Part Two

Current Service Analysis and Future Demand Predictions

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Disclaimer and citation

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Introduction

Demand for dialysis and kidney transplantation services has significantly increased in Queensland and the rest of Australia over recent decades. An ageing population, increasing diabetes prevalence and the heavy burden of chronic disease among Aboriginal and Torres Strait Islander Australians, particularly in North Queensland, have combined to place renal services under intense demand and capacity pressure. Evidence suggests that renal service planning should take into account the strong likelihood that demand will continue to rise over the next decade.

The *Queensland Statewide Renal Health Services Plan 2008–17* has been prepared in response to the increasing pressures and demand on Queensland Health's renal services. It has three parts.

Part One: The Queensland Statewide Renal Health Services Plan 2008–17: The Way Forward

This part is the 'Plan', an easy-to-read document that discusses the current situation and considers demand forecasts and an economic modelling of current and future costs and benefits associated with changing the service model. The strategies are arranged around five objectives.

Part Two: Current Service Analysis and Future Demand Predictions

This part provides in-depth information on the current incidence and prevalence of end-stage kidney disease as well as service models, and workforce and infrastructure capacity in Queensland. It compares Queensland's performance with other states and territories. Predictions of end-stage kidney disease incidence and prevalence to the year 2017 are also contained in this part.

Part Three: Economic Modelling Report: Modelling the Current and Future Costs and Benefits of Renal Replacement Therapy in Queensland

This Part is a supporting document to the Plan, including the more technical elements of the Plan. Data relating to incidence predictions, workforce and current service capabilities are presented in graphs and tables.

Analysis of known data

Chronic kidney disease prevalence

Queensland has experienced rapid population growth in recent years. Between 2004 and 2051, Queensland's population is projected to increase by three million people (77%) to reach 6.9 million people[1]. The number of people aged 65 years and over in Queensland is projected to increase from 465,700 in 2004 to between 1.6 million and 2.3 million in 2051. By then people aged 65 years and over will account for between 25% and 28% of the population, compared to 12% in 2004[2]. Chronic kidney disease prevalence increases with age and these population projections pose significant challenges for renal service planning. The Australian Diabetes, Obesity and Lifestyle Study (AusDiab), a national population-representative cross-sectional survey of Australian adults, has estimated current chronic kidney disease prevalence proportions for those aged over 25 years (Table 1).[3,4]

Table 1 Estimates of chronic kidney disease prevalence in Australia

Stage	Description	% Prevalence from AusDiab	Estimates of CKD Prevalence Numbers in Australia
1	Kidney damage with normal or ↑GFR	0.9%	112,000
2	Kidney damage with mild ↓ GFR	2.0%	660,000
3	Moderate ↓ GFR	10.9%	1,100,000
4	Severe ↓ GFR	0.3%	27,000
5	End Stage Kidney Disease	0.02%	14,442

If nothing is done to improve the early identification and management of chronic kidney disease then the proportion of those individuals with stages three to five kidney damage will continue to grow, impacting on future demand for dialysis and transplantation services.

End-stage kidney disease incidence

Increasing end-stage kidney disease incidence, the population measure of new patients requiring dialysis and transplantation services, is a global phenomenon. According to

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1 Australian Bureau of Statistics 2006, Population projections Australia: 2004 to 2101, ABS Cat. No. 3220.0, Government of Australia, Canberra.

2 Ibid.

3 Chadban, S, Briganti, EM, Kerr, PG, Dunstan, DW, Welborn, TA, Zimmet, PZ & Atkins, RC 2003, 'Prevalence of kidney damage in Australian adults: The AusDiab kidney study', Journal of the American Society of Nephrology, vol. 14, pp. s131-s8.

4 Kidney Health Australia 2006, National Chronic Kidney Disease Strategy, Kidney Health Australia, Melbourne.

the Australian and New Zealand Dialysis and Transplant (ANZDATA) Registry, 2,378 new patients commenced treatment for end-stage kidney disease in 2006, equivalent to 115 per million population (pmp) in Australia.[5] The annual intake of new patients varies between States and Territories from a high of 339 pmp in the Northern Territory to 92 pmp in Tasmania.[6]

In 2006, 483 Queenslanders entered the renal replacement therapy program (119 pmp).[7] All commenced dialysis, apart from 11 patients who had their renal function restored through pre-emptive transplantation (transplantation without first starting dialysis).[8] End-stage kidney disease incidence rates in Queensland (Table 2 and Figure 1) have not been below 100 pmp since 2001 and there has been a consistent upward trend for the last 10 years.[9]

Table 2 Annual intake of new end-stage kidney disease patients and incidence rates (per million population) for Australian States and Territories (2002-2006)

	2002	2003	2004	2005	2006
Queensland	379 (102)	420 (111)	401 (103)	455 (115)	483 (119)
New South Wales	583 (91)	631 (97)	560 (86)	675 (103)	768 (116)
ACT	49 (95)	39 (75)	44 (84)	46 (87)	53 (99)
Victoria	470 (97)	445 (90)	462 (93)	509 (101)	561 (110)
Tasmania	36 (76)	41 (86)	31 (64)	37 (76)	45 (92)
South Australia	120 (79)	152 (100)	157 (102)	173 (112)	182 (117)
Northern Territory	59 (297)	55 (277)	79 (395)	79 (390)	70 (339)
Western Australia	204 (106)	205 (105)	216 (109)	236 (117)	216 (105)
AUSTRALIA	1,900 (97)	1,988 (100)	1,950 (97)	2,210 (109)	2,378 (115)

5 Australian and New Zealand Dialysis and Transplant Registry 2006, Summary Report (1 January 2006 - 30 December 2006), ANZDATA Registry, Adelaide.

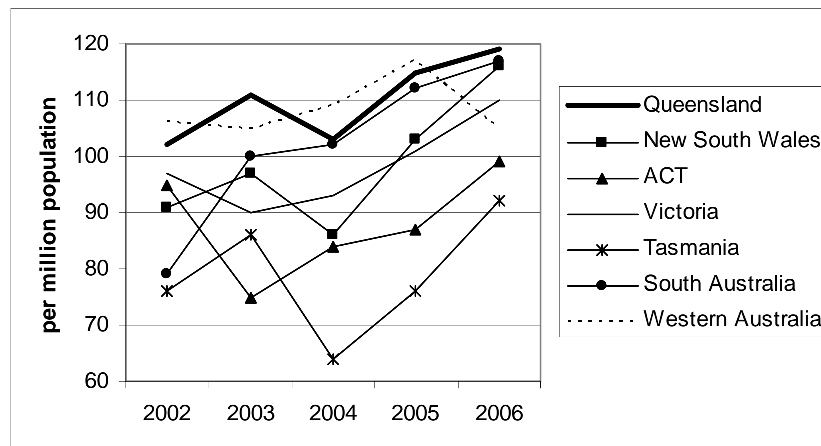
6 Ibid.

7 Ibid.

8 Ibid.

9 Ibid.

Figure 1 End-stage kidney disease incidence rates (per million population) for Australian States and Territories, excluding the Northern Territory (2000-2005)



In 2006, Queensland patients represented 20.3% of all new end-stage kidney disease patients in Australia, behind NSW 32.3% and Victoria 23.6%.[10] Queensland had the second highest end-stage kidney disease incidence rate in Australia after the Northern Territory.

Characteristics of new patients

In Australia in 2005, there was an increase in acceptance of new end-stage kidney disease patients in all age groups (Figure 2) except the youngest (0 to 19 year) group, which decreased from 9 to 7 pmp (50 to 39 patients).[11] In Queensland, the 55 to 64 years of age group constituted the largest number of new patients (24.6%), followed by the 45 to 54 year group (19.8%).[12] The acceptance of elderly patients into RRT programs is increasing across Australia. In 2005, the age-specific rates of new Queensland patients aged 75-84 years (487 pmp) surpassed all other age groups.[13] The mean age of new patients in Queensland was 60.2 years with the majority being male (60.9%).[14]

10 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

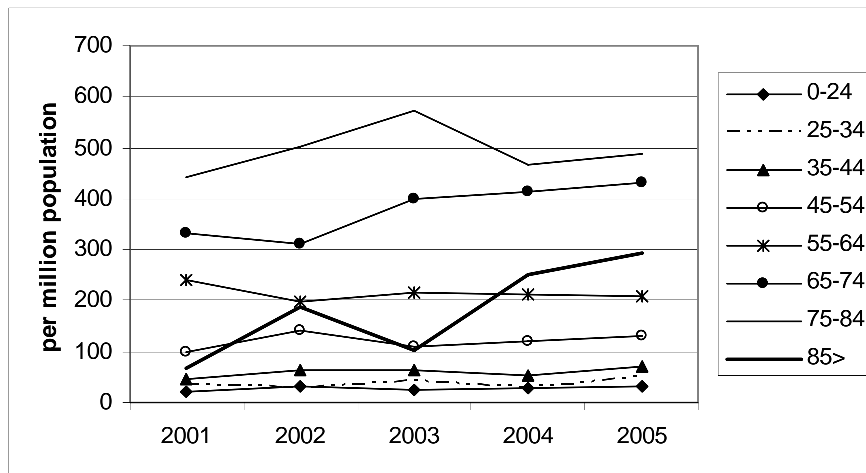
11 Ibid.

12 Ibid.

13 Ibid.

14 Ibid.

Figure 2 **Queensland age-specific rates (per million population) for new end-stage kidney disease patients (2001-2005)**



Diabetes — overwhelmingly type II diabetes — is the most commonly attributed cause of end-stage kidney disease. In 2005, diabetes was the primary cause for 31.5% of new end-stage kidney disease patients in Australia and 31.0% of new patients in Queensland (Table 3).[15] Glomerulonephritis (a painless inflammation of the glomerulus in the kidney which can lead to high blood pressure and progressive loss of kidney function) and hypertension were the second (22.9%) and third (13.2%) leading causes respectively in Queensland, with similar proportions reported across Australia in 2005.[16]

Table 3 **Primary renal disease among new end-stage kidney disease patients in Queensland and the proportion referred late to care**

	Number of New Patients		Number of New Patients Referred Late	
Diabetic Nephropathy	141	31.0%	34	24.1%
Glomerulonephritis	104	22.9%	23	22.1%
Hypertension	60	13.2%	17	28.3%
Polycystic Kidney	26	5.7%	5	19.2%
Analgesic Nephropathy	18	4.0%	2	11.1%
Reflux Nephropathy	9	2.0%	2	22.2%
Miscellaneous	53	11.6%	19	35.9%
Uncertain	44	9.7%	17	38.6%
Total	455	100%	119	26.2%

15 Ibid.

16 Ibid.

Many patients starting renal replacement therapy in Australia have other co-morbidities, including coronary artery disease (33% of all new patients) and peripheral vascular disease (18%).[17] More than half of all new Australian patients are former (41%) or current (11%) smokers.[18] Among people with chronic kidney disease, smoking has been shown to be a risk factor for progression of kidney disease.

Late referral, as defined by the ANZDATA Registry, occurs when a patient is referred to nephrological care less than three months before beginning their first renal replacement therapy treatment. Late referral can have a significant impact on the choice of dialysis modality, timeliness of access surgery and therapy commencement. In 2005, 26.2% of new Queensland patients were referred late, a slightly higher rate of late referral than for all Australia as a whole (24.8%).[19] Late referral occurs disproportionately among elderly patients and Aboriginal and Torres Strait Islander peoples. Between the years of 2001 and 2005, 37% of new Aboriginal and Torres Strait Islander patients were referred late for dialysis initiation in Australia.[20]

At risk populations

Epidemiological research from many countries has confirmed that the burden of chronic disease falls disproportionately on the elderly, disadvantaged, minority groups and in particular Aboriginal and Torres Strait Islander peoples. The Kidney Health Australia *National Chronic Kidney Disease Strategy 2006* suggests that there are groups, readily identifiable in primary care, who are at high risk of developing chronic kidney disease and of disease progression.[21] These include people aged 50 years and over, people with diabetes and hypertension, smokers, people with a family history of kidney disease and Aboriginal and Torres Strait Islander peoples. Modelling in the Kidney Health Australia Report discusses primary care-based, opportunistic screening of people aged 50 to 69 for markers/predictors of chronic kidney disease as a cost-effective strategy for reducing the burden of disease.[22]

End-stage kidney disease typically occurs 10 to 15 years earlier in Aboriginal and Torres Strait Islander peoples compared to non-Indigenous peoples. Patients from remote areas are more likely to experience an accelerated development of chronic kidney disease. This has been demonstrated by cases of mature age diabetes being diagnosed in adolescents that live in remote area communities. Complications relating to this diagnosis include the need to initiate dialysis for biopsy-proven diabetic nephropathy by 20 years of age and in some cases death has resulted from dialysis and vascular related complications before 30 years of age.[23] Most Aboriginal and Torres Strait

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17 Ibid.

18 Ibid.

19 Ibid.

20 Ibid.

21 Kidney Health Australia 2006, National Chronic Kidney Disease Strategy, Kidney Health Australia, Melbourne.

22 Howard, K, Salkeld, G, White, S, Chadban, S, Craig, J, MacDonald, S, Perkovic, V & Cass, A 2006, The cost effectiveness of early detection and intervention to prevent the progression of chronic kidney disease in Australia, Kidney Health Australia, Melbourne.

23 Couzos, S, & Thomas, M (ed.) 2003, Aboriginal Primary Health Care: An Evidence Based Approach, Oxford University Press, Melbourne.

Islander patients have significant co-morbidities including a heavy burden of cardiovascular and respiratory disease.

Aboriginal and Torres Strait Islander peoples also experience different patterns of primary renal disease. In Queensland, more than half of all end-stage kidney disease cases among Indigenous Australians (57.5%) are attributed to diabetes compared to 17.2% among non-Indigenous Australians (Table 4).[24] There are more Aboriginal and Torres Strait Islander patients who do not have a certain diagnosis as seen in Table 4. These patients are also the most likely to have been referred late.

Table 4 Primary renal disease among new end-stage kidney disease patients in Queensland according to Aboriginal and Torres Strait Islander status (1990-2005)

	Aboriginal and Torres Strait Islander Patients		Non-Indigenous Patients	
Diabetic Nephropathy	329	57.5%	695	17.2%
Glomerulonephritis	111	19.4%	1,131	28.0%
Hypertension	24	4.2%	497	12.3%
Reflux Nephropathy	11	1.9%	172	4.3%
Analgesic Nephropathy	4	0.7%	368	9.1%
Polycystic Kidney	4	0.7%	332	8.2%
Miscellaneous	18	3.2%	465	11.5%
Uncertain	71	12.4%	383	9.5%
Total	**572**	**100%**	**4,043**	**100%**

Socio-economic disadvantage is a powerful determinant of health. For rural and remote Aboriginal and Torres Strait Islander peoples disadvantage is evident in poor access to preventative health services, healthy and reasonably priced foods and a lack of community infrastructure inducing basic water, sewerage and housing. This combines with high unemployment, low education attainment and low income to create a strong association with end-stage kidney disease incidence.[25]

Low birth weight is also a symptom of socio-economic disadvantage and has been found to increase susceptibility to renal disease.[26] The presence of scabies, a condition of overcrowding and poor amenities, is also linked to renal damage and remains highly

24 Australian and New Zealand Dialysis and Transplant Registry 2006, The 20th - 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

25 Cass, A, Cunningham, J, Snelling, P, Wang, Z, & Hoy, W 2002, 'End-stage renal disease in Indigenous Australians: A disease of disadvantage', Ethnicity and Disease, vol. 12.

26 Nughson M, FA, Denton-Douglas R, Young R, Hoy W and Bertram J 2003, 'Glomerular number and size in autopsy kidneys: The relationship to birth weight', Kidney International, vol. 63.

prevalent in remote Indigenous communities.[27,28] A multitude of health insults across the lifespan of Aboriginal and Torres Strait Islander peoples are responsible for the excess burden of chronic kidney disease and end-stage kidney disease.

In Queensland, people who self-identify as having an Aboriginal and Torres Strait Islander background comprise 14.8% of all dialysis patients.[29] This underlies the heavy burden of kidney disease in the Aboriginal and Torres Strait Islander community, given that only about 3.5% of the Queensland Population self-identify as Aboriginal or Torres Strait Islander.[30] Queensland has the third highest number of Aboriginal and Torres Strait Islander people on dialysis in Australia.[31] Over 90% of the Northern Territory and 19% of the Western Australia dialysis population are Indigenous.[32] A disproportionate number of Queensland Indigenous end-stage kidney disease patients use in-centre and satellite dialysis (63% compared to 36% non-Indigenous patients).[33] A greater number of non-Indigenous than indigenous Queenslanders are accessing transplantation therapy.

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27 Hoy, W, Mathews, JD, McCredie, DA, Pugsley, DJ, Hayhurst, BG, Rees, M, Kile, E, Walker, KA & Wang, Z 1998, 'The multidimensional nature of renal disease: Rates and associations of albuminuria in an Australian Aboriginal community', Kidney International, vol. 54, no. 4, pp. 1296-304.

28 Currie, B, & Carapetis, J 2001, 'Skin infections and infestations in Aboriginal communities in Northern Australia', Australian Journal of Dermatology, vol. 41.

29 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

30 Queensland Health 2006, The Health of Queenslanders 2006: Report of the Chief Health Officer, Queensland, Queensland Government, Brisbane.

31 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

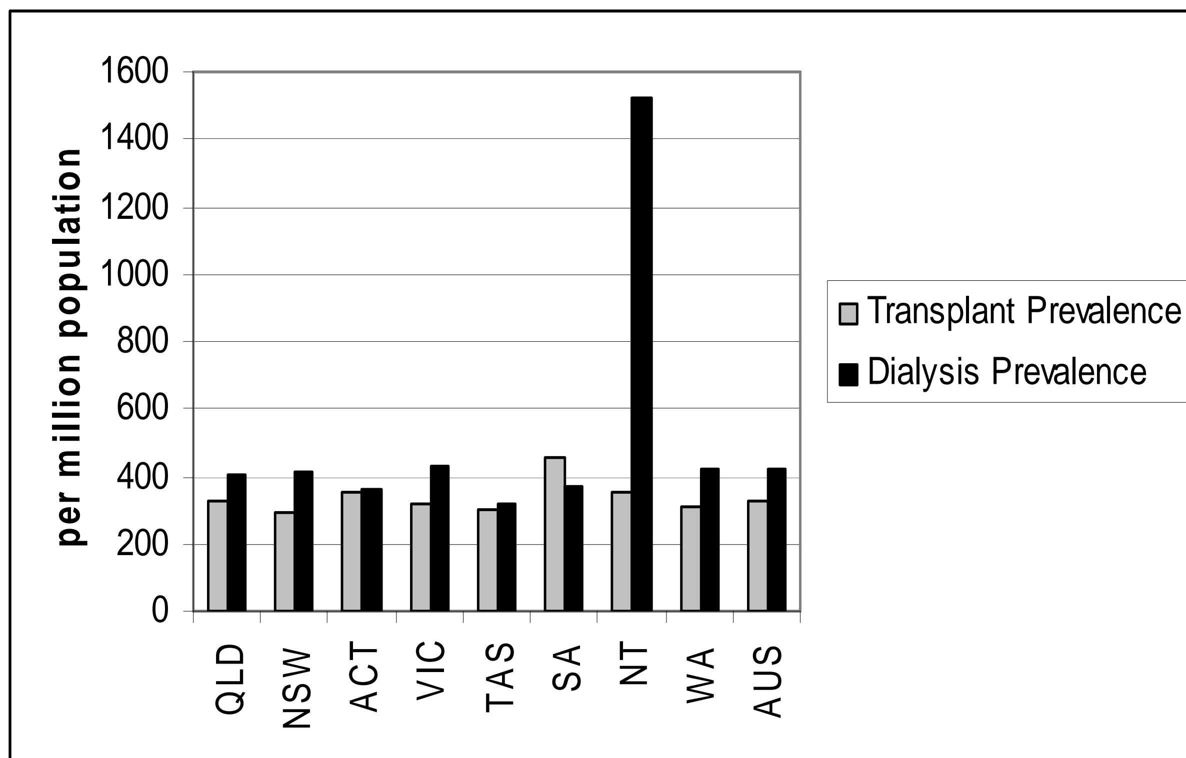
32 Ibid.

33 Ibid.

End-stage kidney disease treatment prevalence

In 2006, there were 3,045 Queenslanders living with end-stage kidney disease and accessing renal health services.[34] Of these patients 44.5% were living with a functioning transplant and 55.5% were on dialysis.[35] Nationally there were 16,045 end-stage kidney disease patients, 42.8% with functioning transplants and 57.2% using dialysis.[36] South Australia is the only State with a higher proportion of transplant patients than dialysis patients, reflecting its much higher organ donation rate (Figure 3).[37] The Northern Territory has the lowest ratio of transplant to dialysis patients.

Figure 3 Comparison of rates of transplant and dialysis dependent patients (per million population) (2005)



34 Australian and New Zealand Dialysis and Transplant Registry 2006, Summary Report (1 January 2006 - 30 December 2006), ANZDATA Registry, Adelaide.

35 Ibid.

36 Ibid.

37 Ibid.

In 2006, Queensland had a slightly lower dialysis prevalence (417 pmp) than the nation as a whole (446 pmp) and a transplant prevalence equal to the nation as a whole (333 pmp) (Table 5 and Table 6).[38]

Table 5 Dialysis patient numbers and per million population dialysis prevalence for Australian States and Territories (2001-2006)

	2001	2002	2003	2004	2005	2006
Queensland	1,094 (301)	1,204 (324)	1,340 (353)	1,443 (372)	1,592 (402)	1,690 (417)
New South Wales	2,339 (367)	2,434 (378)	2,547 (392)	2,549 (390)	2,705 (412)	3,020 (454)
Australia Capital Territory	159 (310)	178 (345)	187 (360)	184 (351)	191 (361)	199 (385)
Victoria	1,851 (385)	1,932 (398)	1,992 (405)	2,054 (413)	2,161 (430)	2,334 (458)
Tasmania	123 (261)	143 (303)	154 (323)	148 (307)	156 (321)	158 (323)
South Australia	434 (287)	457 (301)	505 (331)	511 (333)	567 (368)	599 (385)
Northern Territory	210 (1062)	233 (1173)	247 (1245)	275 (1376)	308 (1519)	326 (1577)
Western Australia	646 (340)	693 (360)	758 (388)	830 (419)	848 (422)	860 (419)
AUSTRALIA	6,856 (353)	7,274 (370)	7,730 (389)	7,994 (397)	8,528 (420)	9,182 (446)

(per million population at the end of each calendar year)

38 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

Table 6 Transplant patient numbers and per million population transplantation prevalence for Australian States and Territories (2001-2006)

	2001	2002	2003	2004	2005	2006
Queensland	1,128 (311)	1,179 (318)	1,231 (324)	1,271 (327)	1,311 (331)	1,355 (333)
New South Wales	1,602 (251)	1,664 (258)	1,752 (270)	1,835 (281)	1,914 (291)	1,983 (299)
Australian Capital Territory	134(261)	146(283)	162(312)	182(347)	185(349)	191(358)
Victoria	1,329 (277)	1,06(289)	1,439 (293)	1,502 (302)	1,593 (317)	1,687 (331)
Tasmania	112(237)	122(258)	130(272)	141(292)	146(301)	156(319)
South Australia	599(396)	627(413)	653(428)	694(452)	710(460)	743(478)
Northern Territory	66(334)	68(342)	67(338)	73(365)	71(350)	73(353)
Western Australia	515(271)	546(284)	544(279)	575(290)	628(312)	675(329)
AUSTRALIA	5,485 (283)	5,758 (293)	5,978 (301)	6,273 (312)	6,558 (323)	6,863 (333)

(per million population at the end of each calendar year)

In general, transplantation is the best form of renal replacement therapy because it conveys a better quality of life. The ability of Queensland to maintain a high number of end-stage kidney disease patients with functional transplants is dependent on the number of organs available for transplantation. In Queensland and across the country, demand for transplantation continues to surpass organ supply.

Amongst all patients receiving renal replacement therapy, 55.5% of patients in Queensland were on dialysis.[39] The Northern Territory (81.7%), NSW (60.3%), Victoria (58.1%) and Western Australia (56.0%) had a greater proportion of their patients accessing maintenance dialysis.[40] The prevalence of patients in Queensland with a functioning transplant (44.5%) was only lower than South Australia (55.4%), Tasmania (49.7%) and the Australian Capital Territory (ACT) (48.2%).[41] Over the years 2001 to 2006, the Queensland dialysis population grew on average by 9% per annum.[42] This is the second highest growth rate in Australia, exceeded only by the Northern Territory, with the national average being approximately 6%.[43] Since 2001, the number of patients on dialysis in Queensland has increased by 54.5%, substantially higher than national growth at 33.1% and just behind the highest growth in the Northern Territory (55.2%).[44]

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39 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

40 Ibid.

41 Ibid.

42 Australian and New Zealand Dialysis and Transplant Registry 2006, The 20th - 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

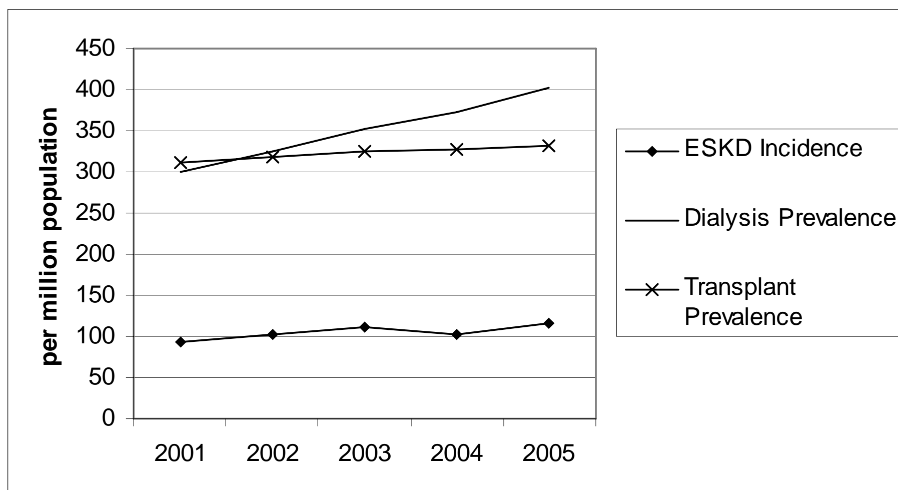
43 Ibid.

44 Ibid.

Between the years 2001-2005, the number of Queenslanders living with a functioning transplant grew by less than 4% per annum on average, lower than the national experience at 4.5% per annum.[45] Only the Northern Territory reported a lower growth rate in transplantation. From 2001 to 2006, the number of patients with functioning transplants in Queensland increased by 20.1%, less than the national increase of 25.1%.[46]

The growth in transplantation has not kept pace with the number of new patients requiring renal replacement therapy resulting in increased demands on dialysis services (Figure 4). This trend is consistent throughout Australia.

Figure 4 Comparison of end-stage kidney disease incidence and dialysis and transplantation prevalence in Queensland (per million population) (2001-2005)



45 Ibid.

46 Ibid.

Organ donation and transplant

In Queensland, the number of kidney transplants performed has decreased from 2001 to 2005.[47] During the same period in other jurisdictions, the number of transplants performed has remained stable or increased (Table 7).

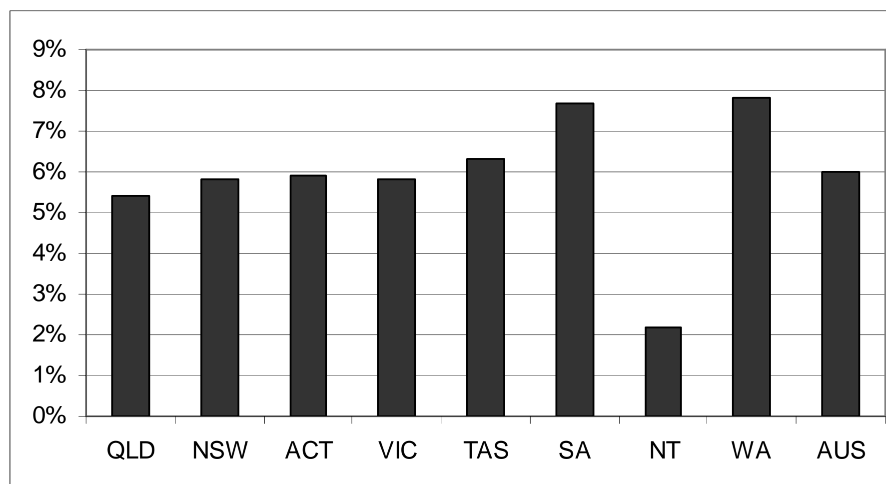
Table 7 Number of transplant operations by Australian Regions (per million population) (2001-2005)

	2001	2002	2003	2004	2005
Queensland	121 (33)	111 (30)	114 (30)	108 (28)	99 (25)
New South Wales/ACT[a]	146 (22)	198 (28)	198 (28)	230 (33)	212 (30)
Victoria/Tasmania[a]	155 (29)	157 (29)	129 (24)	150 (27)	162 (29)
South Australia/NT[a]	69 (40)	77 (45)	66 (38)	98 (57)	68 (39)
Western Australia	50 (26)	61 (32)	36 (18)	63 (32)	82 (41)
AUSTRALIA	541 (28)	604 (31)	543 (27)	649 (32)	623 (31)

[a] Population for these States and Territories were amalgamated.

In 2005, 5.4% of 15 to 59 year old Queensland dialysis patients received a transplant.[48] This was similar to most other States and Territories with the exception of Western Australia (7.8%) and South Australia (7.7%) (Figure 5).[49]

Figure 5 Percentage of dialysing patients receiving a new transplant (2005)



47 Ibid.

48 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

49 Ibid.

The major challenge in kidney transplantation is the shortage of donor organs. Queensland's donation rates have dropped significantly since 2001.[50] At the end of 2005, Queensland had a donation rate of 9 donors pmp (dpmp) compared to the Australian rate of 10 dpmp, South Australia (17 dpmp) and the Northern Territory (20 dpmp).[51] A deficit in the supply of deceased organs compared to demand has stimulated the use of living donations. The majority of living donors are related to the recipients but growth in unrelated donors is occurring.

The use of living donor organs has been steadily increasing throughout Australia. However, the majority (55.6%) of transplants continue to utilise deceased donor organs.[52] In Queensland, the use of live kidney donations has been increasing from 30% in 2001 to 44.4% at the end of 2005.[53] This usage rate is higher than the national proportion (60.5% deceased and 39.5% live) for the same period.[54] Queensland used more live donations in 2005 than any other transplanting State.[55]

In 2005, the proportion of Queensland dialysis patients who were on the transplant waiting list was lower than the national average (9% versus 16%).[56] The majority (72.7%) of these wait-listed patients were waiting for their first transplant. Among the States and Territories, the proportion of patients on dialysis awaiting transplantation ranged from 31% in the ACT to 3% in the Northern Territory.[57] The largest proportion of dialysis patients wait listed for transplantation in Queensland were aged between 15 and 34 years (27.4%).[58] Aboriginal and Torres Strait Islander peoples represent 7.5% of those waiting for a kidney in Queensland and only 2.2% of those living with a functional transplant.[59]

Among Aboriginal and Torres Strait Islander dialysis patients aged 15-59 years in 2005, the transplant rate was 2.4% per annum compared to 13.2% among non-Indigenous patients.[60] Aboriginal and Torres Strait Islander patients continue to experience very low transplantation rates. Reasons for this are complex. However, in view of the organ donation shortage, it seems evident that there are appropriate patients amongst all ethnic groups who are failing to access kidney transplantation.

Renal transplant recipients have benefited from improvements in graft and patient survival over the last decades. First year graft survival using deceased donor kidneys is

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50 Australian and New Zealand Dialysis and Transplant Registry 2006, The 20th - 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

51 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

52 Ibid.

53 Australian and New Zealand Dialysis and Transplant Registry 2006, The 20th - 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

54 Ibid.

55 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

56 Ibid.

57 Ibid.

58 Ibid.

59 Ibid.

60 Ibid.

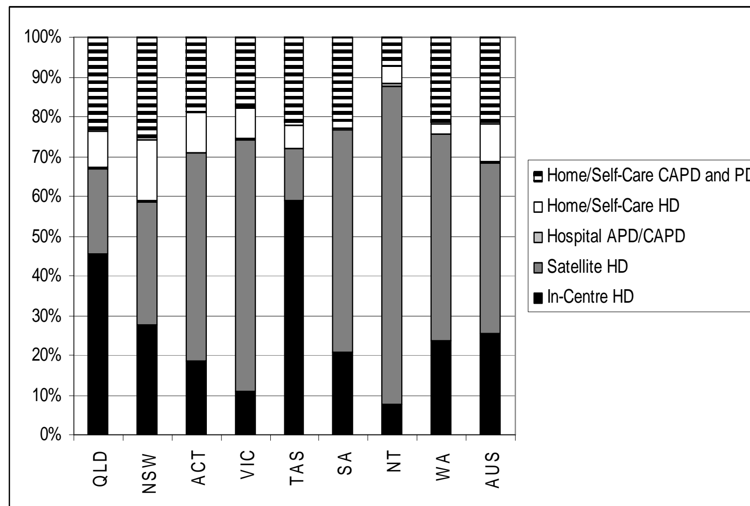
now consistently over 90%.[61] Survival for second and subsequent deceased donations is lower, whereas primary live donor grafts recipients show excellent survival rates. It is also evident that, compared to patients continuing on dialysis, the majority of transplant recipients experience improvements in quality of life.

Aboriginal and Torres Strait Islander transplant recipients experience poorer graft and patient survival rates than non-Indigenous recipients.[62] The small number of Aboriginal and Torres Strait Islander transplant recipients precludes definitive analysis of whether transplantation provides improved survival compared those who remain on the waiting list. Exploration of the key factors which predict transplant outcomes amongst Aboriginal and Torres Strait Islander recipients remains a priority area for research.

Dialysis modality usage

In 2006, the majority of Queensland dialysis patients were treated as inpatients (67.3%).[63] Most of these patients received haemodialysis either in a tertiary in-centre (45.4%) or satellite setting (21.4%).[64] Of the patients accessing inpatient services in Queensland, a significant number appear to be using relatively higher cost in-centre treatments (Figure 6 and Table 8). Only Tasmania surpasses Queensland in the use of in-centre treatment. Queensland has a relatively high proportion of self-care CAPD and APD usage, but a lower proportion of patients using home HD than in New South Wales and the Australian Capital Territory.

Figure 6 Dialysis prevalence by modality type for Australian States and Territories (2006)



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61 Chang, S, Rus, GR, Chadban, SJ, Campbell, SB, & McDonald, SP, 2007, 'Trends in kidney transplantation in Australia and New Zealand (1993-2004)', Transplantation, vol. 84, no. 611-618.

62 McDonald, S 2004, 'Indigenous transplant outcomes in Australia: What the Australian and New Zealand dialysis and transplant registry tells us', Nephrology (Carlton), Supplement 4, pp. 5138-43.

63 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

64 Ibid.

Table 8 Dialysis prevalence by modality type for Australian States and Territories (2006)

	In-Centre HD	Satellite HD	Hospital CAPD and APD	Home/Self-Care HD	Home/Self-Care CAPD and APD
Queensland	45.4%	21.4%	0.5%	8.9%	23.7%
New South Wales	27.7%	30.9%	0.3%	15.5%	25.7%
ACT	18.5%	52.2%	0.00%	10.2%	19.0%
Victoria	11.1%	63.3%	0.1%	7.9%	17.7%
Tasmania	58.9%	13.3%	0.00%	5.7%	22.2%
South Australia	20.9%	55.9%	0.3%	1.8%	21.0%
Northern Territory	7.7%	80.1%	0.6%	4.3%	7.4%
Western Australia	23.6%	52.1%	0.1%	2.4%	21.7%
AUSTRALIA	25.5%	42.9%	0.3%	9.5%	21.8%

Satellite dialysis (21.4%) is under-utilised in Queensland compared to the rest of the country (42.9%).[65] The Northern Territory (80.1%) and States like Victoria (63.3%), South Australia (55.9%) and Western Australia (52.1%) are maximising satellite modalities.[66] In some States, satellites have been removed from hospital campuses and placed in shopping centres and community environments to improve patient access.

Hospital automated peritoneal dialysis (APD) and continuous ambulatory peritoneal dialysis (CAPD) was used by only eight patients in Queensland during 2006. There were 24 patients using this modality nation-wide.[67] Queensland and NSW together represent 66.7% of the activity for this modality nationally.[68]

In Queensland the proportion of patients' utilising home and community-based self-care dialysis options (HD, APD and CAPD) (32.7%) is greater than the Australian average (31.3%).[69] Only NSW achieves a higher uptake of outpatient modalities (41.1%).[70] There is a preference for CAPD as opposed to APD usage in Queensland, 60.8% versus 39.2% respectively among home peritoneal dialysis (PD) therapies. On the whole, self-care PD therapy is relatively high in Queensland, whereas home HD usage is below the national average.

Over the last six years, modality usage patterns in Australia and Queensland have changed in response to emerging technologies, improved treatment regimes and patient

65 Ibid.

66 Ibid.

67 Ibid.

68 Ibid.

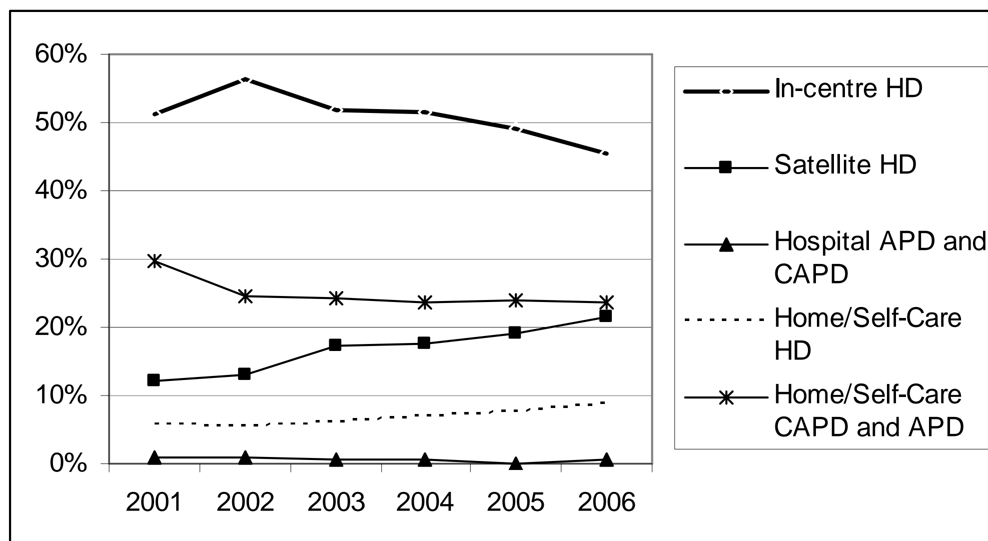
69 Ibid.

70 Ibid.

preferences. Many States and Territories have experienced a growth in satellite services and home modalities, some utilising public-private partnerships. While this growth should help to level out demand for tertiary care, with likely significant cost savings in using a lower cost modality, it has not kept pace with the ever increasing incidence of end-stage kidney disease. In some cases the investment in satellite services has come at the expense of viable self-care modalities.

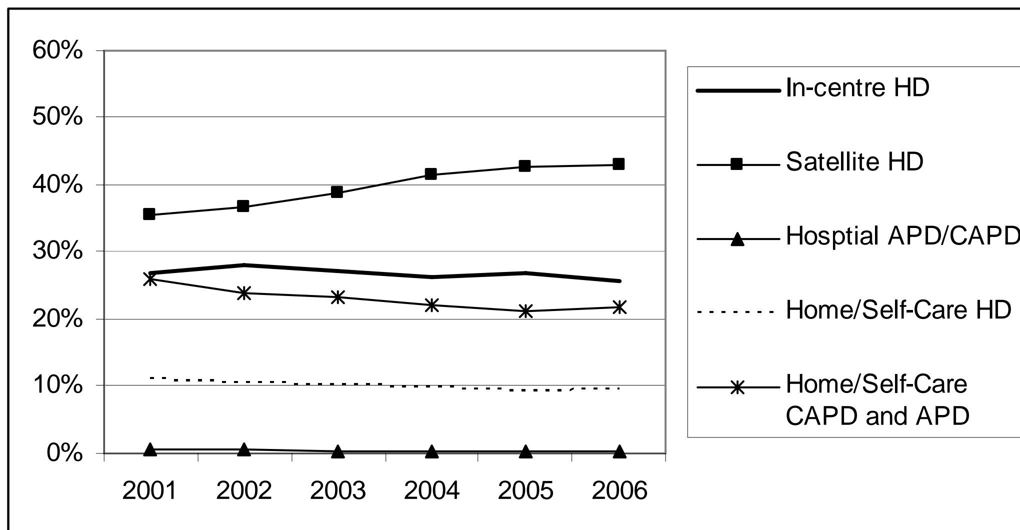
Use of in-centre and satellite haemodialysis services in Queensland is different to that of Australia-wide trends (Figure 7 and Figure 8).[71] The dominant modality across Australia is satellite haemodialysis, whereas in Queensland use of in-centre haemodialysis, although falling in recent years, is significantly greater than other modalities. The spread of dialysis modalities, and incentives and barriers to their use, are crucial issues that have been considered in Objective two in *Part One: The Way Forward* of the *Queensland Statewide Renal Health Services Plan 2008-2017.*

Figure 7 Dialysis modality distributions in Queensland (2001-2006)



71 Australian and New Zealand Dialysis and Transplant Registry 2006, The 20th - 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide.

Figure 8 Dialysis modality distributions in Australia (2001-2006)



The reason behind Queensland's higher proportion of in-centre HD usage may have to do with the presence of private providers, variable clinical capability definitions and/or the role of regional tertiary hubs in delivering care. An assessment of clinical capabilities and patient acuities across the renal health service network could help to inform the reasons behind the dominance of in-centre modalities in Queensland.

Area Health Service patterns

In 2006, 50% of new dialysis patients originated from the Southern Area Health Service followed by the Central (30.9%) and Northern Area Health Services (19.1%).[72] Dialysis activity during 2006 mirrors the distribution of new patients: Southern Area Health Service 49.4%, Central Area Health Service 30.2% and Northern Area Health Service 20.4%.[73]

During 2006, in-centre HD was the most common dialysis modality within the Central (52.0%) and Southern Area Health Services (47.5%) (Figure 9).[74] The Northern Area Health Service had a higher proportion of patients utilising satellite HD services (35.1%).[75] Usage of outpatient modalities appears less common in the Southern Area Health Service with only 31.5% using home HD, APD or CAPD, although this proportion is consistent with national patterns.[76]

72 MacDonald, S, Chang, S & Excell, L (eds), 2006, The 29th Australian and New Zealand Dialysis and Transplant Registry Report, ANZDATA Registry, Adelaide. (Supplementary analysis undertaken to derive Area Health Service distributions)

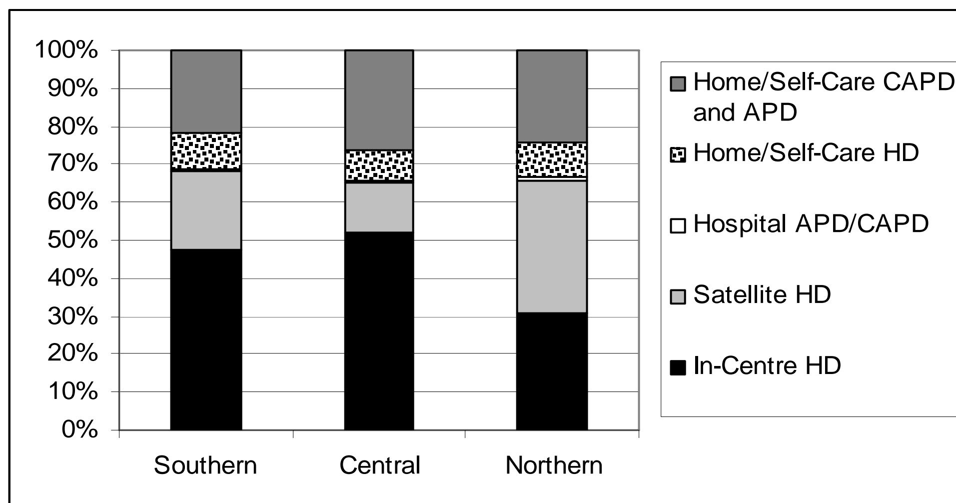
73 Ibid.

74 Ibid.

75 Ibid.

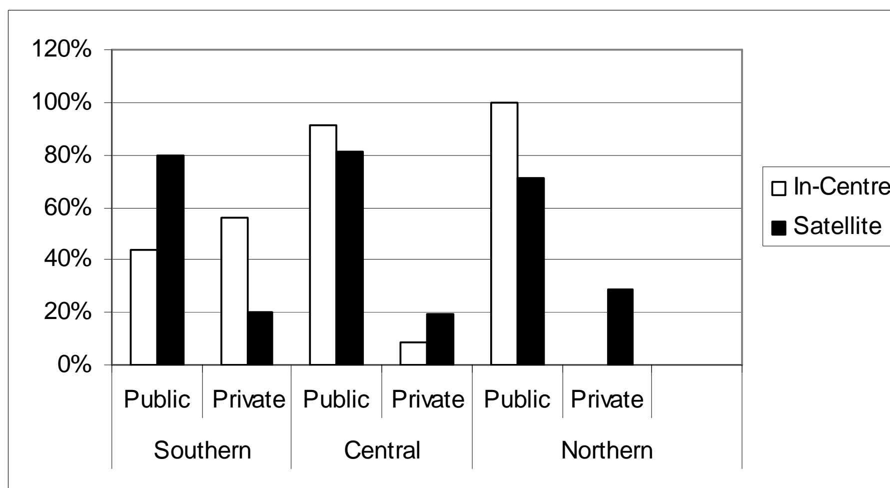
76 Ibid.

Figure 9 Dialysis modality distributions by Queensland Area Health Services (2006)



Eighteen percent of new dialysis patients in Queensland were managed within the private sector and private providers were responsible for 20.1% of dialysis activity in 2006.[77] No information is available on the proportion of these patients covered by private insurance. The highest concentration of private activity (Figure 10) occurred in the Southern Area Health Service (79.1%) with a roughly even split between the Central and Northern Area Health Services (10.6% and 10.3% respectively).[78]

Figure 10 In-centre and satellite dialysis modality distribution by Queensland Area Health Service and provider type (2006)



Private providers in the Southern Area Health Service manage almost a third (32.1%) of dialysis patients in that area.[79] A large proportion of private activity in the Northern Area

77 Ibid.

78 Ibid.

79 Ibid.

Heath Service relates to overseas or holiday visitors requiring dialysis, representing 10.3% of the areas activity.

Predictions of future service demand

The predicted numbers of patients receiving renal replacement therapy in Queensland were obtained in two stages. First, the predicted numbers of incident patients (ie. patients reaching end-stage kidney disease and starting renal replacement therapy) were estimated. Second, the numbers of patients receiving various types of treatment at each year were calculated using the transition probabilities derived from Australia-wide data. The model and assumptions underlying the second step are outlined fully in Part Three of the *Queensland Statewide Renal Health Services Plan 2008-17.*

It is important to realise that predictions of future rates of incident and (treated) end-stage kidney disease are estimates. There are no predictable biological phenomena that determine the rate of increase but rather a combination of factors including changes in the underlying disease incidence, changes in rates of chronic kidney disease progression due to treatment changes, changes in survival from competing mortality risks and alterations in the propensity to treat patients with advanced kidney disease. There is evidence that all of these factors have contributed to the change in rates of treated end-stage kidney disease in Australia over recent years.[80]

The data about Queenslanders receiving treatment for end-stage kidney disease have been derived from the ANZDATA Registry. The population estimates used for calculating historic rates of end-stage kidney disease were Estimated Resident Populations (ERP) for Queensland, inclusive of Indigenous and non-Indigenous populations, for the relevant years. For the years 2007 to 2017, the population projections used were those supplied by the Queensland Health. These differ slightly from the projections released by the Australian Bureau of Statistics (ABS) due to different assumptions about fertility, death rate and migration.

Age-specific incidence rates for the period 1991-2005 were calculated for the whole of Queensland by Indigenous and non-Indigenous groups. Poisson regression was used to examine the trends over the defined period, and these trends were extrapolated to 2017. Predicted rates were critically analysed in comparison with trends observed in other countries and expectations based on clinical assessment of likely changes in future rates. The age- and Indigenous-specific predicted rates were then applied to the predicted future Queensland population, to derive predicted incident renal replacement therapy numbers.

For the prediction of future renal replacement therapy rates, uncertainty about the prediction was illustrated using 95% confidence intervals for the predicted number and derived initially from Poisson regression (or other regression where appropriate). The degree of error in the final predicted numbers will be greater as it will also include an error component related to the particular predicted population numbers. This is

80 Stewart, J, McCredie, MR, Williams, SM & McDonald, SP 2004, 'Interpreting incidence trends for treated end-stage renal disease: Implications for evaluating disease control in Australia', Nephrology, vol. 9, no. 238-246.

especially true for the Indigenous population analysed where there is very substantial uncertainty regarding future population trends.

Historically, there has been a faster rate of growth among Indigenous populations in Australia between censuses than can be explained by birth and death rates. This phenomenon has been attributed to a change in the propensity of people to self-identify as Aboriginal or Torres Strait Islander peoples.[81]

In 2004, the ABS released high- and low-range projections for the Indigenous population based on the 2001 Census for the period to 2009. The ABS recently (15 August 2007) released ERP for Indigenous peoples for Australia and Queensland up to 2006, showing a trend mid-way between the low- and high-range projections.[82] The projections presented here have used a predicted population at a mid-point between low- and high-range projections to 2009, then a linear extrapolation to 2017. While this is likely to be an over-simplification, an in-depth analysis of trends among Indigenous populations to 2017 is beyond the scope of this report. The Indigenous population projections to 2017 should be regarded as very approximate.

Non-Indigenous end-stage kidney disease rate predictions

Rates of end-stage kidney disease in younger age groups appears to be steady over time. However, trends in the older age groups (75-84 and 85 years and older) are less clear (Figures 11 and 12 – red dots show the point estimates of the incidence rates, with the green lines representing ninety-five percent confidence intervals). It was assumed that there will be a continuation of the present trends for the younger age groups (using a Poisson distribution) and a linear trend for the 75+ year age group.

The Poisson model assumes a 'compound interest' situation. For example, if the rate of increase per year is 1.10 (ie. 10%), then the rate will be 1.10, 1.21, 1.33. 1.46, 1.61 in successive years. In contrast, the linear rate assumes an arithmetically steady increase in rate (ie. 1.10, 1.20, 1.30). This is proportionately lower rate of increase in each successive year, and has been chosen for these predictions because of a clinical perception of diminishing rates of increase among the 75+ year age group.

The predicted rate for this 75+ age group by 2017 is approximately the current United States incident rate for that age group. An alternative interpretation (not included in the model) would be that rates in the 75+ age group have stabilised over the past three years. This may be tenable following an inspection of the rates for the 75+ age group for 2002-2005. A similar stable (and erroneous) incidence trend could have been inferred by examining rates for the years 1991-1994 or 1995-1998 when in fact the overall trend for 1991-2005 was a progressive increase in disease incidence.

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81 Stewart, J, McCredie, MR, Williams, SM & McDonald, SP 2004, 'Interpreting incidence trends for treated end-stage renal disease: Implications for evaluating disease control in Australia', Nephrology, vol. 9, no. 238-246.

82 Australian Bureau of Statistics 2007, Population Distribution, Aboriginal and Torres Strait Islander Australians, 2006, Australian Bureau of Statistics, Canberra.

Figure 11 **Observed non-indigenous age-specific treated end-stage kidney disease incidence for Queensland (1991-2005)**

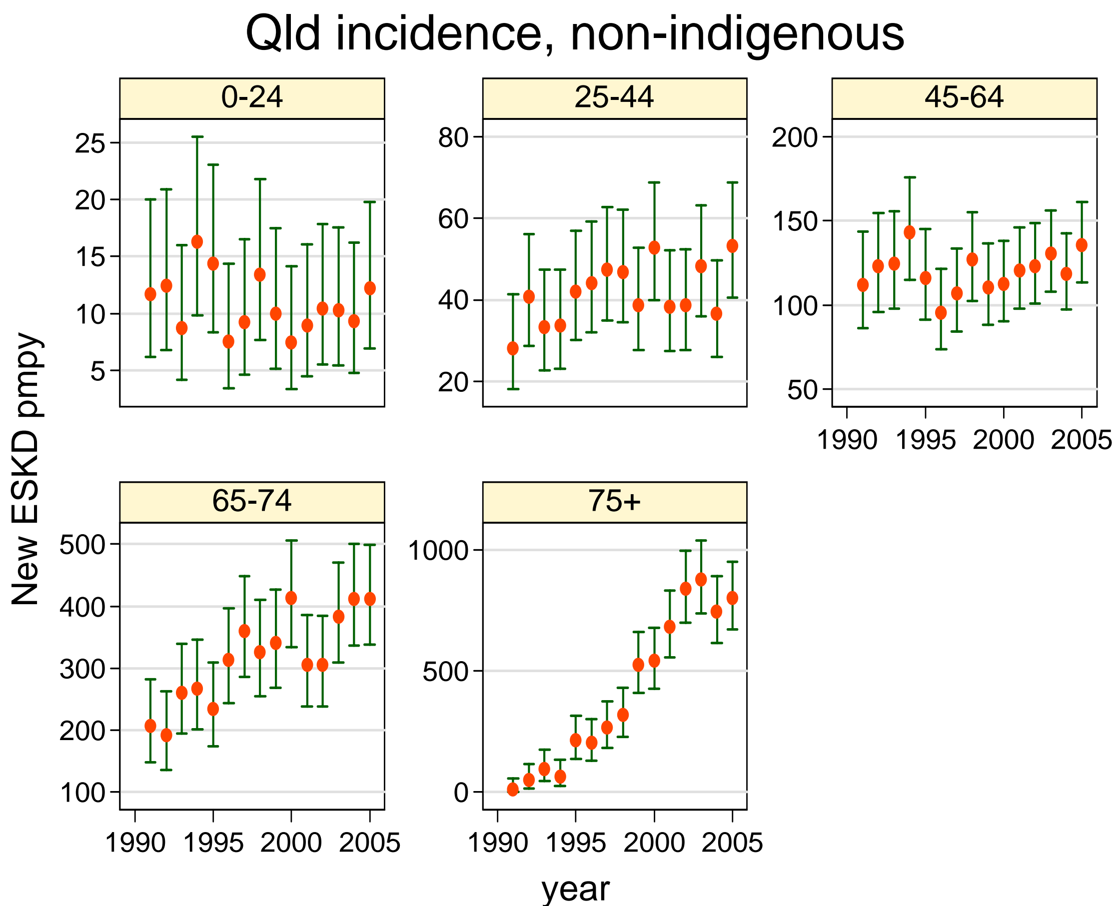
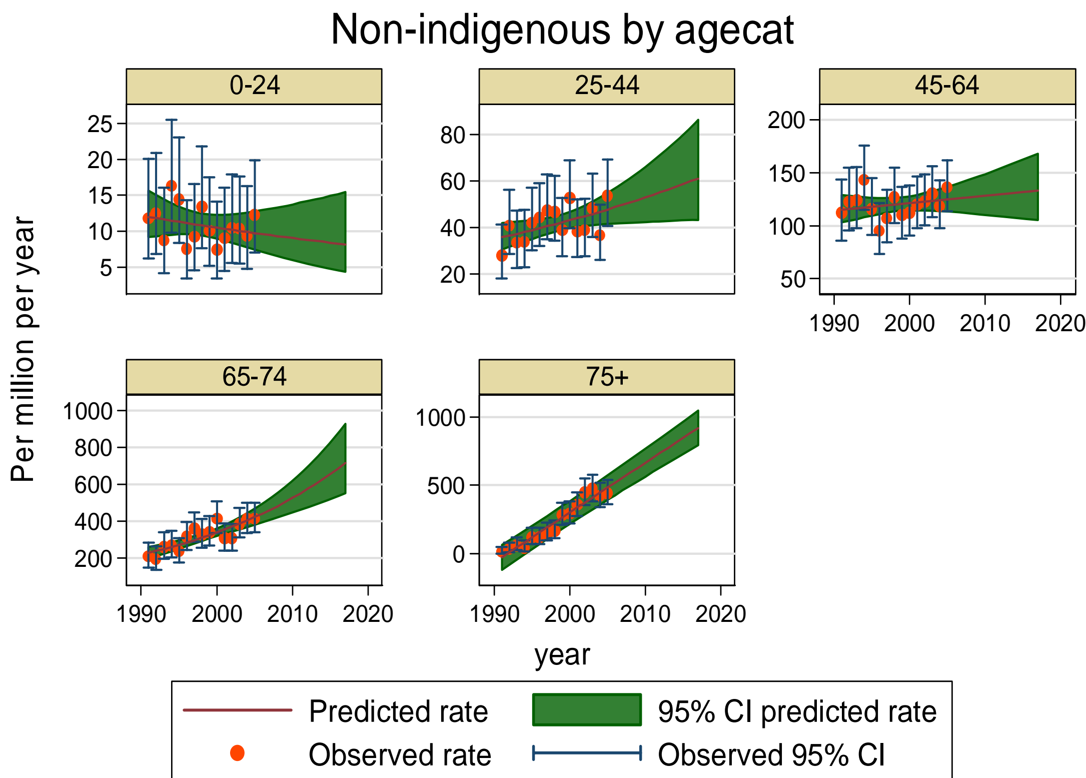


Figure 12 Observed and predicted non-indigenous age-specific treated end-stage kidney disease incidence rates for Queensland (to 2017)[a]



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[a] *Predicted rates are from Poisson regression for all age groups except 75+ year group which is a linear trend. Units are per million per year.*

Aboriginal and Torres Strait Islander peoples end-stage kidney disease rate predictions

There is considerably greater uncertainty surrounding predictions among Aboriginal and Torres Strait Islander peoples. At a statistical level, this arises from the smaller numbers used as a base for extrapolation leading to greater uncertainty about the actual rates. This is encapsulated in the wider confidence intervals around the observed rates (Figures 13, 14 and 15). In addition, the underlying trends are less clear.

Given the uncertainty suggested by inspection of the rates, this analysis has modelled two scenarios - first, a continuation of existing rates (the average of incidence rates for each age group over the period 2002-2005) and second, a linear function of the observed rate over time. Both of these are illustrated graphically in Figures 14 and 15.

Figure 13 Observed Aboriginal and Torres Strait Islander peoples age-specific treated end stage kidney disease incidence for Queensland (1991-2005)

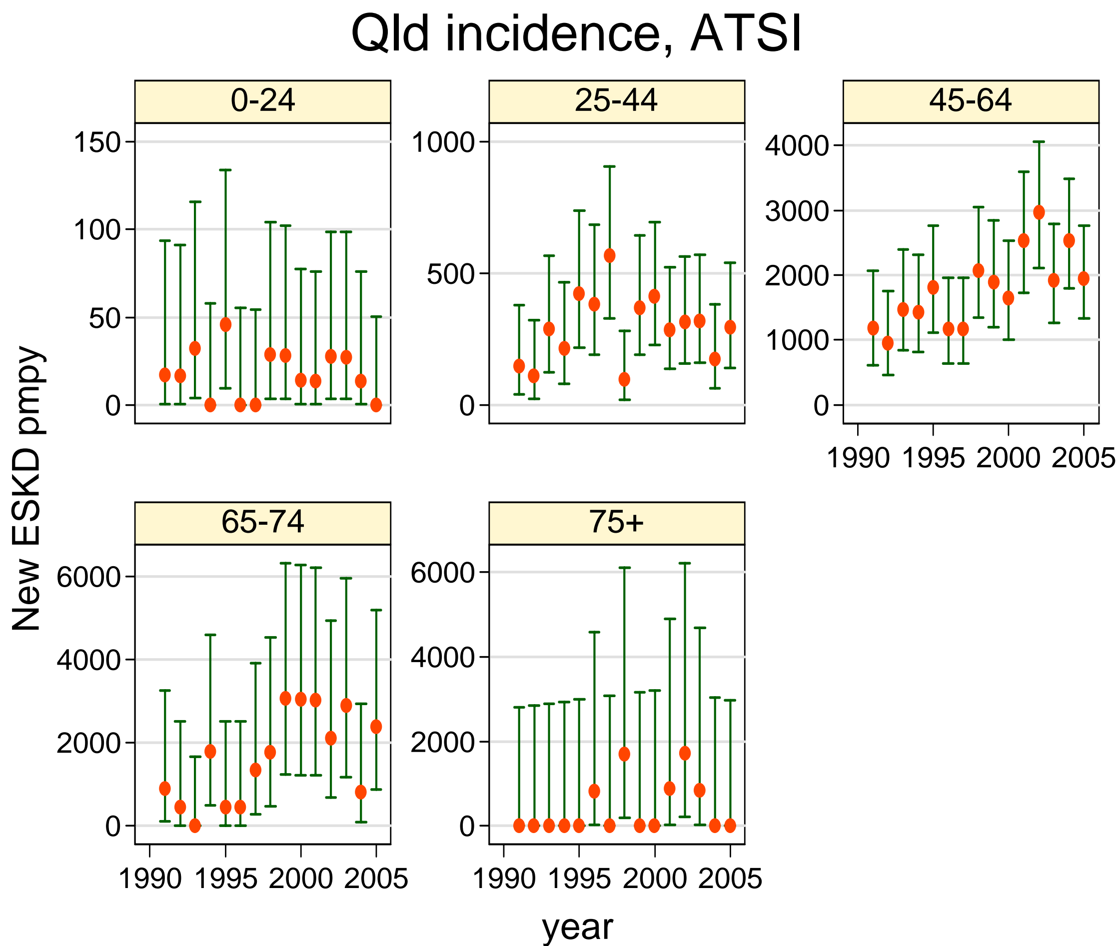
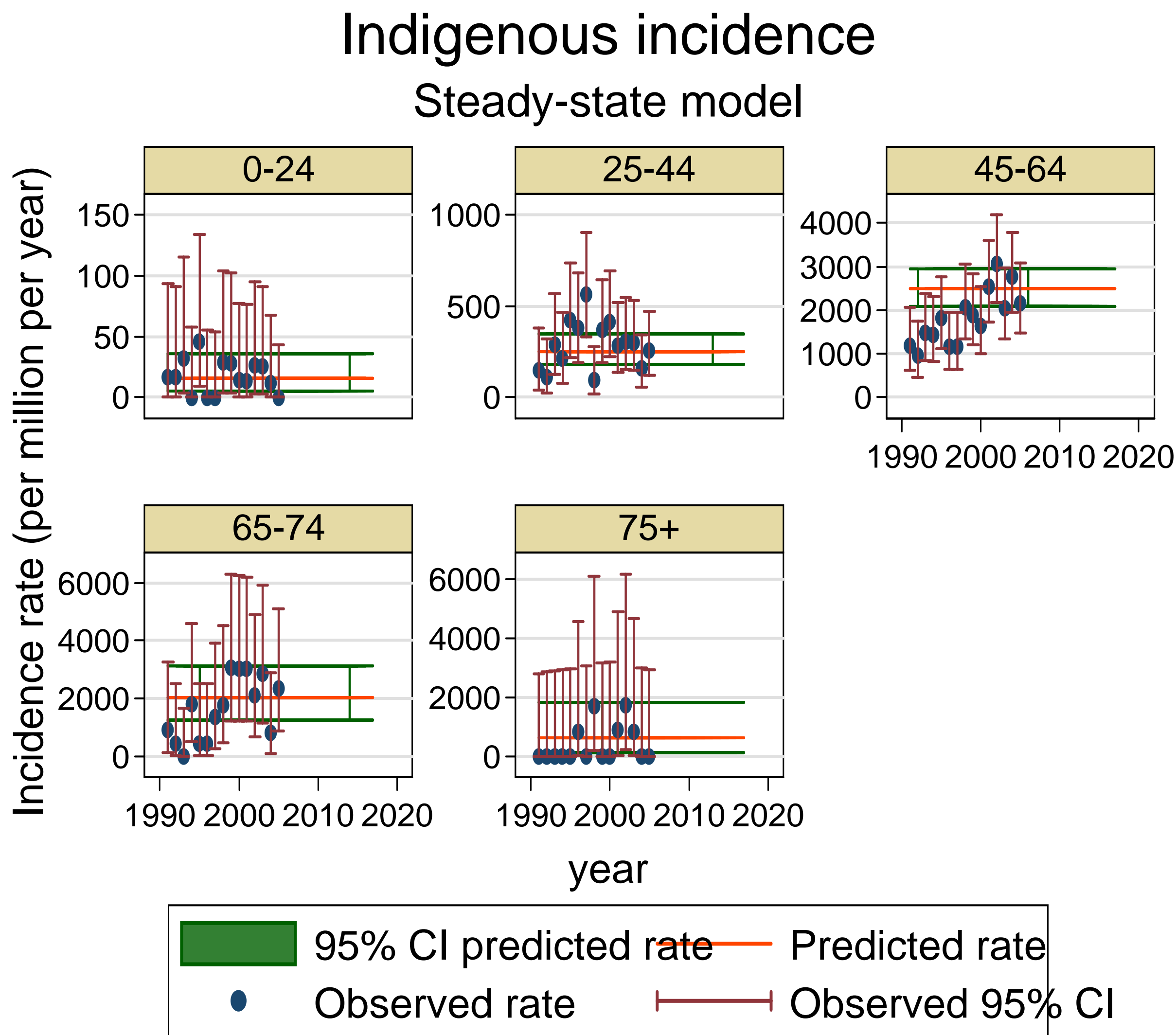


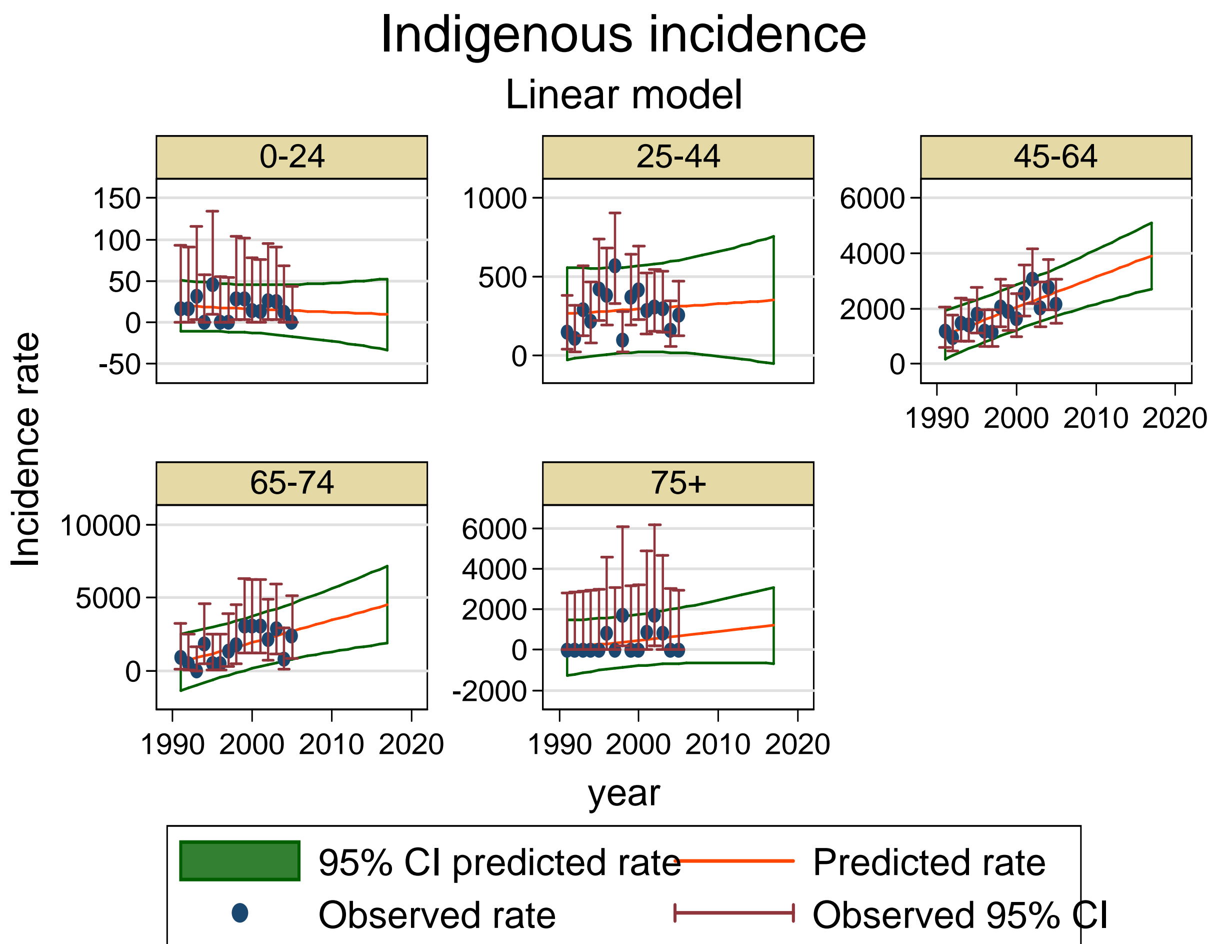
Figure 14 Observed and projected Aboriginal and Torres Strait Islander peoples age-specific treated end stage kidney disease incidence rates using a steady-state scenario for Queensland[a]



Graphs by agecat

[a] *Analysis uses an average of observed rates for 2002-2005 with 95% confidence intervals over the four years of observed rates.*

Figure 15 **Observed and projected Aboriginal and Torres Strait Islander peoples age-specific treated end-stage kidney disease incidence rates using a linear increase scenario for Queensland[a]**

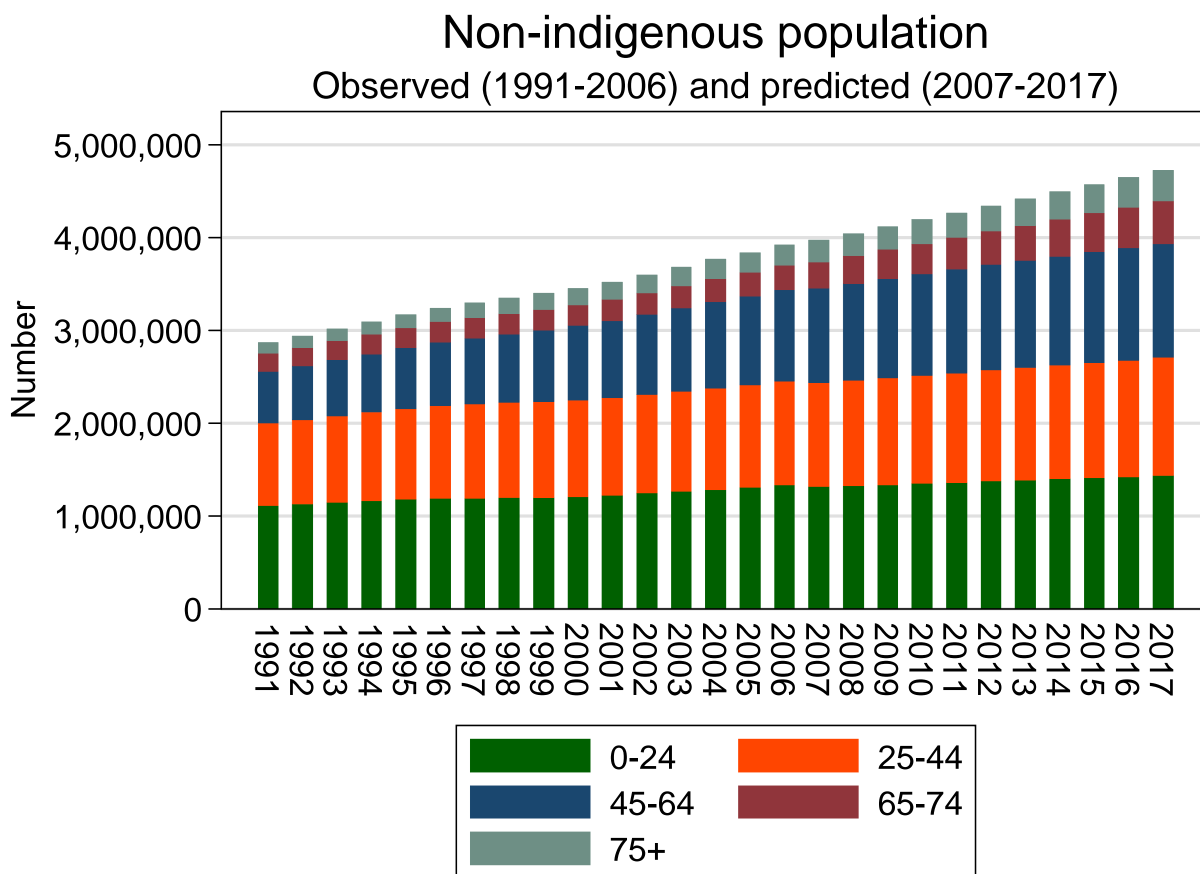


[a] Analysis uses trend from observed rates for 1990-2005 with 95% confidence intervals over the ***15*** *years of observed rates.*
[b] It should be noted that whist the lower range of the confidence intervals in some of the above graphs fall below zero, actual disease incidence cannot be negative.

Predicted numbers of incident patients

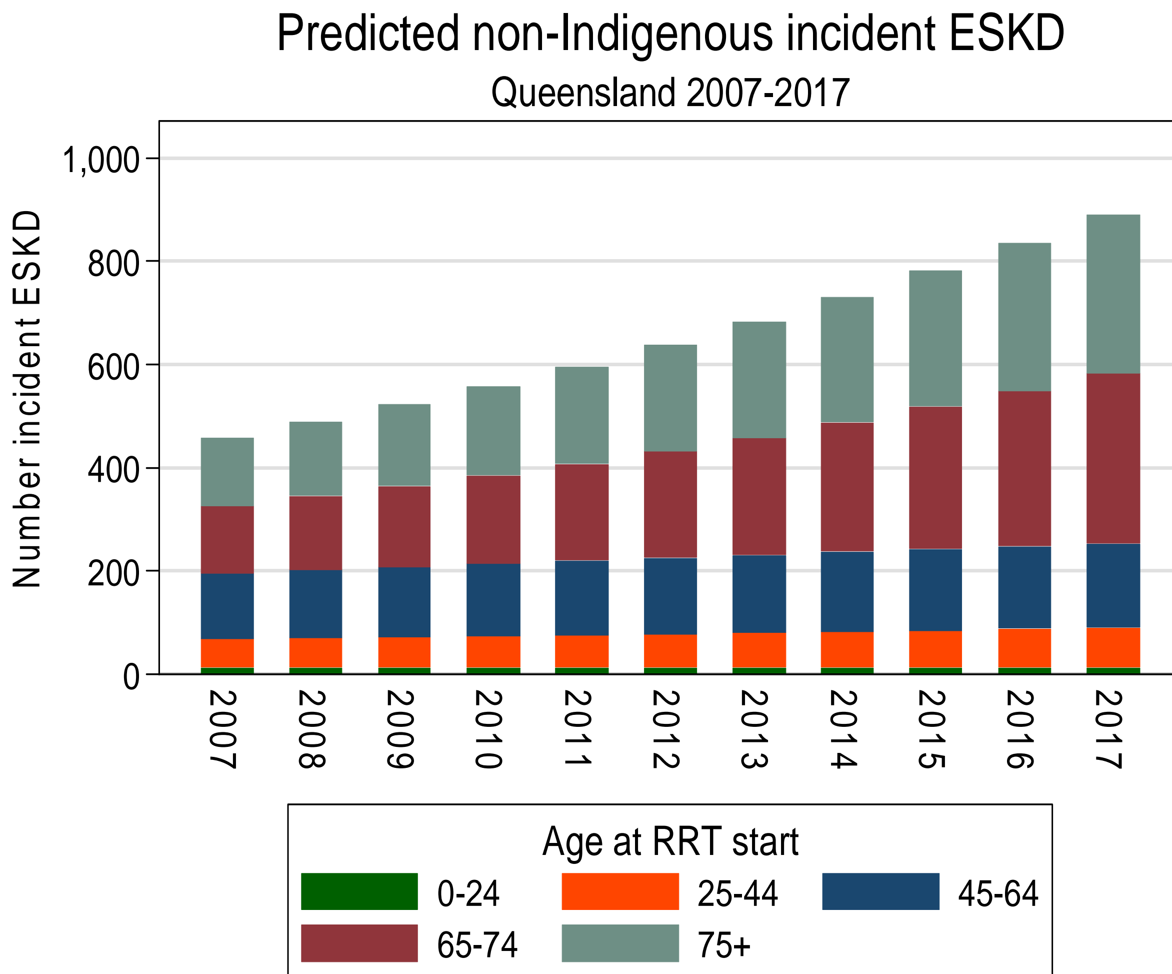
The actual numbers of new patients are a function of the incident rates and the population numbers. For the non-Indigenous population, the predicted populations have been provided by Queensland Health, using assumptions slightly different to those of the ABS. This age distribution is illustrated in Figure 16.

Figure 16 Non-indigenous population for Queensland observed (to 2006) and predicted (to 2017)



Multiplication of the rates by the predicted population numbers gives the information illustrated in Figures 17 and 18.

Figure 17 Predicted incident end stage kidney disease numbers by age group per year for Queensland[a]



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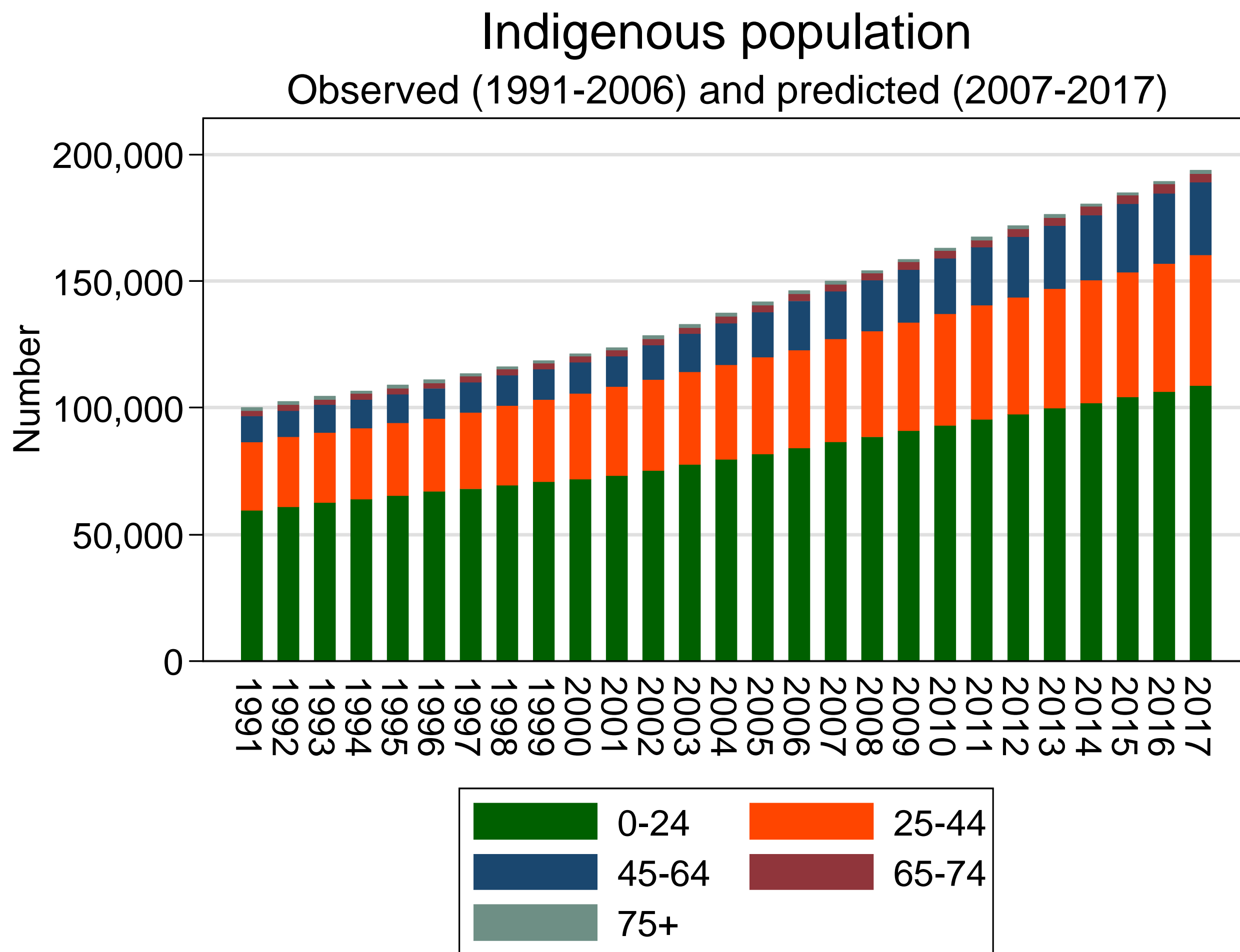
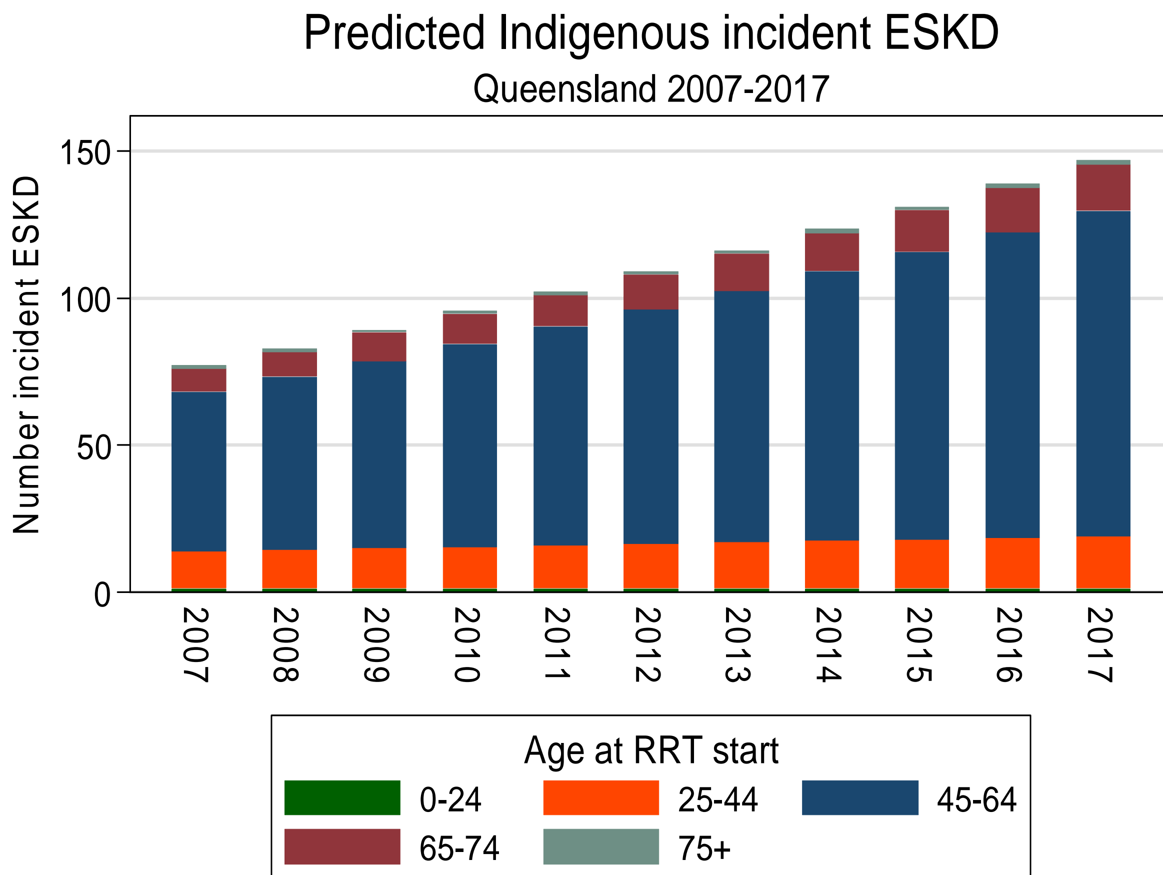
[a] *Note these bars use the mid-point of the predicted rates in Figure 12 and do not illustrate the uncertainty associated with the prediction.*

Figure 18 Aboriginal and Torres Strait Islander population for Queensland observed (to 2006) and predicted (to 2017)



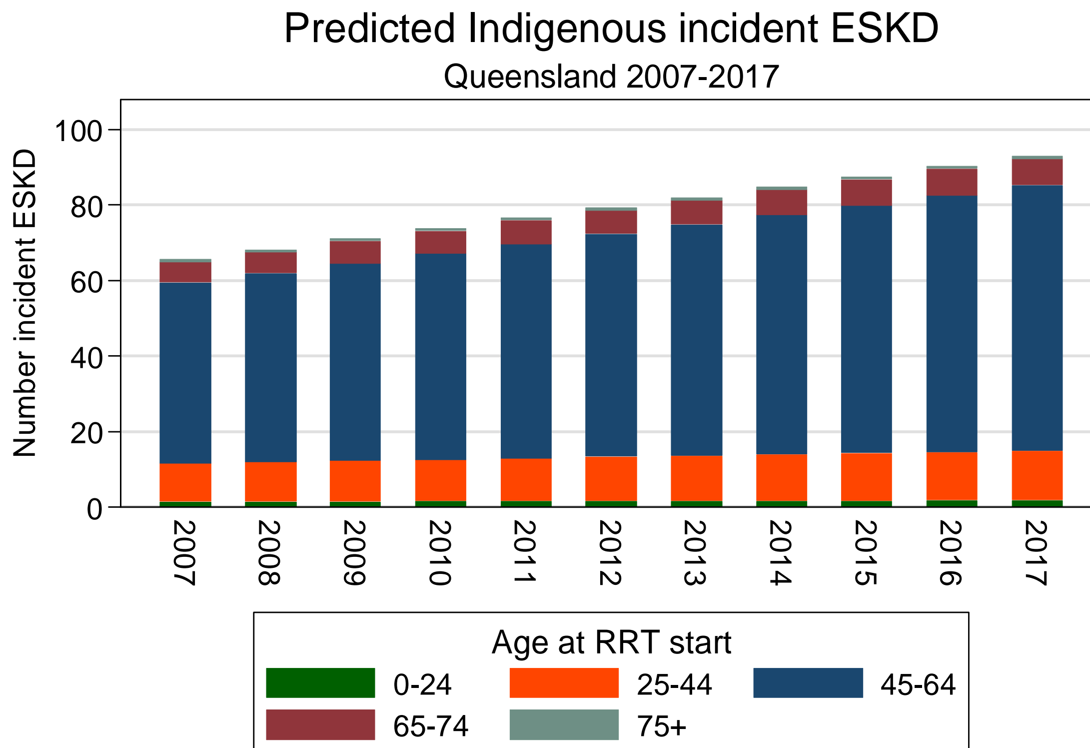
Using the linear growth projections of incident end-stage kidney disease rates and these population projections, the projected numbers are shown in Figure 19. For the steady-state prediction, expected numbers are lower, as illustrated in Figure 20.

Figure 19 Projected incident end-stage kidney disease numbers (linear growth assumption) among Aboriginal and Torres Strait Islander people in Queensland [a]



[a] *The above analysis assumes a linear growth in incident ESKD rates and population growth mid-way between ABS low and high-range estimates, extrapolated to 2017.*

Figure 20 Projected incident end-stage kidney disease numbers (steady state assumption) among Aboriginal and Torres Strait Islander people in Queensland[a]



[a] *Analysis assumes observed Indigenous end-stage kidney disease rates continue at the average of 2002-5 levels, with population growth mid-way between ABS low and high-range estimates, extrapolated to 2017.*

Appendices

Appendix A: Glossary

Access surgery	See Vascular Access
Analgesic nephropathy	Damage within the internal structures of the kidney, caused by long-term use of compound analgesics.
Australian and New Zealand Dialysis and Transplantation Registry	A disease-specific registry, supported by funding from the Australian Government, which collects data from renal units throughout Australia and New Zealand about patients with End-Stage Kidney Disease.
Automated peritoneal dialysis	(APD) A form of peritoneal dialysis treatment where the patient's blood cycles through their peritoneal membrane (abdomen) via a machine overnight. It offers the patient lifestyle advantages, compared with continuous ambulatory peritoneal dialysis.
Cardiovascular disease	Describes a group of diseases that affect the heart and blood vessels, including coronary artery disease (heart attacks), cerebrovascular disease (strokes) and hypertension (high blood pressure). Also referred to as heart disease.
Chronic kidney disease	The slow and progressive deterioration of kidney function.
Community dialysis	Dialysis that is performed in a modified community facility often with the assistance of a carer.
Continuous ambulatory peritoneal dialysis	(CAPD) A form of peritoneal dialysis where the patient manually cleanses their blood through a 'bag system'. This is performed several times a day.
Coronary artery disease	One of a group of diseases that affect the heart and blood vessels - responsible for heart attacks.
Diabetes	A chronic disease in which the body is unable to regulate blood sugar.
Diabetic nephropathy	A complication of diabetes, characterised by high protein levels in the urine, indicating kidney damage.
Dialysis	A treatment for end-stage kidney disease that removes waste products from the blood by filtering the blood through a special membrane. There are two forms of dialysis—haemodialysis and peritoneal dialysis.
Dialysis modalities	Refers to the different types of dialysis treatments (haemodialysis and peritoneal dialysis) that vary depending on location of treatment.
Dominant	Dominant is a health economic term referring to a therapy that is more effective and less expensive than the comparator therapy.
Donor	Someone who provides an organ for transplantation. This person can be living (either related or non-related) or deceased.

End-stage kidney disease	The stage of chronic kidney disease where kidney function has been lost to the extent that death is inevitable unless the patient receives life-saving dialysis or transplantation.
Functioning transplant	Describes those individuals living with a functioning kidney transplant.
Glomerular filtration rate	An indirect estimate of kidney function.
Glomerulonephritis	A painless inflammation of the glomerulus in the kidney that can lead to high blood pressure and progressive loss of kidney function.
Haematuria	The presence of blood in the urine.
Haemodialysis	A treatment where blood is pumped from a patient into an artificial kidney machine (called a dialyser) and back.
Home dialysis	Dialysis performed in a patient's home often with assistance of a carer.
Hub	Hubs are centres within a statewide network renal service. They provide full-time nephrological and specialist nursing staff, and may also support a number of spoke services including outreach clinics.
Hypertension	High blood pressure.
Incremental cost	Incremental cost refers to the change in cost associated with introducing a change to current practice.
Incremental cost effectiveness ratio	The ratio of the change in costs as a result of a clinical intervention (compared to an alternative, such as doing nothing or using best available treatments) to the change in effects of the intervention.
In-centre dialysis	Predominately haemodialysis delivered in a tertiary hospital with the assistance of specialised nurses and on-site nephrologist support. Typically used to support patients with no self-care ability and complex care needs.
Incidence	The number of new cases of a condition occurring within a given population, over a certain period of time.
Indigenous health worker	Indigenous health workers provide primary health care to Aboriginal and Torres Strait Islander individuals, families and communities.
Inpatient	Health services provided to an individual who is admitted (for the day or overnight) to a hospital or health service facility.
Late referral	Those patients who are referred to nephrological care less than three months before commencing renal replacement therapy.
Linear growth	The linear growth model assumes that growth is occurring at absolute increments per year, decade or other unit of time.
Marginal donors	Kidney donations from non heart-beating deceased people or donors with

	sub-optimal kidney function.
Peripheral vascular disease	Disease that affects the peripheral blood vessels, i.e. those furthest from the heart.
Modality	Refers to the different clinical treatments that may be offered, depending on patient circumstances, clinical need, and availability of health services
Nephrologist	A medical doctor who specialises in kidney function and the treatment of kidney diseases.
Nephrology	Study of the function and diseases of the kidney.
Nurse practitioner	A registered nurse educated to function autonomously and collaboratively in an advanced and expanded clinical role. The nurse practitioner role includes assessment and management of clients using nursing knowledge and skills and may include but is not limited to: • the direct referral of clients to other health care professionals • prescribing medications • ordering diagnostic investigations.
Opportunistic screening	Medical testing conducted to detect disease symptoms among high-risk populations or individuals during planned or unplanned interaction with primary care services.
Opportunity costs	What you may forego by choosing one approach rather than another.
Outpatient	A non-admitted health service provided or accessed by an individual at either a hospital or health service facility.
Peritoneal dialysis	A treatment where blood cleansing and waste removal occurs internally, using the body's own peritoneal membrane as a filter.
Polycystic kidney disease	An inherited condition where multiple cysts form on the kidneys, causing them to become enlarged.
Pre-emptive transplant	Kidney transplantation that occurs prior to the commencement of dialysis.
Prevalence	The proportion of a population living with a defined condition at a certain period of time.
Primary health care	General health care focused on the point at which an individual makes their first contact with the health system. Usually delivered by general practitioners, nurses and Indigenous health workers.
Primary renal disease	Attributed cause of end stage kidney disease.
Proteinuria	The presence of protein in the urine.
Quality adjusted life years(QALYs)	Quality adjusted life years (QALYs) are a multidimensional outcome measure used in health economics. This economic index of outcome combines patient survival with an adjustment for the quality of life, where adjustment is based on interval scale from 0 (worst health) to 1 (full health).

Reflux nephropathy	A condition in which the kidneys are damaged by the backward flow of urine into the kidney.
Renal	Of the kidneys. Used interchangeably with the words 'kidney' or 'kidneys'.
Renal replacement therapy (RRT)	Encompasses treatments for end-stage kidney disease including dialysis and kidney transplantation.
Satellite dialysis	Haemodialysis provided in a non-tertiary or secondary hospital or health facility. Patients may have some self-care abilities.
Self-care dialysis	Dialysis that is managed by a patient and their carer following extensive training, and with support from a dialysis centre.
Spoke	Services supported by specialised hubs that may provide satellite dialysis, patient education, self-care training and support.
Steady-state growth	A condition of constant rates of growth.
Telehealth	Health service delivery where the health service provider and the patient are geographically separated using two-way voice and visual communication (such as by satellite, computer or closed-circuit television).
Transplantation	A surgical procedure whereby a healthy organ from a deceased or living donor is implanted to replace the function of a damaged organ.
Vascular access	A necessary surgical procedure that connects an artery and vein in order for dialysis to take place. Access points may be located in the upper or lower arm for haemodialysis, and in the abdomen for peritoneal dialysis.
Vascular disease	Disease of the blood vessels.

Appendix B: Acronyms

ABS	Australian Bureau of Statistics
AusDiab	The Australian Diabetes, Obesity and Lifestyle Study
ANZDATA	Australian and New Zealand Dialysis and Transplantation Registry
CKD	chronic kidney disease
APD	automated peritoneal dialysis
CAPD	continuous ambulatory peritoneal dialysis
dpmp	donors per million population
ERP	Estimated Resident Populations
ESKD	End-stage kidney disease
GRF	glomerular filtration rate
HD	haemodialysis
ICER	incremental cost effectiveness ratio
K/DOQI	Kidney Disease Outcomes Quality Initiative
KHA	Kidney Health Australia
MSAC	Medical Services Advisory Committee
NHCDC	National Health Cost Data Collection
PAH	Princess Alexandra Hospital
PBAC	Pharmaceutical Benefits Advisory Committee
PD	peritoneal dialysis
pmp	per million population
ppt	price per treatment
QALY	quality adjusted life years
QLD	Queensland
RRT	renal replacement therapy
TTO	Time trade-off

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