIALYSIS CENTRE	76	0	0
HONG LEONG - NKF DIALYSIS CENTRE (ALJUNIED CRESCENT)	149	0	0
IFPAS - NKF DIALYSIS CENTRE (SERANGOON)	102	0	0
IHSAN KIDNEY CARE (IKC)	54	0	0
JO & GERRY ESSERY NKF DIALYSIS CENTRE (BLK 204 MARSILING)	120	0	0
KWAN IM THONG HOOD CHO TEMPLE - NKF DIALYSIS CENTRE (KOLAM AYER)	147	0	0
KWAN IM THONG HOOD CHO TEMPLE - NKF DIALYSIS CENTRE (SIMEI)	161	0	0
LE CHAMP - NKF DIALYSIS CENTRE (BLK 639 YISHUN ST 61)	112	0	0
LEONG HWA CHAN SI TEMPLE - NKF DIALYSIS CENTRE (TECK WHYE)	109	0	0
NEW CREATION CHURCH - NKF DIALYSIS CENTRE	90	0	0
NKF BUKIT PANJANG DIALYSIS CENTRE	97	0	0
NKF DIALYSIS CENTRE (BLK 365 WOODLANDS II)	128	0	0
NKF DIALYSIS CENTRE SUPPORTED BY KEPPEL	122	0	0
NKF DIALYSIS CENTRE SUPPORTED BY MAN FATT LAM BUDDHIST TEMPLE (105 BEDOK NORTH)	92	0	0
NKF DIALYSIS CENTRE SUPPORTED BY NGIAM KIA HUM & FAMILY	207	0	0
NKF DIALYSIS CENTRE SUPPORTED BY SANG WANG WU TI RELIGIOUS SOCIETY @ SENGKANG COMMUNITY HOSPITAL	85	0	0

NKF DIALYSIS CENTRE SUPPORTED BY SINGAPORE BUDDHIST YOUTH MISSION	207	0	0
NKF DIALYSIS CENTRE SUPPORTED BY TL WHANG FOUNDATION (BLK 427 PASIR RIS)	124	0	0
NKF HOUGANG PUNGGOL DIALYSIS CENTRE	118	0	0
NKF INTEGRATED RENAL CENTRE (CP1)	169	0	0
NKF INTEGRATED RENAL CENTRE (CP2)	145	0	0
NKF JURONG EAST DIALYSIS CENTRE SUPPORTED BY YUHUA GRASSROOTS ORGANISATIONS	124	0	0
NTUC INCOME - NKF DIALYSIS CENTRE (BUKIT BATOK)	0	0	0
NTUC/SINGAPORE POOLS - NKF DIALYSIS CENTRE (TAMPINES)	137	0	0
PEI HWA FOUNDATION - NKF DIALYSIS CENTRE (ANG MO KIO)	123	0	0
QUEENSTOWN - NKF DIALYSIS CENTRE	152	0	0
SAF - NKF DIALYSIS CENTRE (CLEMENTI)	177	0	0
SAKYADHITA -NKF DIALYSIS CENTRE (UPPER BOON KENG)	92	0	0
SCAL - NKF DIALYSIS CENTRE (YISHUN)	77	0	0
SECK HONG CHOON - NKF DIALYSIS CENTRE	114	0	0
SHENG HONG TEMPLE - NKF DIALYSIS CENTRE (JURONG WEST)	114	0	0
SIA - NKF DIALYSIS CENTRE (TOA PAYOH)	150	0	0
SINGAPORE BUDDHIST WELFARE SERVICES - NKF DIALYSIS CENTRE (HOUGANG)	205	0	0
SINGAPORE POOLS - NKF DIALYSIS CENTRE (BEDOK)	144	0	0
TAMPINES CHINESE TEMPLE - NKF DIALYSIS CENTRE (PASIR RIS)	112	0	0
TAY CHOON HYE - NKF DIALYSIS CENTRE (KIM KEAT)	0	0	0
THE HOUR GLASS - NKF DIALYSIS CENTRE (WEST COAST)	90	0	0
THE HOUR GLASS NKF DIALYSIS CENTRE (ADMIRALTY BRANCH)	107	0	0
THE SINGAPORE BUDDHIST LODGE - NKF DIALYSIS CENTRE (128 BUKIT MERAH VIEW)	95	0	0
THE SIRIVADHANABHAKDI FOUNDATION NKF DIALYSIS CENTRE (JW2)	98	0	0
THONG TECK SIAN TONG LIAN SIN SIA - NKF DIALYSIS CENTRE (WOODLANDS)	118	0	0
TOA PAYOH SEU TECK SEAN TONG - NKF DIALYSIS CENTRE (YISHUN)	77	0	0
TZU CHI RENAL DIALYSIS CENTRE	27	0	0
WESTERN DIGITAL - NKF DIALYSIS CENTRE (ANG MO KIO)	149	0	0
WOH HUP - NKF DIALYSIS CENTRE (GHIM MOH)	73	0	0
WONG SUI HA EDNA - NKF DIALYSIS CENTRE	132	0	0
KDF - BISHAN CENTRE	97	0	0
KDF - GHIM MOH CENTRE (HD)	77	0	0

KDF - KRETA AYER (HD)	75	0	0
KDF - SAN WANG WU TI CENTRE @ ADMIRALTY LINK	41	0	0
Subtotal	**5704**	**0**	**0**
Private clinics and dialysis centres	**HD**	**PD**	**Transplant**
ACE DIALYSIS PTE LTD	23	0	0
ACER DIALYSIS PTE LTD (BEDOK)	34	0	0
ACER DIALYSIS PTE LTD (SERANGOON)	8	0	0
AEGIS DIALYSIS CENTRE	27	0	0
ASIA KIDNEY DIALYSIS CENTRE (BEDOK)	45	0	0
ASIA KIDNEY DIALYSIS CENTRE (JURONG)	30	0	0
ASIA KIDNEY DIALYSIS CENTRE (TAMPINES) BLK 139	71	0	0
ASIA KIDNEY DIALYSIS CENTRE (TECK WHYE)	33	0	0
COMPLEX MEDICAL CENTRE (CHANGI)	8	0	0
DAVITA MEDICAL & DIALYSIS CENTRE (EAST COAST)	21	0	0
DAVITA MEDICAL & DIALYSIS CENTRE (JURONG EAST)	35	0	0
DAVITA MEDICAL & DIALYSIS CENTRE (WOODLANDS)	20	0	0
DAVITA MEDICAL AND DIALYSIS CENTRE @ FARRER PARK MEDICAL CENTRE	39	0	0
DAVITA MEDICAL AND DIALYSIS CENTRE @ ROYAL SQUARE MEDICAL SUITES (NOVENA)	40	0	0
DAVITA MEDICAL AND DIALYSIS CENTRE TAMPINES	21	0	0
DIAVERUM CHOA CHU KANG DIALYSIS CENTRE	35	0	0
DIAVERUM DIALYSIS CENTRE TAMPINES (BLK 139 TAMPINES)	28	0	0
DIAVERUM FAJAR DIALYSIS CENTRE	38	0	0
DIAVERUM FARRER PARK DIALYSIS CENTRE	38	0	0
DIAVERUM KOVAN DIALYSIS CENTRE	35	0	0
DIAVERUM NOVENA DIALYSIS CENTRE	9	0	0
DIAVERUM PUNGGOL DIALYSIS CENTRE	49	0	0
DIAVERUM SENGKANG DIALYSIS CENTRE	38	0	0
DIAVERUM TAMPINES II DIALYSIS CENTRE	45	0	0
DIAVERUM TOA PAYOH DIALYSIS CENTRE	37	0	0
DIAVERUM WOODLANDS DIALYSIS CENTRE	56	0	0
FIRSTLINE DIALYSIS CENTRE (BEDOK)	27	0	0
FRESENIUS KIDNEY CARE YISHUN DIALYSIS CLINIC	28	0	0
FRESENIUS KIDNEY CARE ANG MO KIO 128 DIALYSIS CLINIC	36	0	0
FRESENIUS KIDNEY CARE ANG MO KIO DIALYSIS CLINIC (BLK 422)	0	0	0
FRESENIUS KIDNEY CARE ANG MO KIO DIALYSIS CLINIC (BLK 443)	38	0	0
FRESENIUS KIDNEY CARE BEDOK DIALYSIS CLINIC	1	0	0
FRESENIUS KIDNEY CARE BEDOK RESERVOIR DIALYSIS CLINIC	59	0	0
FRESENIUS KIDNEY CARE BUANGKOK DIALYSIS CLINIC	58	0	0

FRESENIUS KIDNEY CARE BUKIT BATOK DIALYSIS CLINIC (BLK 213)	47	0	0
FRESENIUS KIDNEY CARE BUKIT MERAH CENTRAL DIALYSIS CLINIC	39	0	0
FRESENIUS KIDNEY CARE BUKIT MERAH DIALYSIS CLINIC	0	0	0
FRESENIUS KIDNEY CARE CLEMENTI DIALYSIS CLINIC	17	0	0
FRESENIUS KIDNEY CARE EAST COAST DIALYSIS CLINIC	34	0	0
FRESENIUS KIDNEY CARE FENGSHAN DIALYSIS CLINIC	0	0	0
FRESENIUS KIDNEY CARE JURONG BOON LAY DIALYSIS CLINIC (BLK 353)	33	0	0
FRESENIUS KIDNEY CARE JURONG EAST CENTRAL DIALYSIS CLINIC (BLK 104)	45	0	0
FRESENIUS KIDNEY CARE JURONG EAST DIALYSIS CLINIC (BLK 326)	34	0	0
FRESENIUS KIDNEY CARE KEMBANGAN DIALYSIS CLINIC	46	0	0
FRESENIUS KIDNEY CARE KHATIB DIALYSIS CLINIC	44	0	0
FRESENIUS KIDNEY CARE KOVAN DIALYSIS CLINIC	43	0	0
FRESENIUS KIDNEY CARE MARSILING DIALYSIS CLINIC	27	0	0
FRESENIUS KIDNEY CARE NAPIER DIALYSIS CLINIC	18	0	0
FRESENIUS KIDNEY CARE RENCI DIALYSIS CLINIC	34	0	0
FRESENIUS KIDNEY CARE SERANGOON DIALYSIS CLINIC	63	0	0
FRESENIUS KIDNEY CARE SIMEI DIALYSIS CLINIC	15	0	0
FRESENIUS KIDNEY CARE TAMPINES DIALYSIS CLINIC	35	0	0
FRESENIUS KIDNEY CARE TAMPINES WEST DIALYSIS CLINIC	41	0	0
FRESENIUS KIDNEY CARE TANGLIN DIALYSIS CLINIC	25	0	0
FRESENIUS KIDNEY CARE TECK WHYE DIALYSIS CLINIC	45	0	0
FRESENIUS KIDNEY CARE TIONG BAHRU DIALYSIS CLINIC	25	0	0
FRESENIUS KIDNEY CARE TOA PAYOH DIALYSIS CLINIC (BLK 92)	25	0	0
FRESENIUS KIDNEY CARE WHAMPOA DIALYSIS CLINIC	42	0	0
FRESENIUS KIDNEY CARE WOODLANDS DIALYSIS CLINIC	38	0	0
FRESENIUS KIDNEY CARE YISHUN RING DIALYSIS CLINIC	33	0	0
GLENEAGLES HOSPITAL	1	0	0
HOPE DIALYSIS - RHS	7	0	0
IMMANUEL DIALYSIS CENTRE (MAYFLOWER) PTE LTD	13	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (ANG MO KIO)	14	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (MT ALVERNIA)	31	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (WOODLANDS)	34	0	0
IMMANUEL DIALYSIS CENTRE PTE LTD (YISHUN)	22	0	0
KIDNEY HEALTH ASIA	0	0	1
KIDNEY TREATMENT SERVICES	12	0	0
KIDNEYCARE DIALYSIS CENTRE @ PASIR RIS	45	0	0

KIDNEYCARE DIALYSIS CENTRE @ WEST COAST	27	0	0
KIDNEYCARE DIALYSIS CENTRE @ YISHUN	17	0	0
RAFFLES DIALYSIS CENTRE	23	0	0
RENAL DIALYSIS CENTRE PTE LTD	6	0	0
RENAL HEALTH PTE LTD	59	0	0
RENAL LIFE (ALEXANDRA) DIALYSIS CENTRE PTE LTD	12	0	0
RENAL LIFE (HOUGANG) DIALYSIS CENTRE PTE LTD	17	0	0
RENAL LIFE (W) DIALYSIS CENTRE PTE LTD (BLK 207 BUKIT BATOK)	19	0	0
RENAL LIFE DIALYSIS CENTRE PTE LTD (BLK 463 JURONG WEST)	15	0	0
RENAL LIFE(PIONEER) DIALYSIS CENTRE PTE LTD	36	0	0
TAL DIALYSIS CLEMENTI	36	0	0
CENTRE FOR KIDNEY DISEASE PTE LTD (LUCKY PLAZA)	0	0	40
GRACE LEE RENAL AND MEDICAL CLINIC PTE LTD	0	2	6
KIDNEY & MEDICAL CENTRE	0	0	5
KIDNEY LIFE CENTRE	0	4	7
RAFFLES HOSPITAL	0	4	2
ROGER KIDNEY CLINIC	0	0	8
SH TAN KIDNEY & MEDICAL CLINIC	0	2	3
STEPHEW CHEW CENTRE FOR KIDNEY DISEASE AND HYPERTENSION (MAH)	0	0	16
STEPHEW CHEW CENTRE FOR KIDNEY DISEASE AND HYPERTENSION (MEH)	0	0	1
T.G. NG KIDNEY & MEDICAL CENTRE	0	0	2
THE KIDNEY & TRANSPLANT PRACTICE	0	12	5
THE KIDNEY CLINIC PTE LTD	0	1	11
THE KIDNEY HEALTH CLINIC PTE LTD	0	0	2
THE SINGAPORE CLINIC FOR KIDNEY DISEASES	0	0	3
WU NEPHROLOGY & MEDICAL CLINIC (WU MEDICAL CLINIC PTE LTD)	0	0	31
Subtotal	**2404**	**25**	**143**
Grand total	**8220**	**1202**	**1694**