Transforming lives and saving money

The golden opportunity of kidney transplants and the system changes needed to lift the numbers

NZIER report to Kidney Health NZ

5 November 2021

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Key points

A tsunami of dialysis poses a challenge for the system and for equity

Largely driven by the increasing prevalence of type 2 diabetes but bolstered by the low rate of kidney transplantation, New Zealand is experiencing a growing tsunami of dialysis demand.

According to Ministry of Health data, in 2020/2021, 4,440 New Zealanders used some form of dialysis. If recent trends continue, the number of people using dialysis will increase to around 5,700 by 2031/32 – an increase of over 30 percent in ten years. This growth represents a substantially increased burden for the health system. Dialysis is a costly intervention at approximately $115,712 per year, contributing to $150,878 in total health system costs for dialysis patients in their first year of treatment, compared with $107,361 in our base case for the year of transplantation.

The equity impact of dialysis as the default treatment for end stage kidney disease (ESKD) is particularly concerning: Māori and Pacific New Zealanders represent over 60 percent of dialysis users, with this projected to increase.

The cost of dialysis as the default treatment exceeds the treatment cost

Dialysis offers a low quality of life and an average life expectancy of only six years compared with 15 years and 20 years for deceased and live donor transplantation, respectively. The value of additional quality and length of life from transplantation could be up to $495,808 per person.

Although research to better understand the impact of dialysis and transplantation on employment is much needed, an average New Zealander unable to work due to the difficulty of maintaining employment while using dialysis imposes an additional fiscal cost of $47,026 per year.

New Zealand's performance on renal transplantation lags behind

In 2019, before COVID-19 disruptions, there were 221 transplants in New Zealand, meaning people who needed renal replacement therapy typically have a very low probability of getting the preferred treatment.

New Zealand ranks 16th in the world for its rate of renal transplantation. Countries with similar health systems to which we often compare the New Zealand system have succeeded in significantly lifting their rates of transplantation: The UK, for example, ranks 5th. New Zealand could match the UK rate, but this would require a 23 percent increase in the number of transplants. A realistic approach could involve a five percent year on year increase.

Transplants pay themselves off in the short run, but not necessarily in the first year

In our base case, accounting for all major health system costs, dialysis is more costly than transplantation even in the first year, indicating that transplants may begin generating health system savings in year 1. But our sensitivity analysis indicates savings may not be achieved until year 3. In subsequent years, dialysis patients continue to be heavy health system users while transplant patients commonly enjoy good health and place substantially less demand on health services, even after accounting for graft loss and return to dialysis.

Transplants present a golden opportunity for health system savings and better outcomes

Our sensitivity analysis imposed a high cost on transplantation, but still indicated substantial savings within a few years for the health system and over $350,000 in health system savings over 20 years per transplant.

Opportunities to invest in interventions that offer improved outcomes and cost savings are rare. A total value of health system savings of over half a million dollars per person over 20 years, along with improved quality of life, extended life and the potential of additional fiscal savings should make increasing the rate of renal transplantation a national priority.

But the health system and its funding mechanisms have made increasing transplantation too difficult

Renal services span tier 1 and tier 2 services and have involved many patients accessing services from two or even three DHBs before a transplant is obtained. Where living donors are involved, the complications of coordinating services across DHB boundaries and ensuring donor assessment is prioritised is challenging. DHBs have been weak on regional planning in general.

A key challenge of health budgets has been the difficulty of making major investments that will pay themselves off later. The inability to shift funding “over space and time” has hindered progress on access to transplantation.

At the same time, the leadership and governance of transplant services have been equally fragmented. Ownership of the overall problem of low combined (live and deceased donor) transplantation rates is lacking, and funding has been split into small, ineffective organisations.

A national approach focusing on the full spectrum of renal care is needed

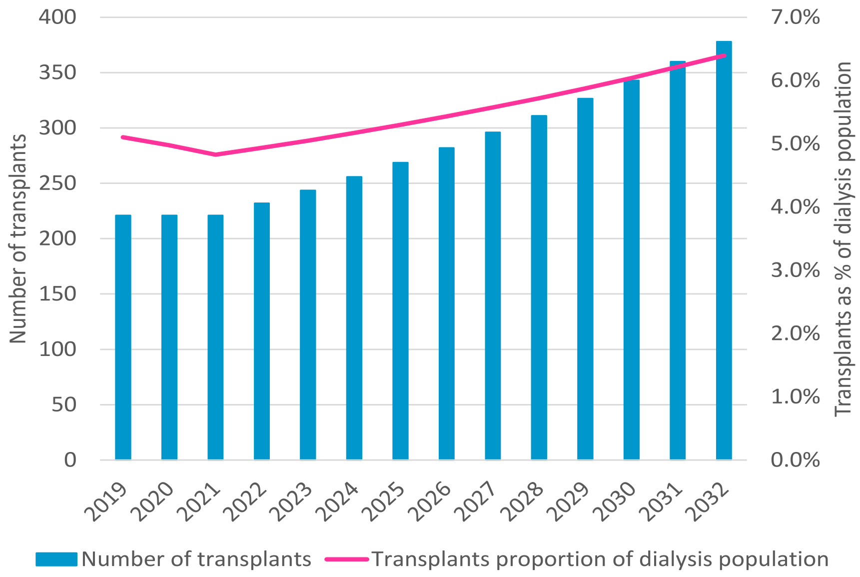
The health and disability system reforms present an opportunity to redesign renal services, funding, and leadership. A focus on lifting the rate of renal transplantation is essential and a single organisation tasked with supporting the sector to achieve this is required. A national view is essential to reduce geographic variation and address equity issues, including lower access to transplantation for Māori and Pacific New Zealanders. They are over 60 percent of dialysis users. Commissioning renal services across the spectrum of care to maximise every patient’s chance of getting a transplant is critical.

We recommend system changes and the establishment of a National Renal Service

Although the DHBs will be rolled up into Health NZ in 2022 and some dimensions of fragmentation will be resolved, regional variation, funding barriers to investment, and fragmented leadership of renal services will continue to hinder progress without the implementation of specific solutions. To ensure all barriers are addressed, we recommend first and foremost:

- A target of increasing the number of renal transplants by five percent year on year to ensure transplantation growth exceeds dialysis growth and increase the probability of getting a transplant from five percent to seven percent by 2031/32 (see Figure 1 below).

Figure 1 Outstripping dialysis growth with 5% per annum target growth in transplants



Source: NZIER IRODaT.org data

- The consolidation of national leadership and governance of renal transplantation with a clear objective of lifting the combined (live and deceased) transplantation rate and ownership of the problem.
- The establishment of a National Renal Service within Health NZ with a planning horizon of 20 years to support the national commissioning of renal services across the spectrum of care.
- The development of Key Performance Indicators (KPIs) across the spectrum of renal services to support tracking of service improvement.
- Allocation of an adequate budget to the National Renal Service to play a strong leadership role in the sector, including supporting critical research, developing a national strategy to increase renal transplantation, supporting increased clinical governance, and increasing the capacity of renal services and key workforce to ensure sustained increased transplantation rates with a target increase of five percent per annum. Our estimates indicate that the value of increasing transplantation by five percent per annum justifies an investment of $4 million to $5.5 million in the first year.

We also describe the required participation of all levels of health sector organisations in enabling the increase in renal transplant rates, including:

- The Ministry of Health to implement effective structures and funding models to support change.
- Health NZ and the Māori Health Authority to align incentives and payment with integrated care models.

- Transplant centres to prioritise value in service planning and delivery.
- Clinical teams to implement improvements and reduce variation.

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1 Background

Chronic kidney disease (CKD) is a general term referring to chronic disorders affecting the kidney's structure and function, resulting in a gradual loss of kidney function. The two main causes of CKD are diabetes and high blood pressure. Complications from CKD can include anaemia, bone disease, heart disease, and other health issues. But most people with mild or moderate CKD have no symptoms at all.

In addition to diabetes and hypertension, risk factors for CKD include high BMI, cardiovascular disease, Māori, Pacific or Indo Asian ethnicity, older age, and several others.

The focus of treatment for CKD is to slow the progression of kidney damage, often by controlling the cause. But in some cases, even controlling the cause may not prevent the progression of CKD, which can ultimately progress to end-stage kidney disease (ESKD), which is fatal without some form of renal replacement therapy (RRT).

1.1 Renal replacement therapy

There are two broad types of renal replacement therapy (RRT) for patients with end-stage renal failure: kidney transplantation or dialysis. Without one of these two options, people with end-stage renal failure will die in the short term.

Not all patients will be medically suitable for a transplant, so for these people, the choice is between dialysis and palliative care.

1.2 Dialysis

There are 3 broad types of dialysis in New Zealand:

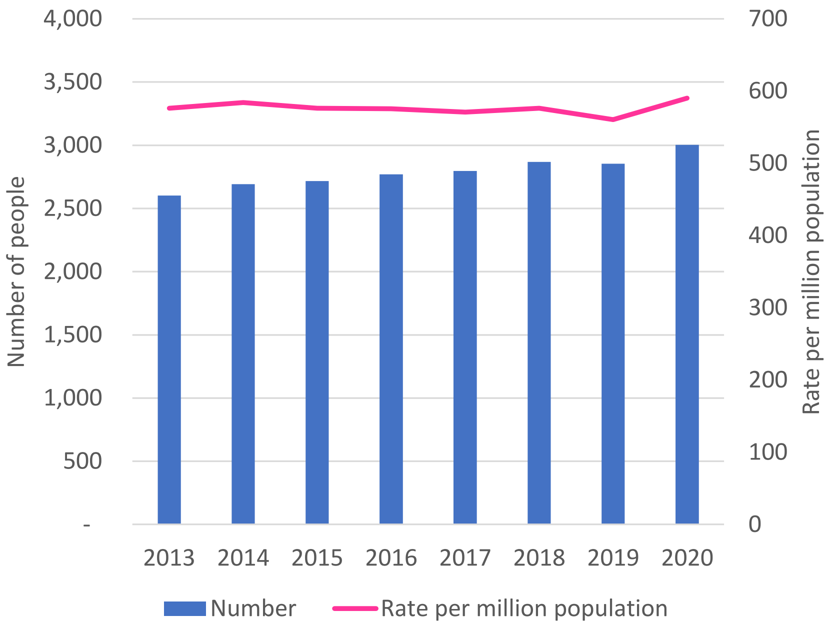
- In centre haemodialysis (including in a hospital context or in a satellite unit)
- Home haemodialysis
- Peritoneal dialysis.

Dialysis does not provide for a long and healthy life: Although some people live for 20 years on dialysis, a US study found that the average life expectancy on dialysis for a 55-year-old man is 5 years, compared with 26 years on average for all 55-year-old men. In New Zealand, life expectancy for dialysis patients is believed to be around 6 years on average.

According to the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA) (2021), there were 3,004 people on some form of dialysis as of 31 December 2020, representing a rate of 590 per million population – the highest this has been since 2013 (see Figure 2 below).

Figure 2 Prevalent number of people on dialysis and rate per million population

2013 - 2020



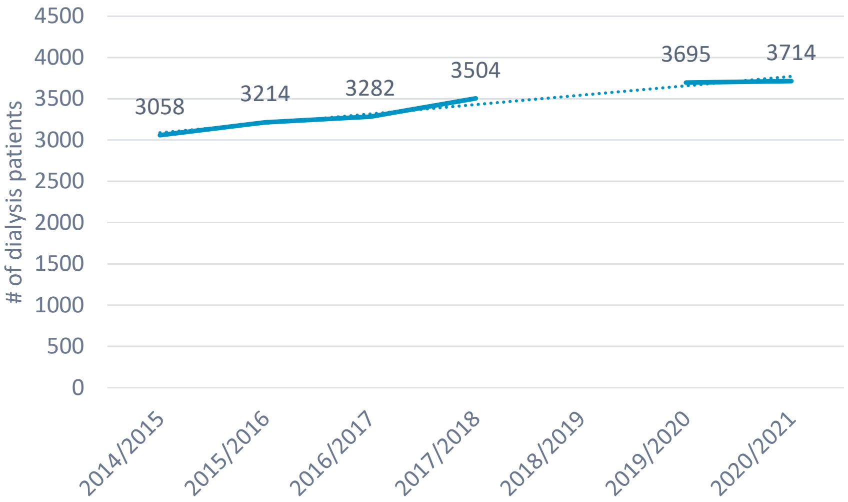
Source: NZIER, ANZDATA

Ministry of Health data is broadly consistent with this, indicating that 3,020 people received some form of dialysis at some point in the 2020 calendar year.

By financial year, the Ministry of Health's National Non-Admitted Patient Collection (NNPAC – the national dataset that describes the use of outpatient services including all forms of dialysis) indicates that there has been over 21 percent growth in the number of people using dialysis since 2014/15 – from 3,058 people in 2014/15 to 3,714 people in 2020/2021 (see Figure 3 below).

Figure 3 Total population using some form of dialysis in each financial year[1]

(2014/15 to 2020/21)



1 Data for Counties Manukau DHB for 2018/19 was incomplete. Because Counties Manukau serves a large percentage of the dialysis population, the incompleteness of the data had a significant impact on national data for 2018/19. As a result, our analysis omits data for 2018/19.

Source: NZIER, NNPAC data

1.3 Kidney transplants are known to offer better value

Kidney transplants are the preferred treatment worldwide for kidney failure. Transplantation offers better patient survival, results in lower costs, and provides superior quality of life (Wolfe et al. 1999 and Tonelli et al. 2011).

Based on a systematic review of 110 eligible studies with a total of 1 922 300 participants (Tonelli et al. 2011):

- Significantly lower mortality is associated with transplantation, and the relative magnitude of this benefit appears to have increased over time.
- The risk of cardiovascular events is significantly reduced among transplant recipients.
- Quality of life is substantially better among transplant recipients.
- The effects and the relative benefits of transplantation are increasing over time despite the increasing age and comorbidity of transplant recipients.
- Inadequate patient referrals, numbers of transplant professionals, and donors are stalling the worldwide need for kidney transplants.

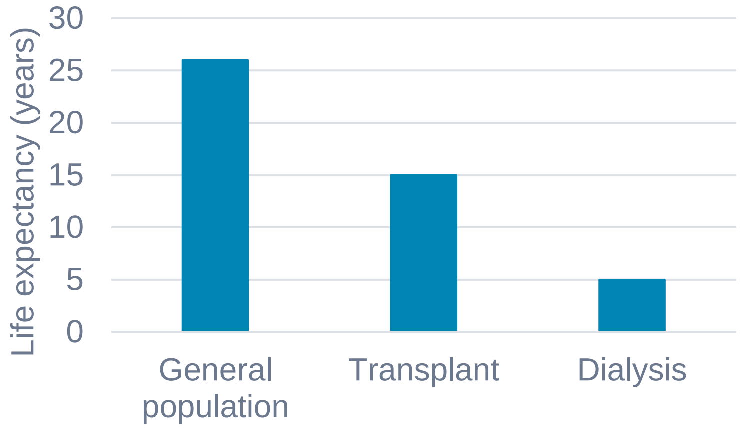
Post-transplant survival has increased dramatically over the last 25 years: Poggio et al. (2021) found that in the US the:

- Median survival for people who received deceased donor transplants increased from 8.2 years in 1995–1999 to an estimated 11.7 years in 2014–2017.
- Median survival for people who received living donor transplants increased from 12.1 years in 1995–1999 to an estimated 19.2 years for transplants in 2014–2017.

Poggio et al. (2021) also found more notable improvement in the survival rates among higher-risk subgroups, suggesting that improvements in transplantation outcomes are narrowing the gap for disadvantaged groups.

Of course, survival depends on many factors, with younger patients facing a lower underlying risk of mortality. Stokes (2011) reports that a 55-year-old man with a kidney transplant has an average life expectancy of 15 years, 10 years longer than if he had been on dialysis (see Figure 4 below).

Figure 4 Life expectancy of a 55-year-old male



Source: NZIER, based on Stokes (2011)

Roake and Morton (2018) argue that the benefits of live donor kidney transplantation are substantial not only for the recipient but for society and potentially also the donor:

- Recipients of live donor transplantation live longer and are healthier than recipients of deceased donor transplantation.
- Recipients of live donor transplantation obtain transplants earlier, meaning the total RRT cost is usually lower due to a reduced duration of dialysis, even no dialysis due to higher rates of pre-emptive transplantation when there is a live donor.
- Society benefits not only because transplantation is cheaper than dialysis but because every live donor transplant potentially frees up a deceased donor kidney for a recipient who has no realistic chance of finding a living donor.
- Donors report that donation enriches their lives and improves their self-esteem.

Of course, Roake and Morton fail to mention that in most cases, because donors and recipients tend to be closely related or have an important pre-established relationship, donors are also securing more years lived with the loved one who receives the kidney. This value is, no doubt, particularly significant and likely to be the primary motivator for the donation and the primary reason for not donating to someone else who needs a kidney when the donor is found to be a poor match for the intended recipient.

Other benefits of transplantation include:

- freedom of choice of food and beverages
- living a more normal lifestyle, including having the freedom to travel

- improved fertility (many people have successful pregnancies and healthy children after a transplant).

  (Kidney Health New Zealand, n.d.)

Disadvantages of transplantation include:

- the risks and inconvenience of surgery
- the need to take medicines daily for life to prevent loss of the kidney and the side effects of medicines, including weight gain, hirsutism, acne, infection risk, increased cancer risk
- the potential for a failed transplant (e.g. rejection) and a return to dialysis or the waitlist
- the need to relocate for a period of time to obtain the transplant and related care from another DHB (although dialysis who prefer or require home dialysis also often need to relocated for training, resulting in significant private costs).

1.4 New Zealand's transplantation rate is low by international standards

Compared with many other countries, including those with which we like to compare our health system performance, New Zealand has a relatively low rate of renal transplantation.

The top-performing country in the world, Spain, achieved a peak rate of 73.77 per million population (pmp) in 2019 (see Table 1 below). That year, New Zealand ranked 16th in the world – below Spain and Canada, the UK, France, Finland, the Netherlands, Norway, Denmark, Sweden, and others.

In 2020, New Zealand's rank improved relative to many other countries due to the reduced disruptive effects of the COVID-19 pandemic for New Zealand, but this should not be seen as a system improvement as long-term rankings are likely to return to pre-COVID levels and New Zealand's rank could even drop as other countries undertake efforts to lift their rates of transplantation. A failure to achieve whatever increase in the rate of transplantation is deemed achievable means that many people who could benefit will never get a transplant and will die earlier as a result. This fact underscores the importance of at least identifying an achievable target for increased transplantation.

Table 1 International renal transplantation rates and ranking based on 2019

Combined live and deceased transplantation, per million population

Country	2019 rank	2015[1]	2016	2017	2018	2019
Spain[1]	1	57.21	64.31	70.16	70.84	73.77
USA	2	56.19	62.56	61.68	69.33	73.76
France	3	62.6	64.77	57.91	54.71	63.05
Netherlands	4	58.2	58.3	57.89	58.1	55.03
UK	5	48.9	50.88	52.95	55.14	54.9
Finland	6	44.47	47.61	43.55	43.11	53.01
Portugal	7	46.6	48.27	51.31	48.93	50.1
Norway	8	48.79	45.82	52.1	45.08	48.17
Czech Republic	9	48.1	43.98	44.47	47.92	48.06
Canada	10	42.38	47.86	48.47	46.11	47.62
Uruguay	11	29.88	35.97	44.82	53.06	47.2
Turkey	12	42.71	47.45	42.44	48.2	47.09
Denmark	13	47.28	44.95	43.56	39.91	46.5
Sweden	14	43.3	43.64	46.91	43.86	46.12
Israel	15	35.5	41.3	42.7	45	45.16
New Zealand	**16**	**32**	**36.7**	**39**	**38.72**	**44.9**
South Korea	17	37.59	43.62	41.77	40.63	44.22
Austria	18	48.7	49.7	48.8	46.9	43.5
Australia	19	39.8	45	44.8	45.41	43.2
Lithuania	20	40	40.4	27.5	30.3	40.4

1 IRODaT does not provide 2015 data for Spain, so 2014 data is used.

Source: NZIER, IRODaT.org and

Internationally, countries tend to have a relative strength in either live or deceased renal transplantation, with few performing equally well at both. This is believed to be linked to lead donation organisations having the capacity to focus on either deceased or live donation, but rarely on both.

To illustrate how rates translate in transplant numbers, we consider the implications of New Zealand matching the transplantation rate of a country whose health system we often make comparisons with: The UK, a country with a similar health system and similar opt-in approach (until recently[1]) and criteria for deceased donors was 5th in the world with a combined renal transplant rate of 54.9 pmp – significantly higher than New Zealand's rate of 44.9. For New Zealand to match the UK's 2019 rate, an additional 50 transplants per year would be needed (see Table 2 below).

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[1] England has now passed a law implementing an "opt out" organ and tissue donation system from 2020.

Table 2 Transplant number increase if NZ matched the UK transplant rate

Ranking in 2019		2015	2016	2017	2018	2019
5	UK	48.9	50.88	52.95	55.14	54.9
16	New Zealand	32	36.7	39	38.72	44.9
	Difference 16th to 5th	16.9	14.18	13.95	16.42	10
	Population NZ in millions	4.609	4.714	4.813	4.9	4.979
	Additional renal transplants for NZ to match the UK rates	78	67	67	80	50

Source: IRODaT.org and NZIER calculation

According to the Australia and New Zealand Dialysis and Transplant Registry (2021) there were 221 transplants provided in New Zealand in 2019. So, an increase of 50 transplants per year to match the 5th ranked country in the world means lifting the overall number of transplants by 23 percent. This may not be achievable in one year, but a phased approach involving an increase in the order of five percent year on year could be a realistic target.

2 Our approach

Our approach first quantifies the problem – the scale of dialysis use in New Zealand and its likely trajectory over the next ten years. Then we describe the solution in terms of increased transplantation by:

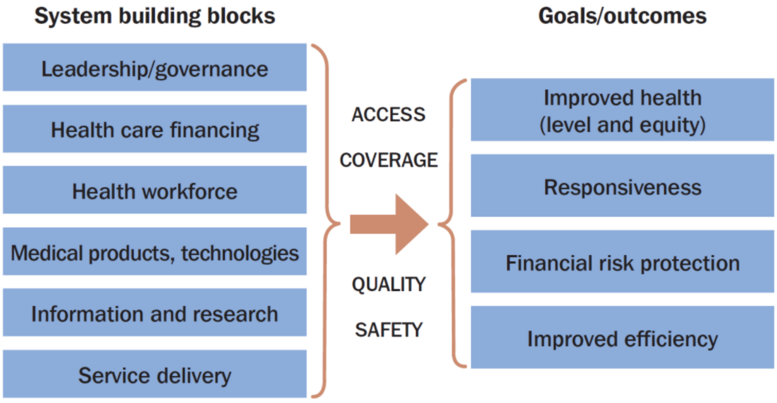
- Assessing the system barriers to increased transplantation
- Quantifying the short term health system costs of dialysis and transplant patients and modelling the long term savings associated with transplantation versus dialysis
- Describing the additional benefits of transplantation in terms of quality of life, employment and income effects, and potential for reduced welfare dependency.

We then identify essential elements for a solution.

2.1 Assessing the system barriers to increased transplantation

To assess the system and identify the barriers to increased renal transplantation, we consider the health system landscape for transplantation against the World Health Organization's six health system building blocks. These support the goals of improved and more equitable health outcomes, better system responsiveness, financial risk protection, and improved efficiency (See Figure 5 below).

Figure 5 World Health Organization's six building blocks of a health system



Source: (World Health Organization 2007)

The World Health Organization's six health system building blocks have been considered as key to improving health outcomes since they were first published in 2007. As well as offering a basis for guiding health system improvement, the framework also provides a foundation for criteria to measure health system performance.

We focus on five of the six building blocks, leaving out medical products and technologies as these are not a major issue for access to transplantation.

2.2 Short term and long-term health system cost implications of transplantation versus dialysis

2.2.1 Analysis of short-term costs

To provide a basis for estimating the cost difference between dialysis and transplantation, we compared patients who had a transplant in 2015/16 with patients who started dialysis in 2015/16. This involved following:

- 760 people who started dialysis in 2015/16 (determined by the NHIs for these individuals not appearing in any dialysis service anywhere in New Zealand in 2014/15)
- 150 people who obtained a transplant in New Zealand in 2015/16 (identified through renal transplant diagnosis-related groups (DRGs) in inpatient data).

The 760 individuals who started dialysis and the 150 individuals who had a renal transplant were tracked over the first year in dialysis or the year of the transplant (2015/16) through to 2020/2021 – six full financial years. We were limited to six years due to the data provided by the Ministry of Health, including only seven years and the first year being used to establish which patients were new to dialysis the following year, to form a true dialysis cohort.

Over six years, we identified and compared:

- The number and rate of emergency department presentations
- The number and rate of outpatient attendances
- The number and rate of acute and arranged admissions
- The number and rate of elective admissions
- The average length of stay in inpatient admissions.

Our cost estimates include the year that dialysis is initiated, or a transplant was obtained and the following five years, taking into account the weighted average annual cost of dialysis, the cost of transplantation (including recipient costs, donor work-up costs, organ retrieval costs)[2] and gross costing of all observed ED visits, outpatient attendances and inpatient stays as well as immunosuppressant drugs for transplant patients. The expected cost also reflects the expected survival of dialysis and transplant patients and the expected graft loss and return to dialysis post-transplantation for transplant patients.

We exclude any costs of dialysis prior to transplantation for the transplant cohort.

2.2.2 Modelling of long-term health system savings associated with transplantation

In addition to comparing service utilisation and cost over the six years of data, we also estimate 20-year costs based on expected survival and a simple assumption that year 6 costs for each surviving member of each cohort continue to be incurred in every year that they remain alive, except transplant patients who survive graft failure and return to dialysis. Those patients are assumed to incur the same costs as dialysis patients.

Because people who have a kidney transplant may survive for 20 years or more (life expectancy is 15 years for a deceased donor transplant and 20 years for a live donor

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[2] We were unable to identify costs for tissue matching for our base case. Our sensitivity analysis is based on a total cost that is supposed to include this cost.

transplant) we model health system costs for 20 years beyond the year of transplantation or initiation of dialysis.

Our long-term cost modelling is based on:

- An assumption that the cost per surviving cohort member in each cohort remain constant from year 6 onwards provided they continue with the same RRT.
- 20-year survival data from ANZDATA (2021)for transplant patients and a published study (Ferreira et al. 2020) for dialysis patients.
- An estimation of the number of transplant patients returning to dialysis based on non-fatal graft failure rates calculated from the difference between total graft loss rates published by ANZDATA (2021) and mortality rates in the transplant cohort.

2.2.3 Data

There are two main sources of data on transplants and dialysis in New Zealand:

- ANZDATA
- National Collections.

We used National Collections for this report and supplemented this where needed with ANZDATA. The reason for this is the need to track patients' health service utilisation across multiple services and across multiple financial years. ANZDATA does not allow this as it contains only data on transplants and dialysis and is reported at an aggregate rather than individual level.

Although ANZDATA should, in theory, agree with National Collections as to the number of people using dialysis and the number of transplants occurring in New Zealand, as DHBs report figures to both ANZDATA and to the Ministry of Health based on their own datasets, one reason for differences may be that data cleaning procedures may differ.

It should also be noted that dialysis figures reported in this report may be different from figures reported by ANZDATA simply because our approach involved counting all people who had used dialysis within a financial year rather than the number using dialysis on a specific date, as ANZDATA reports. Our approach is most appropriate for costing purposes.

While there could be some debate about how accurate the figures are from one source or another, the purpose of this report was to generate broad estimates over a 20-year timeframe and a small margin of error in the underlying data is not expected to have an important impact on overall conclusions.

The basis of the cohort analysis is data provided by the Ministry of Health from two national collections – the National Minimum Dataset (NMDS) and the National Non-admitted Patient Collection (NNPAC) – which were provided with encrypted but linkable NHIs to permit individual patients to be tracked over time across emergency department (ED), inpatient acute and arranged, inpatient elective, and outpatient services (including dialysis).

2.2.4 Costing

Hospital costs are the major cost category for both dialysis and transplant patients, and this is the category of cost for which the most complete and robust data is available from which to estimate costs. Home dialysis is considered a hospital cost for this purpose due to the data on utilisation being recorded in the National Non-Admitted Patient Collection (NNPAC) along with outpatient data and ED data.

Table 3 Costs included in the cohort analysis and 20-year cost model

Cost component	Base case cost	Source	Sensitivity analysis cost	Source
ED visits	$437 per visit	Treasury CBAx values database 2021 (2021/22 value)		
Inpatient admissions	$1,522 per day	Pharmac Cost Manual 2018 (inflated to 2021/22)		
Surgical cost of transplantation (excluding ward costs)	$24,434 per transplant patient	Derived from DRG-related cost provided by the Ministry of Health (subtracting ward costs based on inpatient cost per day as above)	All surgical and inpatient costs for transplant recipient and donor costs for the year of transplantation replaced with a value of $223,279 (compared with total of $74,805 in the base case)	National Renal Advisory Board 2006 value (reportedly based on a personal communication from an individual named as J. Patterson), inflated to 2021/22
Donor work-up and organ retrieval cost	$24,395 per transplant patient	Habbous et al., 2018 (Canadian cost converted to NZD using OECD purchasing power parities and inflated to 2021/22)		
Cost of incomplete donor work-up	$2,446 per transplant patient	Habbous et al., 2018 (Canadian cost converted to NZD using OECD purchasing power parities and inflated to 2021/22)		
Outpatient attendances (excluding dialysis)	$413 per attendance	Treasury CBAx values database 2021 (2021/22 value)		
Dialysis	$115,712 per year	Counties Manukau, (2003/2004 value inflated to 2021/22, weighted average cost reflecting mix of dialysis types)		
Immunosuppressant medication for transplant patients	$8,888 per annum*	Kidney Health NZ Medical Director		

*Calculation of medication costs is described in Appendix A.

Source: NZIER

Health care cost exclusions

Although we take a health system perspective, a number of potentially relevant costs could not be included in our model. These include:

- Primary care
- Other community-based health services
- National Travel Assistance (NTA)
- Other local DHB-funded transportation services

- Additional costs associated with the last year of life.

All of these costs are excluded due to a lack of robust evidence. For the last year of life, although many patients died within the six years of data that we analysed, only 9 patients in the transplant cohort died, providing too small an evidence base for an end-of-life cost comparison. It is likely that last-year-of-life costs per person are not dissimilar between the two groups.

These exclusions are likely to have the following impacts on the cohort comparison:

- Long term costs for the transplant cohort are underestimated due to a higher survival rate: Assuming patients in both cohorts have similar utilisation of primary care, the total cost of primary care over 20 years will be greater for the transplant cohort.
- Short and long-term costs for the dialysis cohort are underestimated due to the exclusion of medication costs for this cohort.
- Short and long-term costs for the dialysis cohort are underestimated due to the exclusion of NTA, which is commonly used by people who must travel long distances to access dialysis services.
- Short and long-term costs for the dialysis cohort are underestimated due to the exclusion of DHB-funded local transportation, which is commonly offered to assist low-income dialysis patients to access dialysis services locally.

Overall, although we estimate that these exclusions are related to more minor cost components than included costs, the exclusions are likely to result in a more substantial underestimation of costs for the dialysis cohort than for the transplant cohort, favouring dialysis in the comparison.

2.2.5 Graft survival

Graft survival is a key concern in renal transplantation, which has a significant impact on both outcomes and costs. Graft survival is the rate at which a transplanted kidney continues to function at a point in time after the transplant. The reverse – graft loss or failure – refers to any instance in which a kidney transplant patient dies or requires long-term dialysis.

From a cost perspective, it is important to distinguish between fatal and non-fatal graft loss: If a transplant patient returns to dialysis after a period of time, then any dialysis-related cost savings will be reduced. ANZDATA provides estimates of graft survival for Australia and New Zealand combined and for both deceased and live donor transplants. Live donor transplants are associated with greater graft survival.

We estimate the number of people in the transplant cohort who return to dialysis as the difference between the number of people who die, and the number of people expected to experience graft loss. The results are shown in Table 4 below based on the cohort of 150 people who received a transplant in 2015/16.

Table 4 Estimation of transplant patients returning to dialysis over 20 years

	Over 6 years	Over 10 years	Over 15 years	Over 20 years
Cumulative deaths (%)	6.0%	17.8%	30.5%	0
Cumulative total graft loss	16.0%	31.5%	48.5%	1
Cumulative non-fatal graft loss	10.0%	13.7%	18.0%	0
Cumulative number returning to dialysis	15	21	27	37
Number returning to dialysis within time period	15	6	6	10
Years in time period	5[1]	4	5	5
Model assumption	3 per year, years 2-6	1.5 per year, years 7-10	1.2 per year, years 11-15	2 per year, years 16-20

`For modelling simplicity, we assume no graft loss in year 1 (the year of transplantation). All graft loss in the first 6 years is modelled as occurring from year 2 to year 6.

Source: NZIER

In total, across the cohort of 150 people who received a kidney transplant in 2015/16, our model estimates 37 would return to dialysis within 20 years.

2.3 Additional benefits of transplantation

To describe the additional benefits of transplantation, we describe the published evidence on quality of life and consider the potential for employment and income effects, potential for reduced welfare dependency. Potential benefits are quantified using a combination of values from published studies and Treasury CBAx values.

3 The growing burden of dialysis

3.1 Future dialysis utilisation

According to NNPAC data, in 2020/2021, there were 4,440 people using dialysis in New Zealand at some point during the year. This represented a 24 percent increase in the number of people using dialysis in 2014/15.

To get a picture of what dialysis utilisation could look like in the future, we projected the population using dialysis to 2031/2032 using three slightly different approaches due to the rate of growth in dialysis patients varying across the seven years of data we obtained from the Ministry of Health.

Each projection method involved identifying the rates of dialysis use within ethnicity-specific 5-year age bands in each DHB for a specified period in the data and then applying those rates to the population projections used by the Ministry of Health to calculate funding under the population-based funding formula:

- Projection A was based on the average 2014/15 to 2016/17 age-ethnicity-DHB group rates.
- Projection B was based on the average 2017/18 to 2020/21 average age-ethnicity-DHB group rates.
- Projection C was based on the 2020/2021 age-ethnicity-DHB group rates.

Similar results were obtained from each projection: All three indicate that the population using dialysis is expected to increase to over 5,700 (5,727 to 5,792) by 2031/32 – a 29 to 30 percent increase in dialysis patients over the next ten years or a 60 to 61 percent increase since 2014/15.

Table 5 Projections of dialysis patients

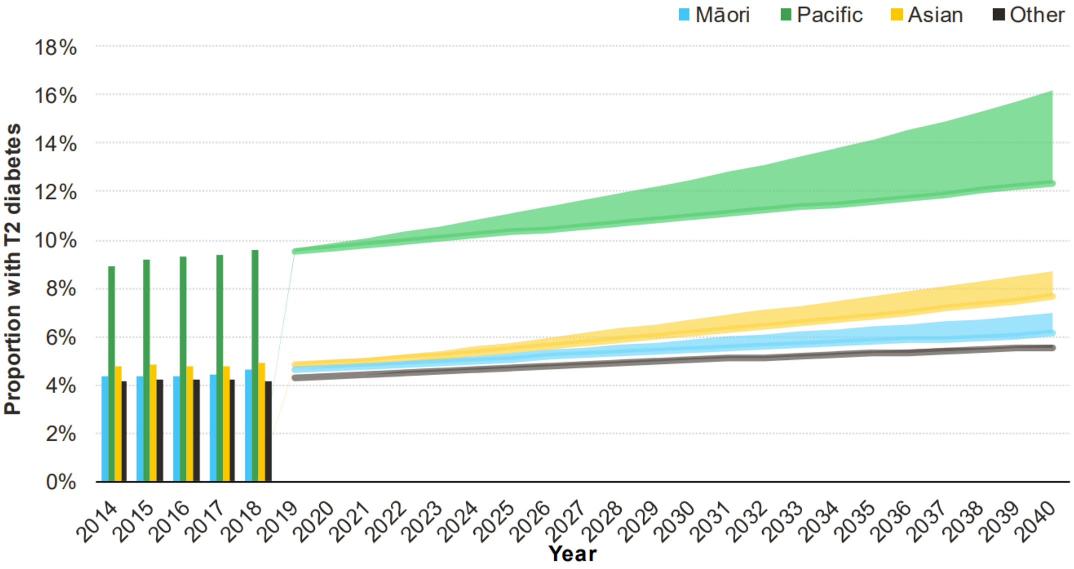
Financial year	Actual dialysis patients (all types)	Projection A	Projection B	Projection C
2014/2015	3,590			
2015/2016	3,758			
2016/2017	3,918			
2017/2018	4,088			
2018/2019	*			
2019/2020	4,331			
2020/2021	4,440			
2021/2022		4,538	4,580	4,558
2022/2023		4,656	4,700	4,675
2023/2024		4,777	4,824	4,799
2024/2025		4,896	4,948	4,923
2025/2026		5,014	5,069	5,043
2026/2027		5,132	5,191	5,164
2027/2028		5,252	5,312	5,284
2028/2029		5,375	5,436	5,405
2029/2030		5,494	5,556	5,524
2030/2031		5,611	5,675	5,640
2031/2032		5,727	5,792	5,754

* Excluded due to incomplete data
Source: NZIER

These increases appear large, but it is important to note that the projection methods implicitly assume that the rates of diabetes and other conditions that contribute to dialysis demand remain constant within each population sub-group. Currently, approximately 58 percent of incident dialysis patients need dialysis due to the complications of Type 2 diabetes.

Any increase in the prevalence of these conditions that are not matched by improvements in treatment will result in an even greater increase in the number of patients using dialysis. A recent report (PwC 2020) estimated that the prevalence rate of Type 2 diabetes has increased in recent years and will continue to increase, particularly for Pacific New Zealanders, so our projected demand for dialysis is likely to be on the conservative end of the spectrum.

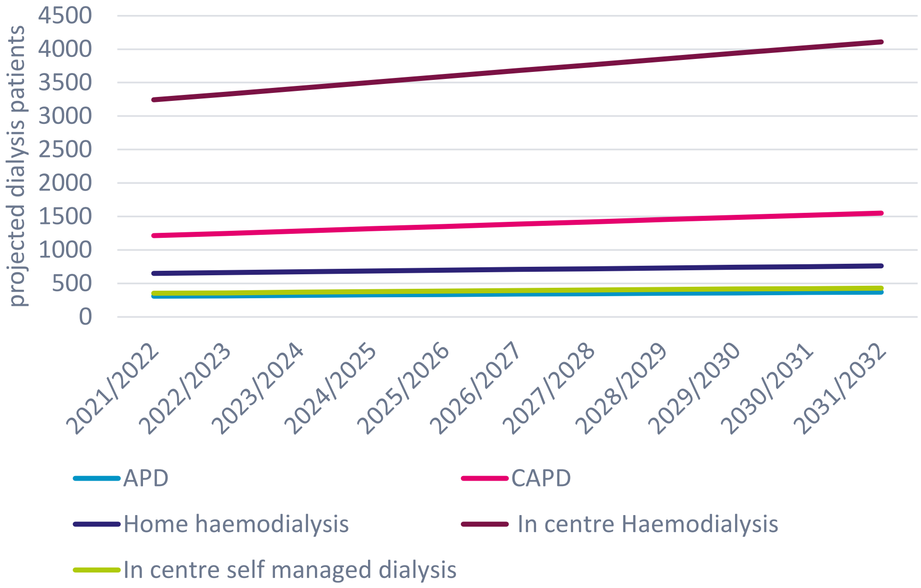
Figure 6 Expected increase in prevalence rate of Type 2 diabetes in New Zealand



Source: PwC (2020)

In terms of the type of dialysis, our projections indicate that in-centre haemodialysis will continue to be used by most dialysis patients (see Figure 7 below).

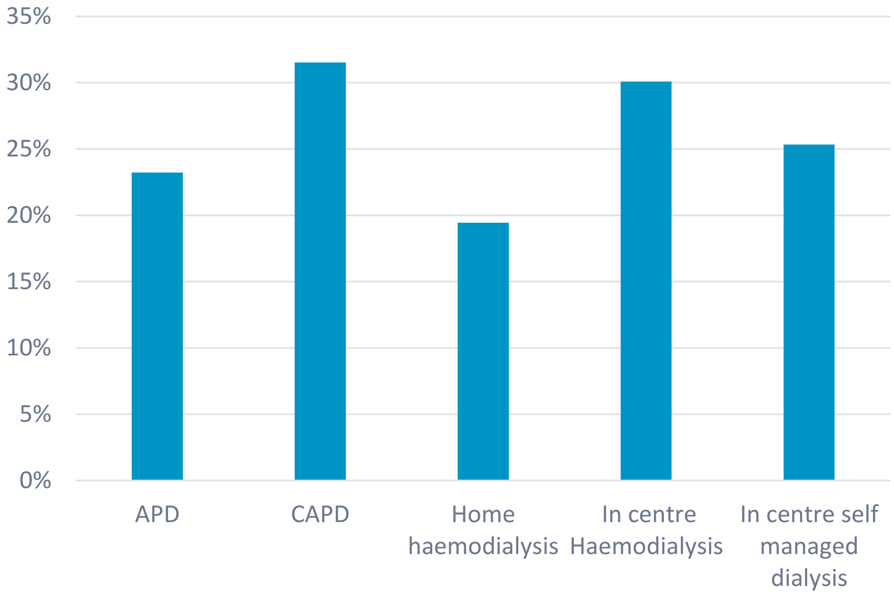
Figure 7 Projections of future dialysis utilisation by type



Source: NZIER

However, the projected growth from 2020/21 to 2031/32 indicates that the greatest growth will be seen in continuous ambulatory peritoneal dialysis (CAPD) and in centre haemodialysis, with growth of 31.5 percent and 30.0 percent, respectively (see Figure 8 below).

Figure 8 Projected growth in dialysis utilisation to 2031/32, by type



Source: NZIER, NNPAC data

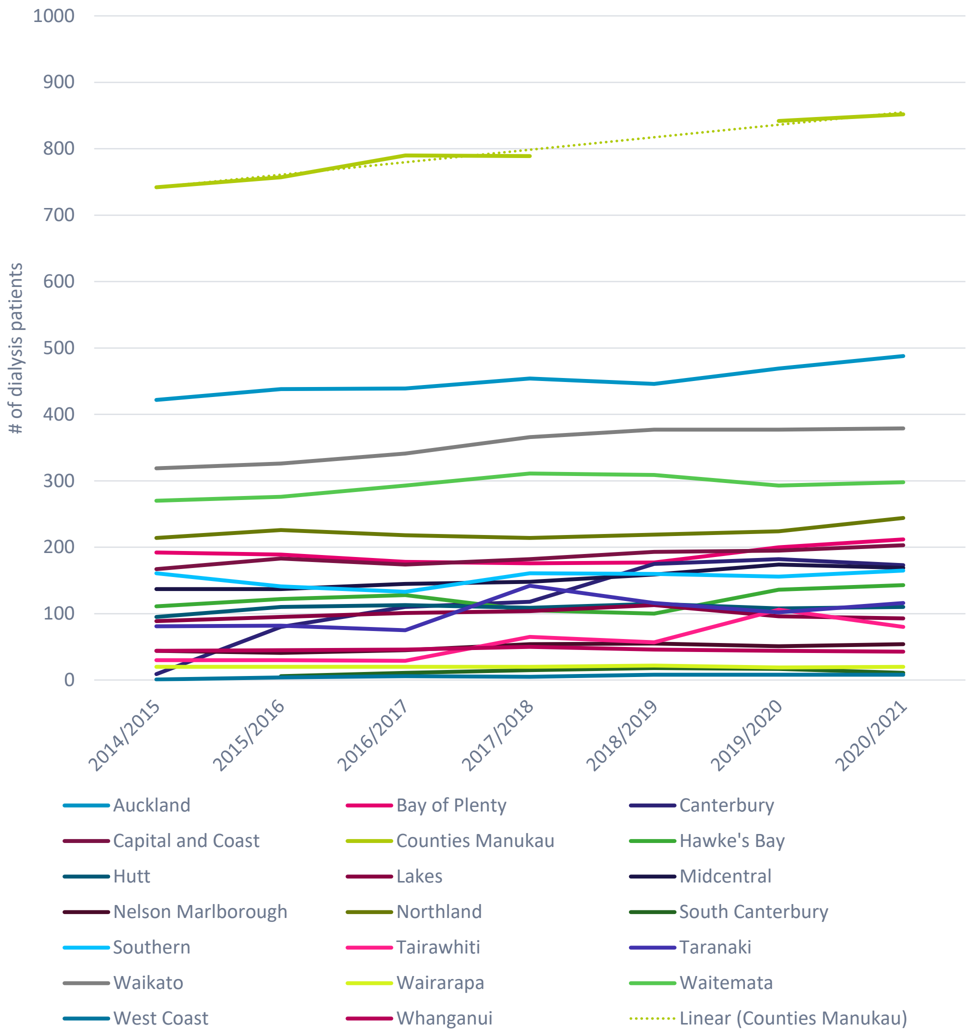
3.1.1 Geographic distribution of dialysis demand

Looking across the DHBs, the majority of the patients who use dialysis live in Counties Manukau DHB, Auckland DHB, and Bay of Plenty DHB. Together, people living in these three DHBs accounted for 40 percent of all dialysis use across New Zealand in 2020/21. This has not changed much over the 2014/15 to 2020/21 period. DHBs that have seen significant growth in their population's use of dialysis include:

- Tairawhiti, which has seen a 250 percent increase from 2014/15 to 2019/20
- Canterbury, which has experienced its population using dialysis more than doubling between 2015/16 and 2020/2021
- Taranaki has seen 43 percent growth in its population accessing dialysis.

(see Figure 9 below)

Figure 9 Number of dialysis patients by DHB

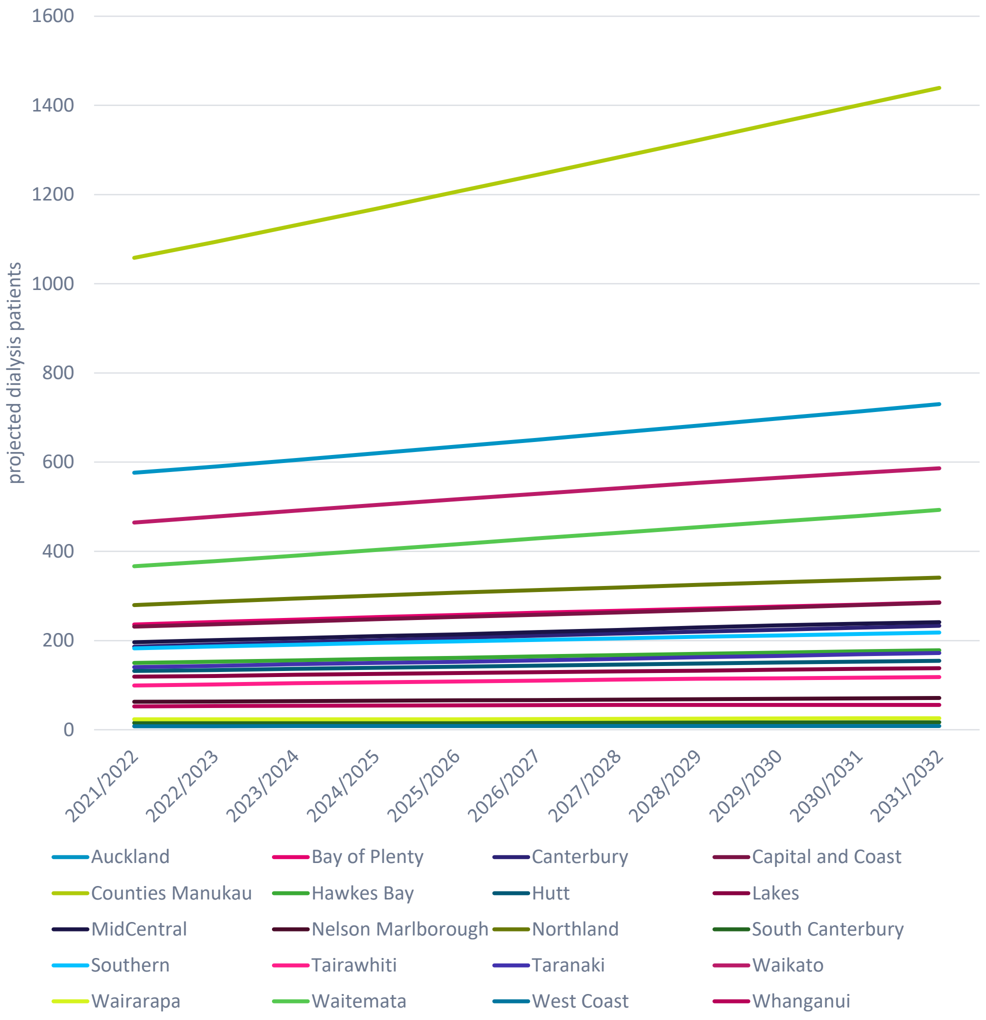


1 Data for Counties Manukau DHB for 2018/19 was incomplete and has been omitted and filled in with a trendline.

Source: NZIER

Our projections indicate that demand growth in Counties Manukau DHB will be the primary driver of demand growth nationally, with 36 percent growth from 2021/22 to 2031/32.

Figure 10 Projected growth in dialysis patients by DHB



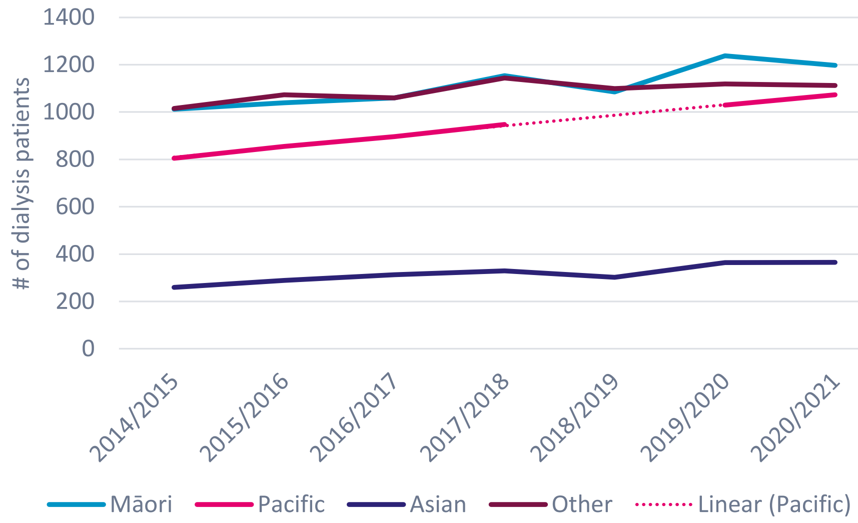
Source: NZIER

3.1.2 Utilisation by ethnicity

Nationally, people who used dialysis in 2020/2021 were more likely to have been Māori than any other ethnicity. Based on population size, Māori and Pacific New Zealanders are over-represented in the population of dialysis users (see Figure 11 below).

Figure 11 Number of dialysis patients by ethnicity

National

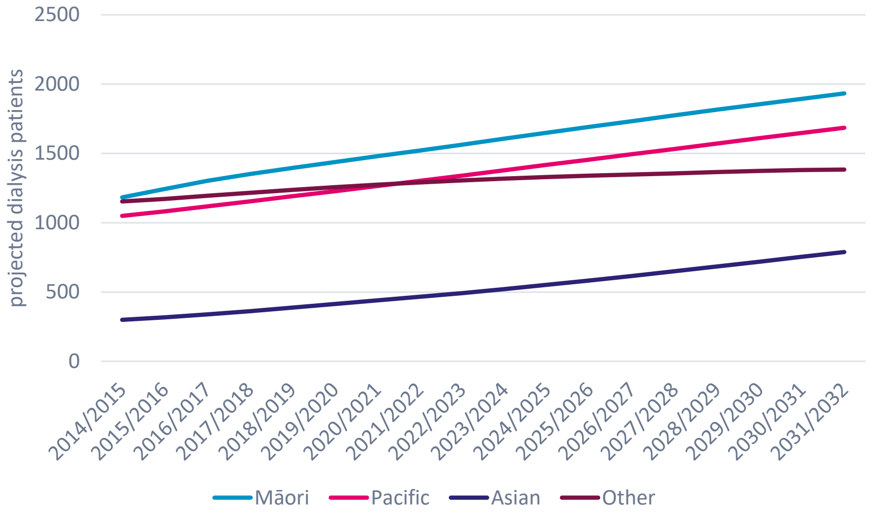


1 Data for Counties Manukau DHB for 2018/19 was incomplete and has been omitted from the analysis. This had a major impact on the count of Pacific New Zealanders using dialysis in 2018/19, so this has been omitted as well and filled in with a trendline.

Source: NZIER

Based on our projections, the number of Māori and Pacific users of dialysis will grow fast and outnumber other ethnicities in dialysis utilisation by a wide margin in 2031/32 (see Figure 12 below).

Figure 12 Projected growth in dialysis utilisation by ethnicity

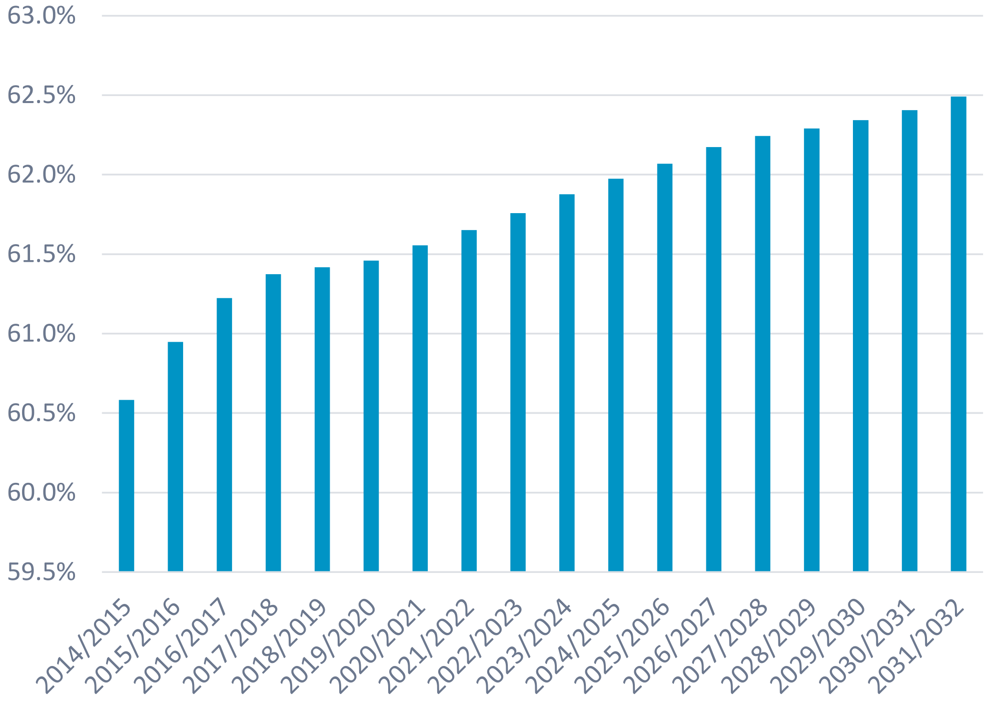


Source: NZIER

In terms of proportions, dialysis and its limited potential to offer either quality or length of life is and will continue to be experienced predominantly by Māori and Pacific New

Zealanders. Our projections indicate that a slow shift over time will result in an increasing proportion of Māori and Pacific New Zealanders amongst dialysis users.

Figure 13 Projected increasing proportion of Māori and Pacific dialysis users



Source: NZIER

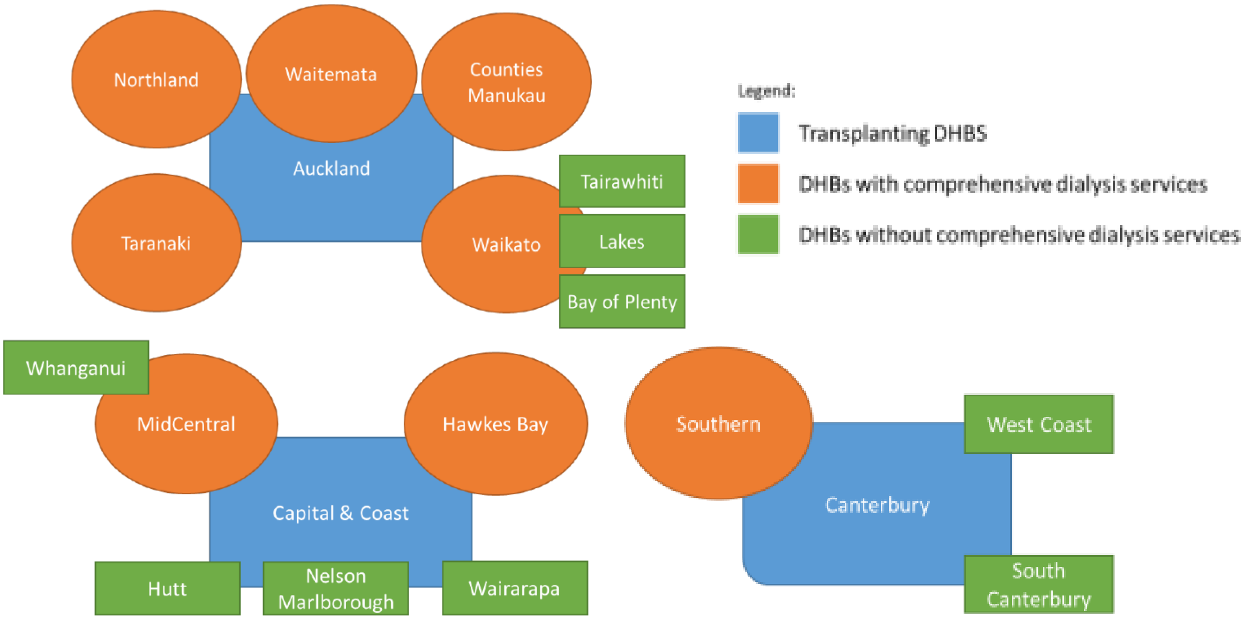
4 Service delivery

4.1 The organisation of transplant and dialysis services in New Zealand

Transplants are only provided in three DHBs in New Zealand: Auckland, Canterbury and Capital and Coast DHBs. Other DHBs feed into these three to access transplantation surgery for their populations.

Only eight DHBs offer comprehensive dialysis services. Nine DHBs do not have comprehensive dialysis services. This could mean no dialysis services at all or very limited choice. Many people who need RRT in these DHBs and cannot access pre-emptive transplantation are faced with a choice of travelling across DHB boundaries to access dialysis services (this can be 3 to 4 times per week) or opting for palliative care in their DHB of domicile.

Figure 14 Organisation of transplant and dialysis services across DHBs



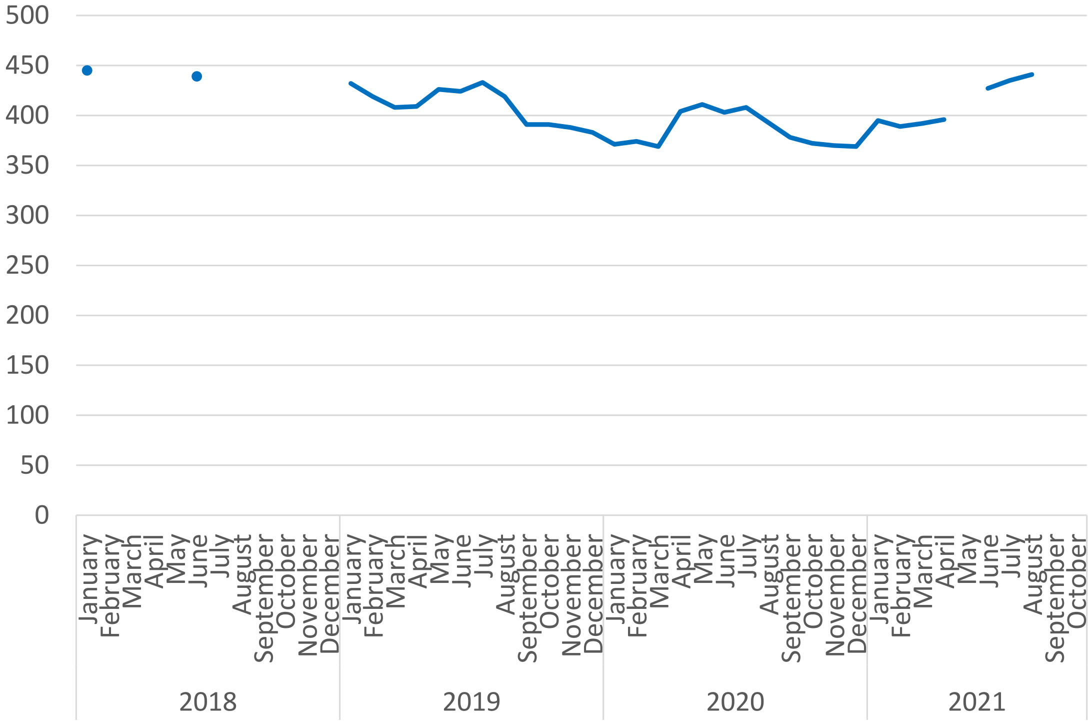
Source: Ministry of Health 2019

4.2 Transplantation

4.2.1 The demand for transplantation

The closest measure of demand for transplantation available is the deceased donor active wait list kept by the New Zealand Blood and Organ Service (NZBOS). According to the data provided by NZBOS, as of 4 October 2021, there were 462 people labelled as ‘active’ on the deceased donor kidney waitlist. These people are considered eligible and have not yet found a donor.

Figure 15 Number of people on the deceased donor kidney active waitlist*



* For unknown reasons, NZBOS provided incomplete data for the date range made available.

Source: NZBOS

Data from NZBOS, the custodian of the deceased donor waitlist, indicates that the waitlist has been fairly stable over the last 33 months, with some decline achieved by early 2020 and an increasing trend since then, the latter most likely related to the COVID-19 pandemic and the implications of restrictions on access to services and surgical cancellations and delays.

Based on the number of people receiving dialysis as of 31 December 2018 (2,846) and the nearest waitlist date (15 January 2019), the total waitlist for deceased donor kidneys represented 16 percent of the dialysis population. However, although the proportion of the waitlist population to the dialysis population is a useful indicator, because the waitlist data does not indicate whether people on the waitlist are on dialysis, the data does not make it immediately clear what percentage of the dialysis population are *actually* on the waitlist.

The NRTS report the number of transplants per 100 incident (rather than prevalent) end-stage kidney disease patients. This is shown in Table 6 below.

Table 6 Transplants per 100 incident ESKD patients

2012-2019

Year	Incident ESKD patients[1]	Transplants per 100 1 ESKD patients
2012	489	21
2013	524	22
2014	559	25
2015	557	26
2016	565	30
2017	582	32
2018	623	29
2019	625	35
2020	656	29

1 Incident as per 31 December in the year prior.

Source: (National Renal Transplant Service 2021)

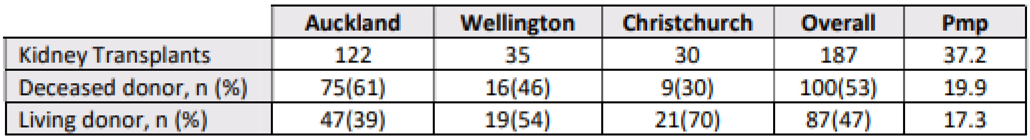
Ministry of Health data indicates that each year, the number of people who get a transplant represents approximately 17 percent of the population using dialysis. If some of these are pre-emptive transplants, then the probability of a person on dialysis having a transplant is even lower than 17 percent each year.

4.2.2 Supply of transplantation

According to the National Renal Transplant Service (NRTS), there were 187 recipients of kidney transplants in New Zealand in 2020. These included 87 living donor and 100 deceased donor kidney transplant recipients. Three deceased donor recipients received a dual transplant (two kidneys each from a single deceased donor). There were 24 living donor kidney transplants as part of kidney exchanges (National Renal Transplant Service 2021).

Based on an estimated population of 5.03 million (StatsNZ at 30 June 2020), these figures implied a total kidney transplant rate of 37.2 per million population (pmp) in 2020. This rate represents a significant drop from the rate in 2019 of 44.9 pmp (National Renal Transplant Service 2021). The drop is not unexpected given the restrictions imposed due to the COVID-19 pandemic, which resulted in significant volumes of cancelled and delayed hospital-based services, including outpatient services and inpatient surgeries. According to the NRTS (2021), the assessment of potential live organ donors and potential recipients was significantly affected, and this is expected to result in continued low volumes of transplantation in 2021.

Figure 16 Live and deceased donor transplants by transplant centre, 2020



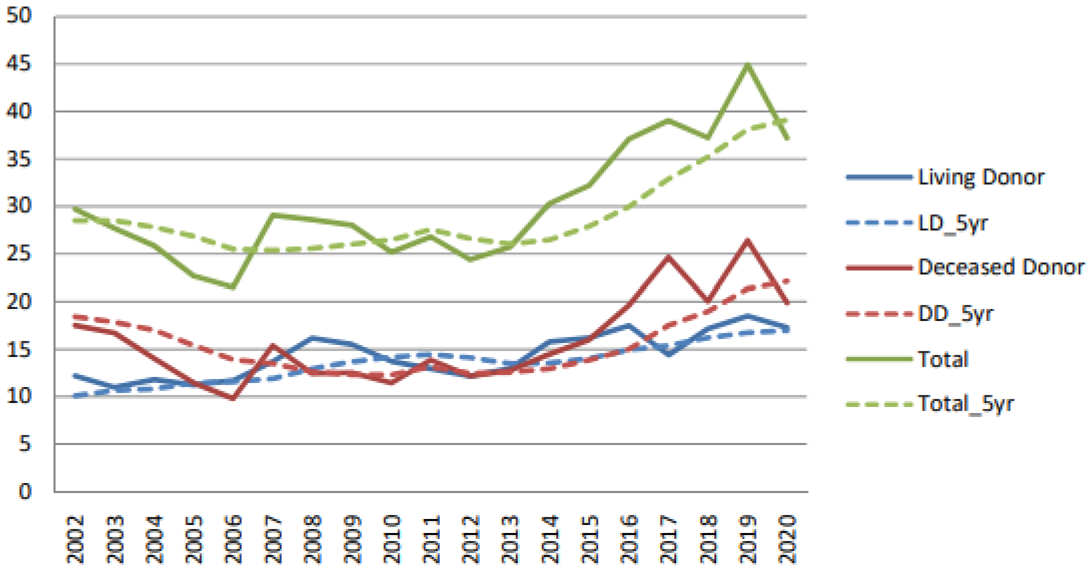
	Auckland	Wellington	Christchurch	Overall	Pmp
Kidney Transplants	122	35	30	187	37.2
Deceased donor, n (%)	75(61)	16(46)	9(30)	100(53)	19.9
Living donor, n (%)	47(39)	19(54)	21(70)	87(47)	17.3

Source: National Renal Transplant Service (2021)

Despite a significant slowdown in 2020, there has been an increase in the total kidney transplant rate per million population since 2013, shown by the five-year moving average in Figure 17 below. However, the rate of increase in living donor transplantation is lower than the rate of increase in deceased donor transplantation (NRTS 2021).

Figure 17 Rate of kidney transplantation over time with 5-year rolling average

By type, rate per million population



Source: National Renal Transplant Service (2021)

4.2.3 The dialysis incentive in the scoring system

In New Zealand, most patients go onto dialysis before or at the same time as they are considered as potentially eligible for transplantation.

Pre-emptive transplantation has been shown to offer improved patient and graft survival compared with transplantation after dialysis is initiated (Gourlay 2018) – a combination of reduced cost and improved outcomes over transplantation after dialysis has been initiated.

Anecdotally, the pattern of pre-emptive transplantation varies across the country, with this being more common in the South Island. Our cohort analysis based on patients new to dialysis and patients transplanted in 2015/16, presented in Appendix B, indicated that there were no pre-emptive transplants at all in New Zealand in that year. That is, all transplant patients were all coded as having received some dialysis in 2014/15.

4.2.4 The pathway to transplantation

The demand for kidneys outstrips supply around the world. To deal with this supply shortage, all countries where transplants are performed have an allocation system that determines who the next available deceased donor kidney will go to. In New Zealand, a patient must be on the waiting list to be eligible for a deceased donor transplant. The waitlist criteria for a deceased donor transplant include consideration of:

- The probability that the potential recipient has at least an 80 percent chance of living for more than 5 years after a deceased donor transplant

- The potential recipient’s overall health (including consideration of their other health conditions)
- How kidney disease has affected the rest of the potential recipient’s body
- Any other surgery that the potential recipient might need at the time of the transplant.

Deceased donor organs are allocated to individual recipients through the National Kidney Allocation Scheme, which considers:

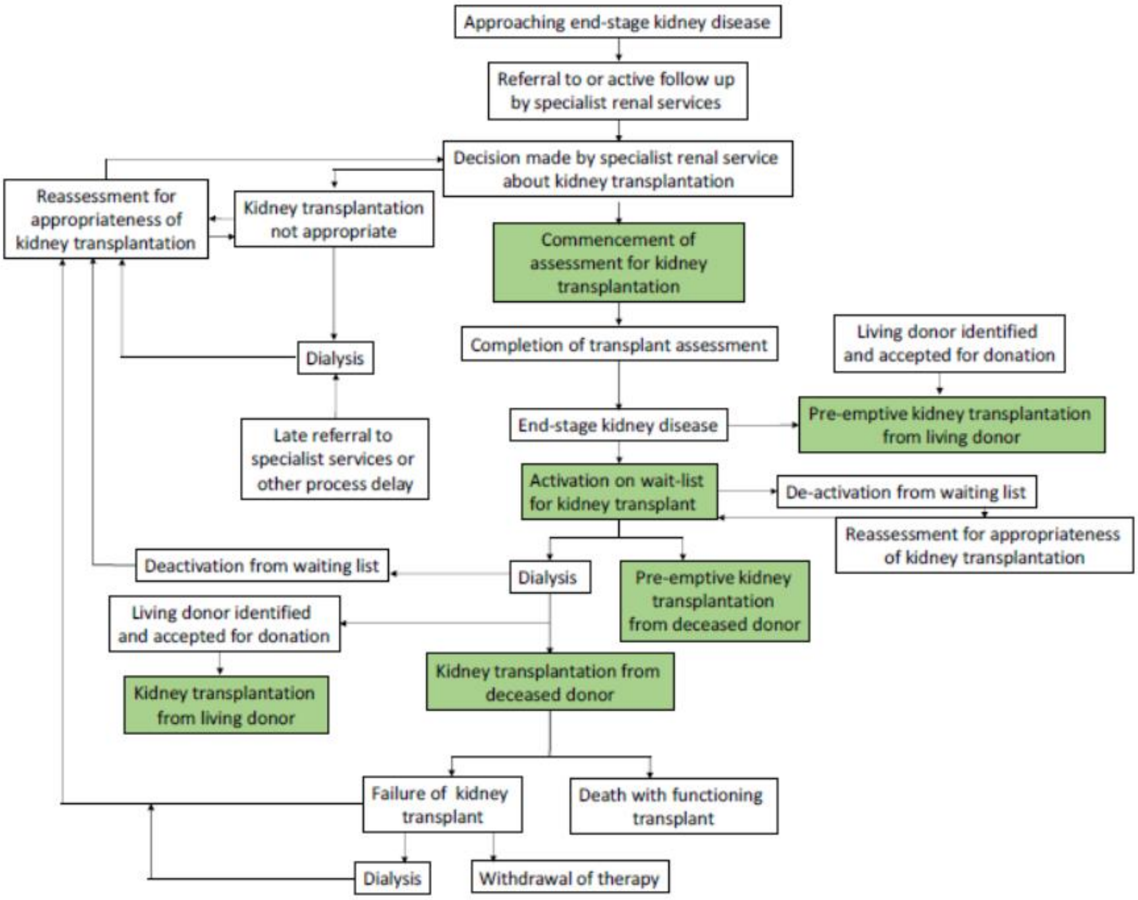
- time spent on the waitlist
- best match between donor and recipient.

An aspiration that everyone who would benefit from a transplant should get one would be the ultimate expression of transplant equity if enough kidneys were available.

4.2.5 The kidney transplant pathway

The kidney transplant pathway illustrates that from ESKD to transplant is a multi-step process and a textbook case for integrated care and service coordination at a patient level, but also a system very much in need of oversight across the spectrum of services to ensure that outcomes are optimised.

Figure 18 Kidney transplant pathway



Source: Huria et al. (2018)

Timely referral for transplants is essential to maximising the chance of a transplant going ahead and minimising the total cost of care.

Timeliness is often compromised by the many steps and services that both potential recipients and potential donors must access. For most kidney transplants, blood group compatibility between the potential recipient and potential donor must be established. This requires a blood test, which may be followed by a second blood test to further investigate compatibility by tissue typing and cross-matching. Potential donors also need to have their medical history checked and have a general physical examination, including a blood pressure check, to ensure the person is healthy enough to proceed. This is typically undertaken by the renal service. A series of blood tests and X-ray tests, as well as an ECG, will be done to check for kidney function, liver function and rule out hepatitis, heart disease, lung disease and past viral infections. In addition, results from routine annual health checks (e.g. cervical smear, mammogram, colonoscopy, etc.), as well as any necessary medical clearance for pre-existing conditions, will need to be submitted to the living donor team for review.

What is currently known or believed about the time dimension of the pathway includes:

- Patients can wait up to four months for an outpatient appointment with a specialist.

- The time involved in assessing a patient for eligibility can be significant (up to two years), especially where there is high demand for imaging and diagnostics.
- It can take time for a patient to feel comfortable initiating the discussion about donation with family and friends, if they ever do.
- Once the potential donor agrees, the referral for eligibility and compatibility assessment can involve a wait, generally until the person with ESKD reaches a certain point of reduced kidney function.
- The process of donor work-up and compatibility assessment can require months, with multiple medical tests (According to Kidney Health New Zealand, the time from when a person decides to become a kidney donor to the time when the transplant takes place is usually a six to nine-month process but can take up to two years (Kidney Health New Zealand, personal communication).

Two key modifications to the organisation of health services for people with kidney failure could increase access to pre-emptive transplantation and avoid the additional cost of a period of dialysis (Gourlay 2018):

- Earlier referral from primary care (which in New Zealand would also require renal services to agree to assess potential recipients and potential live donors earlier for eligibility and compatibility).
- Shorter time to complete the living donor assessment.

Achieving these is likely to require improvements in:

- Healthcare financing
- Health workforce – both quantity and quality
- Information and research
- Leadership and governance.

4.3 Equity issues

There are major equity concerns for Māori and Pacific New Zealanders across the care spectrum for CKD, including:

- Māori experience chronic kidney disease at three times the rate of non-Māori, non-Pacific (Stewart, McCredie, and McDonald 2004)
- Māori and Pacific New Zealanders experience high rates of diabetes – a major cause of CKD
- Māori and Pacific New Zealanders are more likely to experience unmet need for GP services, particularly where co-payments are high and/or appointments have long wait times
- Māori begin long term dialysis at three times the rate of New Zealand European adults (Palmer 2015).

In 2020/21, there were 46 transplants for people of Māori ethnicity, 30 for people of Pacific ethnicity, 22 for people of Asian ethnicity and 102 for people of Other (including European) ethnicity. Despite a similar level of use – and a far greater rate of use – of dialysis, Māori people only benefited from less than half the number of transplants that people of Other ethnicity had (see Table 7 below).

Table 7 RRT by type and ethnicity

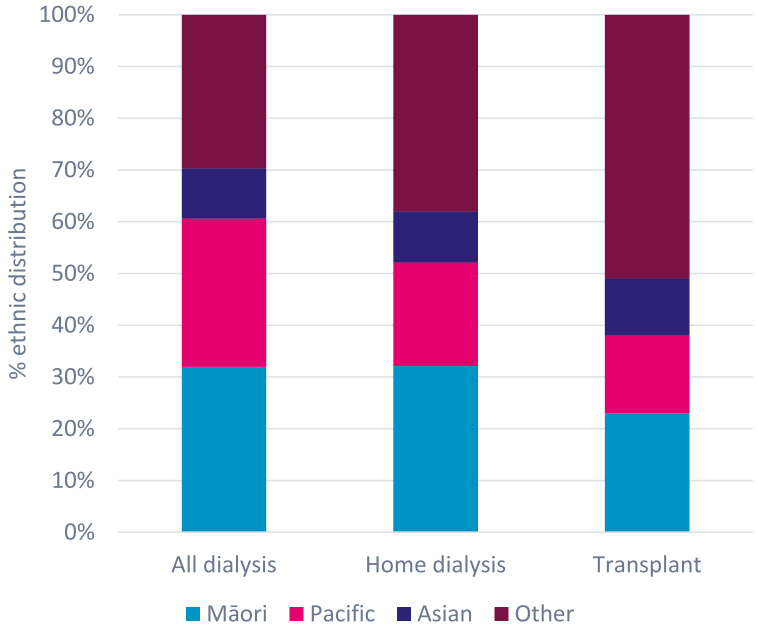
Ethnicity group	All dialysis	Home dialysis	Transplant
Māori	1197	538	46
Pacific	1073	336	30
Asian	365	165	22
Other	1112	638	102

Source: NZIER, NMDS data for transplants, NNPAC data for dialysis

Looking at these figures proportionally tells an even clearer equity story:

- People of Pacific ethnicity are under-represented in home dialysis and transplants relative to their use of all types of dialysis
- People of Māori ethnicity are under-represented in transplants relative to their use of dialysis.

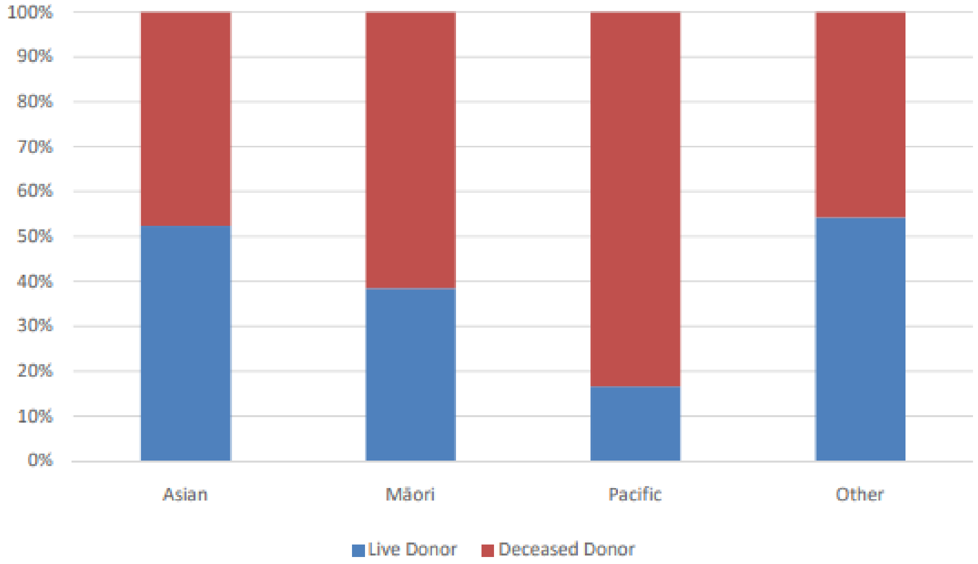
Figure 19 Proportion of RRT type used by ethnicity groups, 2020/21



Source: NZIER

Even within the transplants that occur, there are important differences that affect Māori: According to the NRTS, kidneys for Māori and Pacific recipients are most likely to come from deceased donors (over 60 percent and over 80 percent, respectively), while kidneys from Asian and Other donors are most likely to be from live donors.

Figure 20 Donor type and ethnicity



Source: NRTS

Equity issues require a pro-equity solution

Although Māori and Pacific ESKD patients are currently less likely to benefit from live kidney donation, it is important that this issue is not confused with Māori and Pacific New Zealanders being less likely to benefit from increased live kidney transplantation. Rather, these differences indicate the importance of addressing system barriers to live kidney donation from an equity perspective, with solutions designed to close the equity gap.

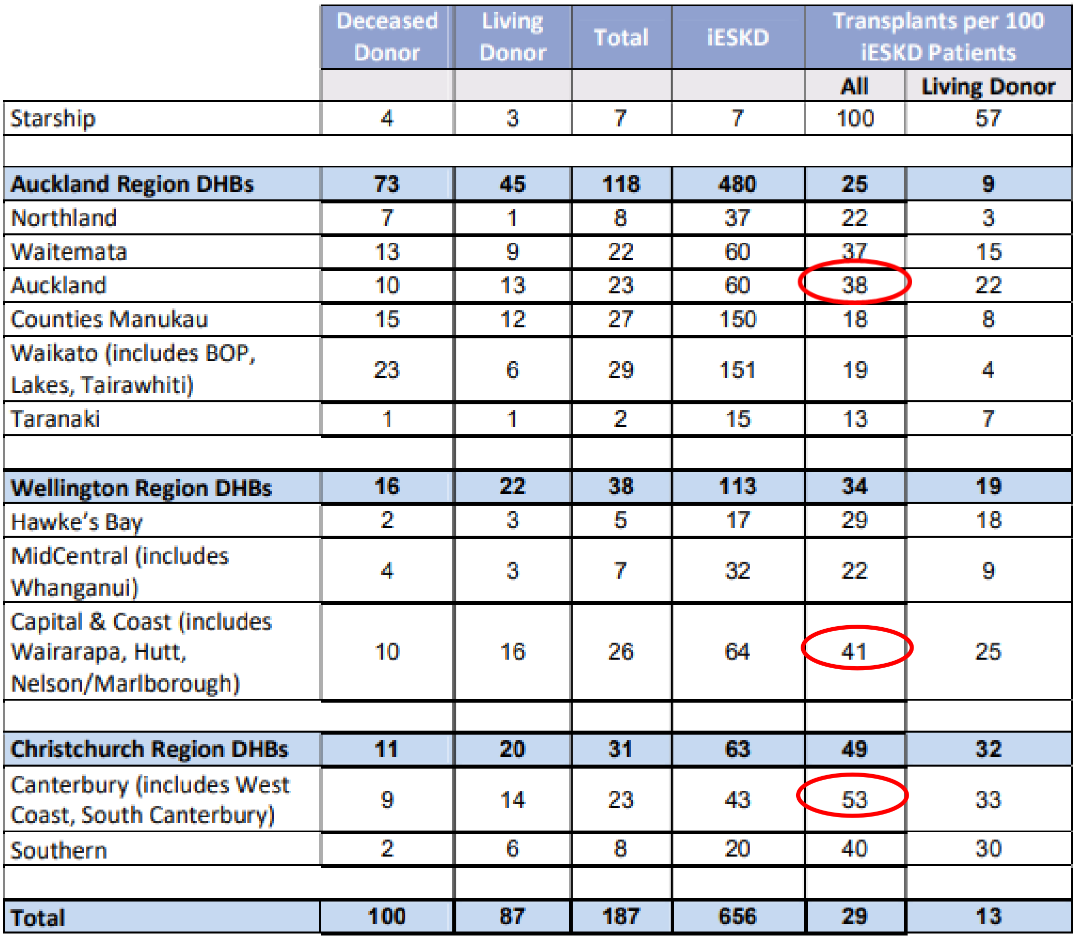
Geographic inequities may be partly due to system barriers

Geographically, there are equity issues as well. Christchurch has the highest rate of transplantation per 100 incident ESKD patients (49, compared with 34 for Wellington and 25 for Auckland). But does this mean that an ESKD patient would stand a better chance of getting a transplant in Christchurch than in Wellington or Auckland? The answer is not clear, as ethnicity and disease type play a role in regional differences, but system settings are also insufficient to ensure people have the same chance wherever they live. Issues include:

- Differences in the eligibility criteria applied by transplant centres (anecdotally, at least one transplant centre imposes a hard line for body mass index, while at least one other is more flexible on this criterion to improve access for Māori and Pacific patients).
- Differences in the organisation and coordination of services and service capacity within the DHBs that feed into each transplant centre.
- Differences in the solutions that transplant centres are offering to help potential donors overcome health issues that impact negatively on their eligibility to donate (anecdotally, in at least one centre, donors with high BMI are offered gastric banding surgery to help reduce BMI prior to organ donation).

Data from the NRTS (2021) indicate that the highest rates of transplants per 100 ESKD patients are observed in the DHBs that have a transplant centre: Canterbury, Capital and Coast, and Auckland (See Figure 1 below).

Figure 21 Transplants per 100 incident ESKD patients, by DHB of domicile and donor type



	Deceased Donor	Living Donor	Total	iESKD	Transplants per 100 iESKD Patients	
					All	Living Donor
Starship	4	3	7	7	100	57
Auckland Region DHBs	**73**	**45**	**118**	**480**	**25**	**9**
Northland	7	1	8	37	22	3
Waitemata	13	9	22	60	37	15
Auckland	10	13	23	60	38	22
Counties Manukau	15	12	27	150	18	8
Waikato (includes BOP, Lakes, Tairawhiti)	23	6	29	151	19	4
Taranaki	1	1	2	15	13	7
Wellington Region DHBs	**16**	**22**	**38**	**113**	**34**	**19**
Hawke's Bay	2	3	5	17	29	18
MidCentral (includes Whanganui)	4	3	7	32	22	9
Capital & Coast (includes Wairarapa, Hutt, Nelson/Marlborough)	10	16	26	64	41	25
Christchurch Region DHBs	**11**	**20**	**31**	**63**	**49**	**32**
Canterbury (includes West Coast, South Canterbury)	9	14	23	43	53	33
Southern	2	6	8	20	40	30
Total	**100**	**87**	**187**	**656**	**29**	**13**

Source: NRTS (2021)

Possible reasons for differences in the rates of transplantation between DHBs include:

- Social and cultural differences between DHB populations that impact on the acceptability of live donation, deceased donation and transplantation.
- Differences in access barriers to health services anywhere along the spectrum of care from primary care to transplant surgery.
- Differences in referral patterns from primary care.
- Differences in eligibility criteria between transplant centres
- Differences in wait times for specialist appointments and diagnostics.
- Specific access barriers related to distances needed to travel (e.g. travel costs) to be assessed for transplantation eligibility and compatibility for both recipients and donors and the interactions of these access barriers with differences in income levels between DHB populations (higher income groups can overcome these barriers more easily).
- Differences in requirements for donor work-up.

- DHBs favouring their own populations (this was found to be true generally by the Office of the Auditor General (2013) in a major review of regional service planning – see section 7.2).

4.4 Myths that perpetuate unmet need

In every context, a professional culture based on received wisdom has the potential to override evidence and hinder attempts to change the status quo. In the CKD context, a range of myths appears in the received wisdom of patients, clinicians, service planners, and health system funders. These include myths about people with ESKD, who can safely have and benefit from a transplant, myths about Māori and Pacific New Zealanders and their culture, and the optimal transplant pathway.

Myths affect the way patients are treated and their chances of being referred early enough to get a pre-emptive transplant, the probability of being supported to find a live donor, the probability of getting on the waitlist for a deceased donor transplant, and the probability of potential live donors amongst family and whanau being deemed suitable for live donation.

Some of the myths that commonly affect decisions are:

- People with CKD are very unhealthy, with high rates of comorbidities[3]
- Māori and Pacific New Zealanders with CKD are not likely to be healthy enough for a transplant
- Transplantation – particularly live donor transplantation – is incompatible with Māori and Pacific culture
- People with a high BMI cannot receive or donate a kidney
- Dialysis should be initiated before transplants are considered (this is incentivised by the current waitlist criteria)
- Transplantation is a last resort after dialysis fails
- People who have been on dialysis for a long time can't have a transplant
- Recipient and donor must be compatible
- The wait for a kidney transplant is long, so that most people will become too ill before a suitable kidney becomes available.

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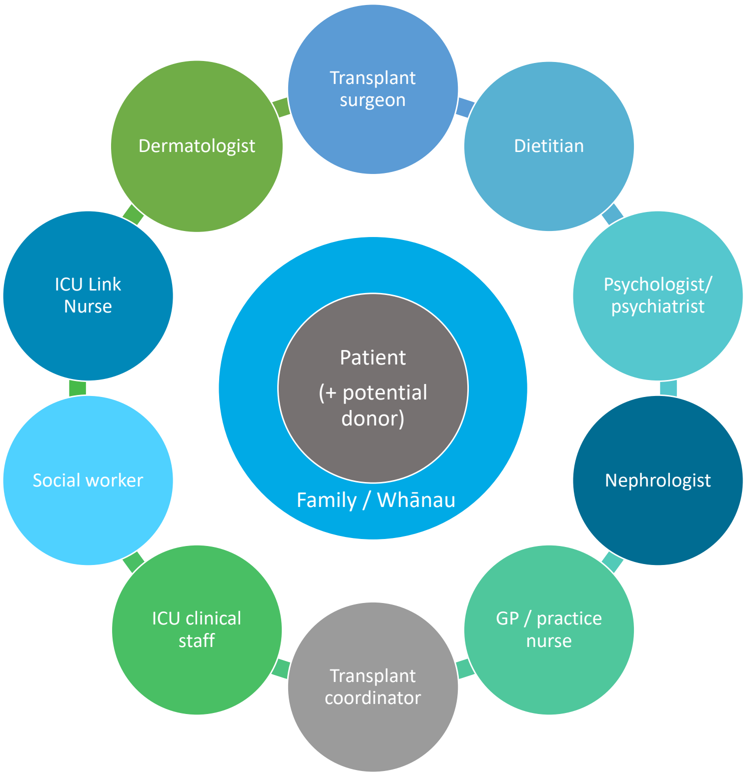
[3] According to ANZDATA, the prevalence of comorbidities amongst people with CKD is not so high as to hinder a significant increase in the rate of kidney trasnplants: At least 69 percent of patients beginning kidney replacement therapy have no coronary artery disease, at least 86 percent have no peripheral vascular disease, at least 92 percent have no cerebrovascular disease, and at least 84 percent have no chronic lung disease

5 Health workforce

5.1 The transplant pathway workforce

The workforce that is relevant to ensuring a cost-effective pathway to transplantation includes a wide range of health professionals. In some cases, these professionals are included in the Ministry of Health workforce models and supported by workforce strategies to ensure that their services remain sustainable. But some critical roles are frequently neglected.

Figure 22 Renal workforce

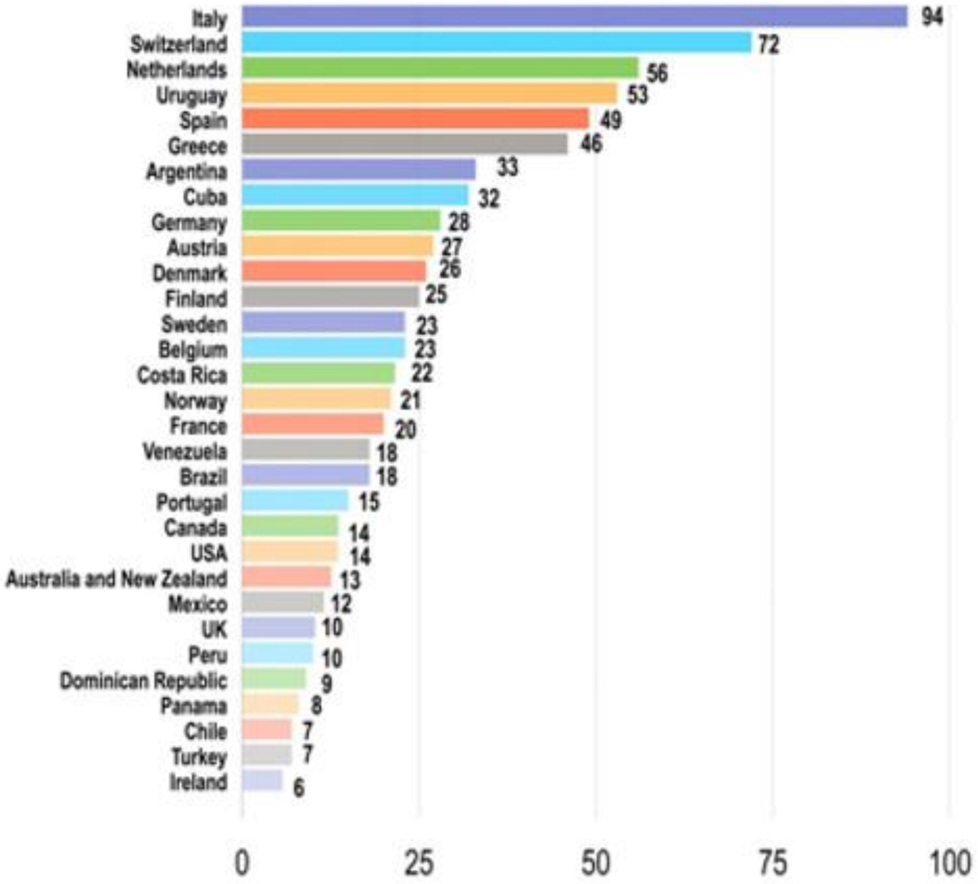


Source: NZIER

5.2 The nephrology workforce

The nephrology workforce represents the key speciality for renal patients. According to a study of nephrology workforce numbers worldwide, Australia and New Zealand have a relatively shallow pool of nephrologists (see Figure 23 below).

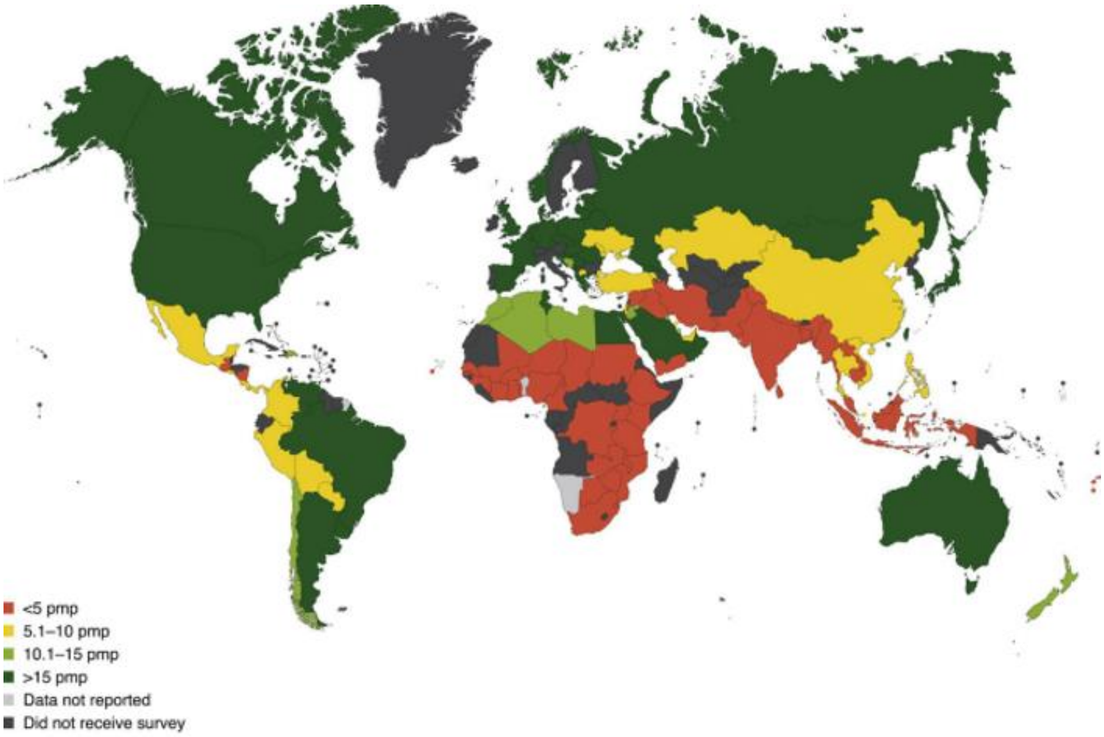
Figure 23 Number of nephrologists per 1000 ESKD patients



Source: Sharif, Elsayed, and Stack (2016)

Another study reveals that New Zealand in fact, drives the poor results for Australia and New Zealand: Osman et al. (2018) conducted a global survey of nephrology workforce (nephrologists and nephrology trainees) and nephrology training capacity and found that New Zealand lags behind Australia with 13.07 per million population, whereas Australia had 20.88 per million population, or nearly 60 percent more capacity than New Zealand (see Figure 24 below).

Figure 24 Health workforce for nephrology care: existing workforce and training capacity



Source: Osman et al. (2018)

It is possible to increase workforce numbers, but it is important to be clear on what the right number is.

A global survey of the nephrology workforce, nephrology trainees and nephrology training capacity revealed that when compared on a per million population basis Australia has 60% more capacity than New Zealand and the average capacity of high-income countries was nearly 120% greater than New Zealand's. [4]

The UK – another country with relatively low nephrology workforce numbers - provides a good example of how to determine staffing levels within the multidisciplinary kidney teams for renal services based on evidence-based requirements. In 2001, the British Renal Society assembled a multi-professional National Renal Workforce Planning Group to prepare recommendations for staffing levels across each professional group involved in kidney care. This was aligned with the Renal National Service Framework, a policy document that described the recommended standards of care and the indicators of good kidney care practice to be achieved for patients with CKD.

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[4] Osman et al. (2018)

A fundamental goal for the UK was to provide robust evidence that could be used to confidently model the future need for nephrology staffing to manage future demand from patients with CKD. The result of the process was the estimation of an appropriate staffing ratio: 1 nephrologist per 75 RRT patients. This estimate considers that many nephrologists in clinical practice in the UK have additional work commitments to general internal medicine (up to 13 hours per week). Nephrology workforce planning in the UK has resulted in an increase in the nephrology workforce aligned with increasing ESKD patients.

5.3 Other critical roles

One of the three guiding principles of Organ Donation New Zealand (ODNZ) is that:

> *"Every opportunity for deceased organ donation should be recognised by Intensive Care Unit (ICU) staff and every family should have donation discussed with them by a health care professional with compassion, respect and appropriate knowledge and skill. Donation should be discussed with all families irrespective of whether the word 'donor' is on the driver licence."* (Organ Donation New Zealand 2019)

ICU Donation Link nurses work in ICUs around New Zealand, supporting clinical staff and families of potential donors to discuss organ donation. Ideally, these roles would be a 24-hour per day, 365 days per year role to ensure that no opportunity for deceased organ donation is missed simply due to staffing levels. However, the Ministry of Health funds these roles only on a part-time basis (Organ Donation New Zealand 2019) and contracts – also managed by the Ministry of Health – are often short-term with no certainty of continuity. Link nurses were funded according to the 2014 Multi-Employer Collective Agreement (MECA) and have not had a remuneration since then. DHBs have not been required to provide additional funding to enable these roles to be full-time, although some have done so voluntarily. Across New Zealand, however, the part-time nature of these critical roles almost certainly means opportunities to improve deceased organ donation rates are being missed.

At ODNZ, another role, the donor coordinator, is responsible for providing advice and support to health professionals involved in organ and tissue donation and coordinating the process of organ and tissue donation throughout New Zealand for deceased donor transplant services in New Zealand and Australia and tissue banks in New Zealand. If the health system wants to improve transplantation rates, increasing capacity within the donor coordination team will be required.

Additional coordination is needed to ensure that potential live donors and potential recipients can access the services required to be assessed for eligibility and suitability. These donor liaison coordinators work across the 13 renal units and experience high demand due to the rising use of dialysis and the need to assess all people accessing dialysis for eligibility. As demand continues to increase, particularly if transplantation rates are to increase in such a way that the increase in dialysis demand is substantially reduced, additional coordination capacity will be required.

6 Information and research

The World Health Organization includes health information systems as one of the six building blocks of health systems because robust, reliable, useful, timely and accessible information is the foundation of decision-making across the system, from frontline diagnostics to health policy. Information supports good governance and leadership, informs research, and enables priority setting to achieve health system objectives.

The four key functions of health information systems are:

- data generation
- data compilation
- data analysis and synthesis
- communication and use of data and data insights.

> **Information is of little value if it is not available in formats that meet the needs of multiple users, i.e. policy-makers, planners, managers, health-care providers, communities and individuals. Dissemination and communication are therefore essential attributes of the health information system (World Health Organization 2010)**

6.1 Data generation

Data relevant to renal transplants are generated across the spectrum of care. Data from primary care is difficult to obtain, and this prevents a better understanding of why some patients 'crash land' into dialysis and why some are referred earlier than others as well as what opportunities exist to improve the primary care of people with CKD and the timeliness of referrals to secondary care.

Once patients access secondary care, their use of secondary care services is recorded in either the NMDS (inpatient care) or NNPAC (ED and outpatient care, including all forms of dialysis). These two sources of data have the following issues that affect the analysis of renal services and transplants:

- NNPAC does not describe dialysis types in the same way as the data provided to ANZDATA, and this is problematic for reconciling figures.
- The NMDS does not distinguish between live donor and deceased donor transplants.
- The NMDS does not allow organ retrieval to be readily identified.
- Outpatient data (in NNPAC) does not provide sufficient detail to be able to track the donor work-up process.
- NNPAC purchase units for dialysis are based on visits/events for some dialysis services and enrolments for others.

6.2 Data compilation

The New Zealand Blood and Organ Service (NZBOS) plays a key role in compiling data by bringing together the information on patients from across the system that have been put on the deceased donor waitlist. The waitlist resides with NZBOS because NZBOS is responsible for the testing that establishes donor-recipient compatibility for transplants. Waitlist data is essential to understanding how well the system is performing, but as the system has no performance target that it is held to, the data is not compiled in a way that makes this possible.

It is not entirely clear what information is contained within NZBOS's waitlist dataset, but despite numerous data requests, the waitlist data that NZBOS agreed to provide for this project is very limited in the insights it can provide. This is due to:

- Not going back any further than January 2018, so that long term trends cannot be identified. NZBOS indicated that this was due to older data not being kept rather than an unwillingness to share it.
- Not being broken down by domicile or ethnicity, hindering any attempt to analyse equity issues related to waitlisting or time spent on the waitlist. NZBOS indicated that this information was not available directly and would have to be sought from the transplant centres. That would mean obtaining this information would require NHI identifiable waitlist data to be matched with another NHI identifiable dataset containing ethnicity and domicile.
- Not identifying the status of people on the waitlist with regards to their stage of ESKD. NZBOS indicated that this was due to this information not being available rather than an unwillingness to share it.
- Not identifying the status of people on the waitlist with regards to whether they are receiving dialysis and how long they have been receiving dialysis.
- Not being made available as a microdata set, describing each individual on the waitlist with the date they appeared on the list and, in cases where they are no longer on the list, the date they were removed, preventing any analysis of the length of time that people spend on the waitlist. NZBOS indicated that they do not share individual-level data, even though such data could be made available with encrypted NHI in the same way that the Ministry of Health shares individual-level data with researchers.
- Not including any outcome measures, making it impossible to identify whether people who are no longer on the waitlist obtained a transplant, gave up, became too ill, or died while waiting. NZBOS indicated that this information is not contained in the waitlist dataset and that transplant centres would have this information. Answering the question about outcomes, however, would require NHI-matching of the waitlist data and the transplant surgery data, which is not possible for researchers as NZBOS do not release NHI-identifiable data.

These are significant shortcomings in the data, which raise important concerns about the potential for identifying how the system is performing and for whom it is performing best.

6.3 Data analysis and synthesis

ANZDATA is a clinical quality registry that collects and produces a range of statistics on treatment outcomes for people with end-stage renal failure. All dialysis and transplant services across Australia and New Zealand contribute data to the registry.

6.4 Communication and use of data and data insights

Apart from reports published by ANZDATA that are primarily descriptive in nature, we identified little communication and use of data or data insights on renal care and transplantation. Communication and the use of data is a critical factor in achieving improvement. System-leading organisations like the Health Quality and Safety Commission could play an important role in making data insights relevant to renal transplantation more visible and readily available, focusing on equity and geographic variation.

7 Health care financing

Health care financing often operates as an implicit structure for the health system. It determines what choices are available, what outcomes are easier to achieve, and what behaviours are rewarded. It is critical, therefore, that health care financing is designed deliberately to achieve envisaged results.

The financing-related challenges for renal transplantation include:

- The system-wide involvement of services and providers.
- Geographic distribution of dialysis and transplant services that mean:
  - DHBs that invest in increasing transplant capacity will often generate savings for the patient's home DHB and a revenue decrease for the DHB providing dialysis, requiring multi-DHB planning and financial arrangements that may not always be agreed
  - Patients must often travel and incur high private costs
- The high need for coordination services across the transplant pathway and beyond and across DHB boundaries.
- The high cost of transplantation in the short term with the potential only to generate savings later.

These issues currently create insurmountable barriers due to health care financing based on:

- Siloed funding arrangements
- Short term planning and funding
- Inadequate consideration of private costs.

7.1 Siloed funding arrangements

The health and disability system review noted that the current system is characterised by *"multiple barriers to the shift to a more population health-focused system"*. Two specific barriers related to health system planning were identified, along with one barrier related to health care financing: The siloed funding arrangements.

Currently, DHBs purchase services for their own populations using the funding they each receive for this purpose, calculated using the population-based funding formula (PBFF). The PBFF aims to equitably distribute available funding between DHBs according to the relative needs of their populations and the cost of providing health and disability support services to meet those needs. But how the funding flows from there is where the silos begin to have an impact.

7.1.1 Integrated care, or not?

Fragmentation of services results in sub-optimal outcomes. It occurs when service users require services from a wide range of professionals across multiple provider organisations. A lack of information sharing, delays in sharing information, and poor liaison between professionals and organisations (Cumming 2011) contribute to poorer outcomes.

Renal services within a DHB are a poster child for the need to move from fragmented care to integrated care. People with chronic kidney disease are managed in primary care, reliant on timely referral to secondary care when they progress to ESKD, generally become heavy users of outpatient services (including but not limited to dialysis) as well as inpatient services (often acute admissions due to complications of their underlying health conditions), are regular users of diagnostic services (e.g. laboratories) for tests ordered by both GPs and hospital-based specialists, and require the involvement of transplant coordinators to assist with the pathway to transplantation for both themselves and their potential donors. If a transplant is obtained, continued use of primary care, outpatient and diagnostic services will be required, and in the event of graft failure, the patient may return to dialysis or attempt another transplant.

Transplant coordinators are tasked with achieving integrated care for potential recipients and their potential donors throughout the transplant pathway. Apart from often being an under-resourced part-time role, transplant coordinators are employed by hospitals and don’t coordinate the patient’s referral from primary care to hospital-based renal teams. This is a key area where fragmentation is a concern. To ensure the best possible chance of a pre-emptive or early transplant, primary care providers need to refer patients early and renal services need to facilitate earlier assessment of patients and potential donors. Earlier transplants would be further enhanced by some visibility of the pipeline of potential ESKD patients for renal teams. Anecdotally, many patients – particularly Māori and Pacific patients – ‘crash land’ into dialysis (arriving into dialysis services at an advanced stage of ESKD with no advance warning). There are two reasons for ‘crash landings’:

- Late referrals due to GPs being inadequately supported to manage CKD patients, identify ESKD in a timely manner and ensure referrals occur early enough to maximise transplant potential.
- Access barriers to primary care, including patient co-payments.

Access barriers to primary care represent the first opportunity for barriers to transplantation to begin to form, and these illustrate the critical importance of aligning funding not only to improve the interface between primary and secondary care but also to improve the interface between primary care and the community.

Primary care funding itself is a barrier to integrated care. Primary care funding is designed to cover the cost of providing primary care services to the enrolled population. No funding exists to cover the costs of liaising with secondary care providers or coordinating patient services across a spectrum of services and providers. And funding may also be the main reason for the lack of information sharing between providers that results in poorly coordinated services (Cumming 2011). Generally, despite integrated care being an objective for primary care, there has been a general failure to identify what a comprehensive model of primary care might look like and how it could be delivered (Smith 2009).

7.1.2 DHB boundaries introduce further barriers

Many health services, including dialysis, transplant patient and donor work-up, and transplant surgeries and after-care, are delivered across DHB boundaries due to a lack of services in the patient’s own DHB or, in some cases, due to long wait times or clinical complexity issues. People on dialysis may also receive services while travelling. Unplanned visits to other DHBs also occur for a wide range of acute services.

Because the PBFF only provides for funding for the DHB's resident population, when patients cross DHB boundaries for services, funding flows between DHBs occur to ensure the provider DHB receives a payment that, in theory, covers the cost of the patient's care. The flows of funds between DHBs for this purpose are called interdistrict flows (IDFs). IDFs may occur for unplanned services, such as when a person is on holiday in another part of New Zealand and needs medical care or for planned services. Inter-district flows associated with regional planning are generally planned based on national prices. DHBs can agree on different prices, particularly where the agreement results in significant capital investment, increasing marginal costs in the short term, but to do this, the boards of all DHBs involved in the agreement must explicitly agree to the price change. Another option available to DHBs is to request national prices to be adjusted, but in practice, this is rarely supported.

Planned services can occur as one-off agreements between DHBs for individual patients or can be provided under regional services planning agreements. Regional services planning was introduced in 2011 as an alternative to structural change for the health system. Regional services planning requires DHBs to work together to plan, fund, and deliver services regionally to reduce service vulnerability associated with a critical mass shortfall and workforce shortages, reduce costs, and improve the quality of care.

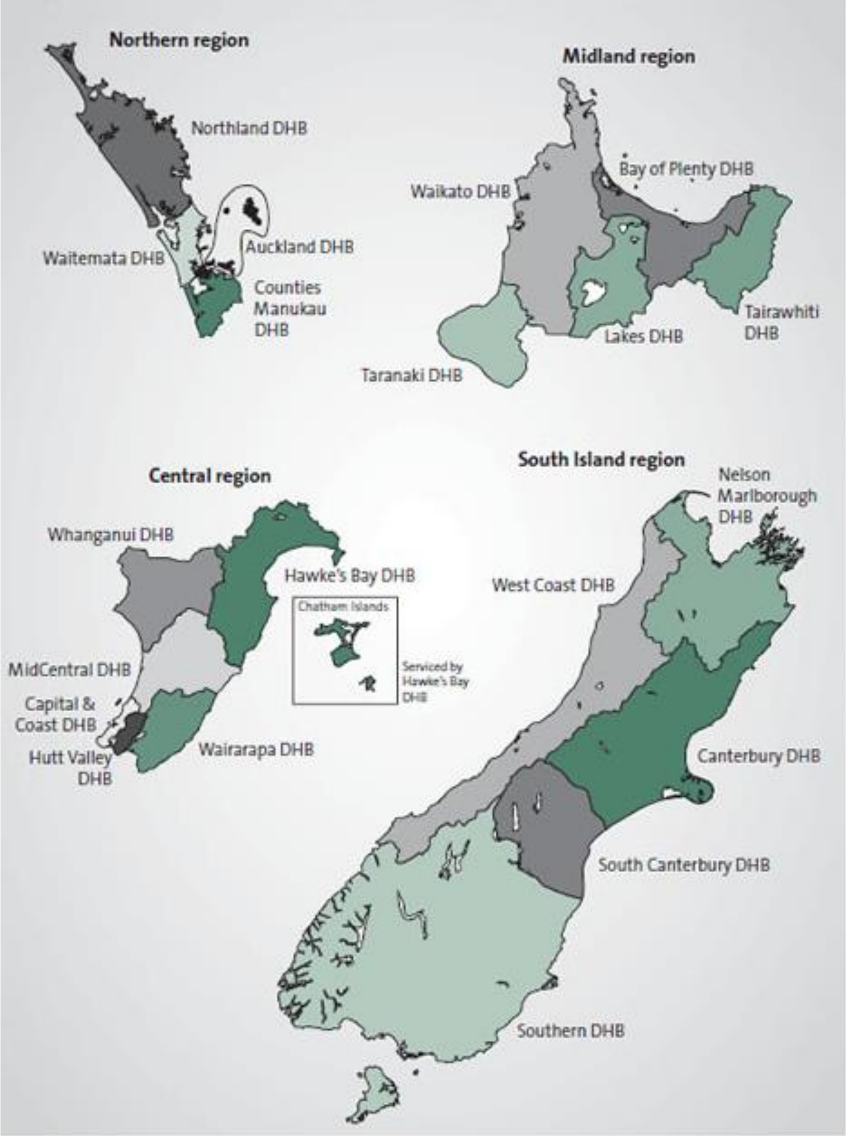
Regional services planning agreements are intended to be strategic documents setting out significant changes in service delivery. These are considered critical in influencing decisions about capital investment: If DHBs within a region agree that the best way to provide a particular service is for it to be concentrated in one DHB, but serving the entire region's population, the capital investment required to ensure facilities and equipment can support the level of service needed can be significant. In asking for that level of capital investment to be supported by the Treasury and the Ministry of Health, the provider DHB would need to provide confidence in the level of service envisaged and assurances that this would not duplicate service planning within other DHBs.

But DHBs have shown that regional planning is a weakness rather than a strength. A 2013 review of DHB regional planning by the Office of the Auditor General (OAG) found that:

- Regional planning often takes place in isolation, with little attention given to connections between plans. Renal teams may discuss dialysis planning, for example, but this may not be connected in any way to discussions about transplantation.
- Regional planning is often just an aggregation of individual DHB plans rather than a coordinated plan to make the best use of services and resources across the region.
- Incentives to engage in regional planning were seen as not strong enough.
- Meetings of decision-makers in regional planning were infrequent, limiting opportunities to resolve persistent challenges.
- Primary care providers were rarely involved in regional planning, limiting opportunities for new models of care, drawing on system-wide resources.
- Regional planning lacked measurable targets, and timeframes for implementing changes were often very long.

Overall, the OAG saw few instances of DHBs funding services together, such as pooling money and devising criteria to ensure equity of access.

Figure 25 DHB planning regions



Source: Office of the Auditor-General 2(013)

The overall funding barriers to regional planning identified by the OAG were:

- DHBs prioritising their local population: A need to meet local demand and balance budgets meant regional planning would not be prioritised.
- Outward inter-district flows are seen as a loss of needed revenue: DHBs in financial deficit seek to retain patients.

These funding barriers have obvious implications for renal services, given the need for many patients to travel across DHB borders for dialysis and transplants being available from only three hospitals in the country, meaning many patients' transplant pathways involve the flow of IDFs across three DHBs in the short term and a significant change in service use in the dialysis-providing DHB consequent to obtaining a transplant from a different DHB altogether.

7.2 Short term planning and funding

DHB budgets are announced each year for the following year and are intended to support DHBs to provide services for their resident populations over the course of a year. Multi-year funding – an identified amount of funding for each of a number of years that would allow DHBs to plan over a longer timeframe and potentially reallocate funds between time periods – is not a feature of current funding arrangements. This means DHBs can't undertake a major investment today that will be funded through the savings it generates next year and the year after that.

Due to the absence of multi-year funding, the options available to DHBs to fund major increases in operating expenses in specific services have required one of three options:

- Cutting back services in other areas
- Re-directing capital funding
- Working with the Ministry of Health to develop a budget initiative for additional funding.

Most major changes to DHB annual expenditure are related to capital expenses. DHBs are expected to manage their operational expenditure within the budget allocated on an annual basis. For example, if a DHB identifies an opportunity to commission additional services from community-based providers and that this will result in reduced costs from hospital-level acute care services, then DHBs are expected to be able to reallocate funding to achieve this. In reality, however, even where new investment is expected to generate cost savings in the same year, DHBs struggle to shift expenditure between uses. This has been observed as primary care funding has failed to grow despite widespread recognition that increased investment is warranted.

Occasionally opportunities to deliver significant improvements in outcomes and value for money arise that require substantial operating expenditure. In general, if a DHB needs to make major expenditure shifts that cannot be achieved by cutting back services in other areas, the DHB would need to work with the Ministry of Health to gain the Ministry's support and the Ministry would then put forward a budget bid for additional funding. For the Ministry of Health to be supportive of such requests would open it up to pressure from every DHB for any cost pressure or service change that increases costs in the short run. The more capacity-constrained the DHB, the greater the pressure on the Ministry. Therefore, it is not surprising that initiatives to generate additional funding for DHBs have tended to be generated from the Minister or Ministry of Health and apply to all DHBs, e.g. additional elective services, building colonoscopy capacity to support the National Bowel Cancer Screening Programme.

An additional challenge to getting DHB-initiated service changes with requirements for funding increases through the budget process is the strong element of politics as the budget initiatives are put forward. A DHB, and indeed the Ministry, could devote a significant amount of resources to modelling the costs and benefits of an initiative and still find that the initiative does not get put forward for consideration.

The lack of avenues for increasing short-run operating expenditure to generate longer-term savings and the general lack of visibility and flexibility in DHB's annual budgets are a disincentive to long term planning

It is not surprising, also, that DHBs have dipped into their capital budgets to fund increases in operating expenditure, resulting in the now well-recognised deferred maintenance problem facing DHB physical infrastructure. The Government's response has been to prioritise supporting DHBs to make the required capital investments to ensure buildings are fit for purpose. But as yet, no changes have been made to facilitate increases in operating expenditure. This means that DHBs are likely to prioritise initiatives that require capital funding over those that require significant new operating expenditure.

7.3 Private costs

Private costs are an important issue for renal patients, whether they have dialysis or a transplant. These costs include:

- Travel and accommodation for recipient and donor work-up
- Travel and accommodation costs for dialysis patients whose home DHB does not offer dialysis
- Travel and accommodation costs for dialysis patients who want or need to use home dialysis and must travel to another centre for training.

Due to the lack of available services to support recipient and donor work-up, in many areas, many New Zealanders who could benefit from transplantation incur significant costs associated with travel and accommodation to obtain services. The Compensation for Live Donors Act does not provide compensation to donors for travel and accommodation costs associated with the work-up process or follow-up appointments post-surgery. Instead, donors must apply to the Ministry of Health for National Travel Assistance (NTA) (Ministry of Health 2021).

NTA is a scheme provided by the Ministry of Health to assist people who must incur travel costs to obtain health services. Patients who have travelled can claim for kilometres travelled by car, public transport, accommodation, and specialised transport, including taxis and air travel.

Dialysis patients may also access NTA funding to travel for dialysis or home dialysis training. In these cases, travel is frequent and/or there is a need for accommodation – long-term accommodation in the case of people who must travel to access home dialysis training which may take nine months to complete. Not only are travel costs high to the NTA scheme, but private costs are high due to the insufficiency of NTA to cover the true costs of travel.

The Ministry of Health states that "*the NTA scheme is in place to provide some financial assistance to people for whom the cost of travel is a barrier to accessing treatment. It is not possible to cover the total cost in all instances due to limited funds*." Failing to cover total costs results in inequitable access. People with better access to financial resources are better able to meet the additional costs, while those with few financial resources to draw on, may face insurmountable barriers.

According to the Ministry of Health's website, the NTA reimbursement levels have not been revised since 2009. This means the gap between costs and reimbursement and the resulting inequities have likely grown considerably in the last twelve years. The IRD mileage rate for the use of vehicles for business purposes (including both running and fixed costs) is 79 cents per kilometre[5] – nearly three times the amount reimbursed through the NTA. For patients who travel into New Zealand's major centres, it is difficult to imagine that $100 per night will cover the cost of reasonable accommodation. In fact, a 2020 Kidney Health NZ survey of accommodation options within a two-kilometre radius of the three transplant centres (Auckland, Wellington, Christchurch) found that patients would have to pay $160 per night for accommodation.

Other concerns related to private costs for patients raised with Kidney Health NZ by DHBs include:

- Patients' costs for travel (eg taxi) between accommodation and hospital is not covered by NTA. Transplant recipients sometimes face real hardship after a period of accommodation that is not fully funded and multiple hospital appointments over a period of months.
- Patients transferred between facilities may not be approved for NTA to return home.
- Peritoneal dialysis (PD) patients are unable to access NTA to deal with the cost of getting to the PD unit for training, clinics and surgery, resulting in an inequity for patients who want to be more independent.
- Dialysis patients may choose to drive themselves to dialysis facilities but they are often tired afterwards, making a long drive potentially dangerous. Alternative transport options are needed.
- Even when accommodation costs are met, patients face additional costs resulting from a need to eat out while away from home. These costs become out-of-pocket expenses for patients.
- NTA de-registers dialysis patients from taxi travel eligibility if the patient can sometimes be driven to dialysis by friends or family: Patients are disincentivised to help the health system save money.
- NTA coordinators are not medically trained and yet they interpret clinical letters from clinicians to determine whether patient's medical needs indicate eligibility for NTA.
- There is inconsistency in approvals that results in differential access barriers and private costs for patients.

In addition, for patients who must travel by air, the NTA will only cover airport transfers from the airport to treatment and back. It will not cover transfers from the patient's home to the airport. It also will not cover airport departure taxes.

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[5] https://www.ird.govt.nz/income-tax/income-tax-for-businesses-and-organisations/types-of-business-expenses/claiming-vehicle-expenses/kilometre-rates-2020-2021

Table 8 National Travel Assistance reimbursement levels

Cost category	Reimbursement
Mileage	28c per kilometre
Accommodation	Up to $100 per night
Public transport	Actual cost
Air travel	Actual cost
Taxi	Actual cost

Source: Ministry of Health (n.d.)

The requirement to incur the cost first and then to provide receipts for reimbursement six weeks later with no mechanism to query or challenge reimbursement decisions means that there remains both a real and potential upfront travel cost barrier for some patients.

For those on low incomes, a particular issue is that local travel, such as travel to the GP or for testing and diagnostics that can be done locally, the NTA provides no reimbursement for travel costs. On the other hand, some DHBs provide free travel and accommodation for some patients receiving dialysis treatment without paying upfront, saving receipts, and applying for reimbursement.

8 Leadership and governance

Leadership and governance are essential to the effective and equitable operation of a health care system. The role of leadership is to provide strategic vision and support the implementation of that vision by directing and managing resources. Governance is critical to health system operation and overall performance. This is backed up by experience from many contexts indicating that strong governance has enabled greater increases in health outcomes and access to care after controlling for differences in wealth and health care spending (Siddiqi et al. 2009).

According to the WHO, leadership and governance "*involve ensuring strategic policy frameworks exist and are combined with effective oversight, coalition building, regulation, attention to system design and accountability*" (World Health Organization 2007).

8.1 System oversight

Renal services from primary care to RRT and beyond form a system of care that spans all service contexts from tier 1 services to tertiary hospitals and highly specialised care. To function well as an integrated and coordinated spectrum of care for patients, effective and responsive system oversight is needed.

Across the system, clinicians and other decision-makers indicate that policy and practice are not always the same: While there is broad agreement on policy, from the use of the eligibility algorithm to scoring requirements, practice tends to vary between clinicians and between transplant centres. Without strong national oversight, implementation of policy into practice risks introducing geographic variation in access to transplantation: Some nephrologists may be more pro-active in assessing patients who may be borderline cases and helping them address health issues that negatively affect their scoring, while others are more conservative and use their judgement as a strict rationing device to the use of eligibility assessment. Similarly, transplanting centres may accept or reject certain patients, and referring nephrologists may or may not attempt to get patients transplanted in another centre if rejected by the nearest one. The use of an algorithm to determine what testing is required may not provide optimal or equity-focused decision-making.

8.2 Regional and national planning

The health and disability system review noted that the current system is characterised by "*multiple barriers to the shift to a more population health-focused system*". Two specific barriers related to health system leadership and governance were identified:

- Excessive focus on measuring short-term impacts or throughput (such as elective surgery targets) rather than long-term population health gains
- A lack of long-term planning and forecasting.

In 2006 the National Renal Advisory Board noted that with some exceptions, there was a lack of regional and national planning of renal care.

The lack of regional and national planning in renal services means:

- There is no visible pipeline, actual or modelled, for secondary care service planning

- There are clear referral guidelines for referrals from primary care to support equitable access to early or pre-emptive transplantation, but low awareness suggests these are not well socialised.
- There is inadequate coordination and integration between tier 1 services and tier 2 services to support innovative models of care that improve patient management and delay the onset of ESKD.
- There is little transparency about how the system works for people with ESKD. While data is published indicating the volumes of dialysis and transplantation, time spent on the waitlist, delays in the living donor work-up process, and the outcomes of waitlisted people are not published or easily obtained.
- The fragmentation of this relatively small service area across 20 DHBs hinders investment in solutions that may increase access to transplantation, including specific solutions for Māori and Pacific New Zealanders.
- Forward planning even at a single DHB level is impossible due to the high volumes of patients who cross DHB borders for dialysis or transplantation, resulting in rapid escalation of urgent need for new dialysis capacity, which might have been avoidable if increased transplantation had been planned and funded earlier.
- DHBs compete with each other for a small workforce, with no strategic view of workforce needs and how to meet them over the longer term and no plan to train new staff.

The National Renal Advisory Board (NRAB) recommended establishing a national framework for renal services to provide guidance to DHBs on service planning to prevent, delay the onset of and better manage chronic kidney disease. A national framework for renal services should take a whole system perspective, integrating renal services with other services and including the full spectrum of care from primary prevention and primary care management to ESKD treatment options and end of life care.

A national framework for renal services would:

- lay the foundation for improved interface between tier 1 and tier 2 services
- Increase transparency in service provision and access
- Establish the set of high-level principles for regional service planning
- Provide guidance for planning and service provision as demand escalates
- Outline how the system should respond to CKD in Māori and Pacific populations.

  (National Renal Advisory Board 2006).

The NRTS was established as a national service in September 2014 to provide clinical leadership, strategic oversight, direction, and support for implementing initiatives to improve access to live donor kidney transplants in New Zealand. But the NRTS does not do the same for deceased donor kidney transplants.

The target for the NRTS is to "*increase the volume of live donor transplantation by 10 per annum from a base of approximately 110 live and deceased donor transplants per annum to 160 per annum in 2018/19*" (National Renal Transplant Service 2019).

The NRTS monitors live kidney transplantation rates based on:

- data provided directly by the Clinical Directors at the three Transplanting District Health Boards (DHBs)
- data from individual renal units provided by the ANZDATA
- donation data provided by the New Zealand Blood and Organ Service (NZBOS).

(National Renal Transplant Service 2021)

8.3 Consensus to implementation

A National Consensus Statement is a document that articulates best practice in a particular area of care for specified health concerns. The National Consensus Statement, Managing Chronic Kidney Disease in Primary Care (Ministry of Health 2015) specifies how primary care clinicians should identify and manage patients with CKD and set expectations for provider and funder organisations.

While acknowledging that many people with CKD can be fully managed in primary care, the consensus statement indicates that integrated care is an essential component of a high-quality care pathway: "*An important focus of secondary renal and diabetes services should be to work innovatively together with primary care to ensure that all clinicians are well supported in their provision of optimal renal care*" (Ministry of Health 2015, 5).

Although Guidelines for the management of CKD are well accepted, the implementation of best practice in primary care settings is noted as being challenging due to:

- The general lack of time and resource in primary care and in renal services to do this work.
- Variable implementation of decision-support tools based on current guidelines.
- The complexity of incorporating detection and management of CKD into primary practice patterns.
- The skill and time required for GPs to effectively collaborate with patients to make significant lifestyle changes.
- The need for high-risk patients with progressive CKD to have a focused case-management approach.
- The decision to involve specialist clinicians in the care of patients with CKD being largely left up to individual primary care clinicians to make.

Ensuring that consensus is carried through to implementation is a key role for leadership and governance.

8.4 Performance management

The Planned Care programme is the Ministry of Health's main mechanism for improving the way healthcare resources are designed and delivered. According to the Ministry of Health "*Planned Care generally begins from the point a person is referred for specialised care from their primary care provider or other health professional. It includes more than just hospital-based care and admissions and covers all appointments and support that people need during their healthcare journey*".

Kidney transplants and the work-up required naturally fit the planned care framework, but they are not included in planned care targets that DHBs have been incentivised to reach in order to access additional funding.

Planned care targets could be extended not only to include transplant surgery and organ retrieval surgery but also the donor work-up diagnostics that may take place in the community and hospital settings.

8.5 Ownership of the problem

Responsibilities for kidney donation and transplantation are split across two organisations:

- The New Zealand Blood and Organ Service (NZBOS) is responsible for increasing only deceased donation (Organ Donation New Zealand, the coordinating service for deceased donor transplants, now sits within NZBOS)
- The National Renal Transplantation Service, a group of renal specialists, has been tasked by the Ministry of Health to oversee kidney transplantation. In practice, this primarily focuses on live kidney donation.

Martin (2013) noted that ownership of the problem was a critical barrier to increasing transplantation, arguing that *"leadership or governance arrangements of the transplant service are not necessarily the same as leadership of a specific strategy to increase rates of LDKT*".

8.6 Uncertainty and risk

A key role for leadership and governance in the kidney transplant landscape is identifying how to deal with the level of risk and uncertainty that may hinder investment and perpetuate the status of dialysis as the default option for ESKD patients.

Significant uncertainty exists at almost every decision across the patient pathway from primary care to live donor transplantation:

- When should a patient be referred to specialist care?
- Will the patient be eligible for transplantation?
- Will the patient be able to find a live donor?
- Will the donor be compatible or assessed as otherwise suitable as a donor?
- Will the patient still be healthy enough to have the transplant by the time the donor work-up is completed?

At every stage, there is potential for the probability of a transplant taking place being severely hindered. This uncertainty results in a significant financial risk for funders: Despite investing in improvements across the system, there may still be a significant risk that many patients end up having dialysis anyway, so the path to potential LDKT represents a potential additional cost.

But currently, no single group or body is undertaking the kind of research needed to understand the level of uncertainty better so that modelling of possible solutions can be made possible to inform decisions to minimise the financial risk.

9 The opportunity for increased transplantation

The role of a publicly funded health system is to provide the best possible outcomes for the population it serves. But doing so within a constrained budget means having to make tough decisions that often result in some services being excluded due to the value they offer is less than what could be achieved through a different investment.

Value for money in health care is a question of what outcomes are achieved at what cost. Outcomes are typically measured as quality-adjusted life years (QALYs). In general, publicly funded health systems are willing to pay more for additional QALYs up to a maximum value that provides a threshold against which all health investment decisions may be evaluated.

The expectation is usually that additional QALYs will come at a cost, so the question is really about whether that cost is acceptable. However, in rare cases, it is possible that additional QALYs can be obtained while at the same time achieving health system or societal savings. In such cases, the result of cost-effectiveness analysis is not just favourable; it is indicative of resources being wasted and a system that is failing to optimise health outcomes within its budget.

When interventions that offer both improved outcomes and cost savings are not maximised, the health system is wasting resources and failing its population.

The following sections examine the evidence for costs and outcomes associated with transplants compared with dialysis. The results summarised here are cost estimates based on health service utilisation over six years and modelled to 20 years of follow-up. Detailed results of the six-year cohort comparison are presented in Appendix B.

9.1 Emergency department presentations

Based on a Treasury value of $437 per ED presentation, the total six-year cost of ED presentations per person in the transplant cohort was $2,986 compared to $4,153 per person in the dialysis cohort - a cost difference of $1,167 over six years.

Table 9 ED costs per cohort member

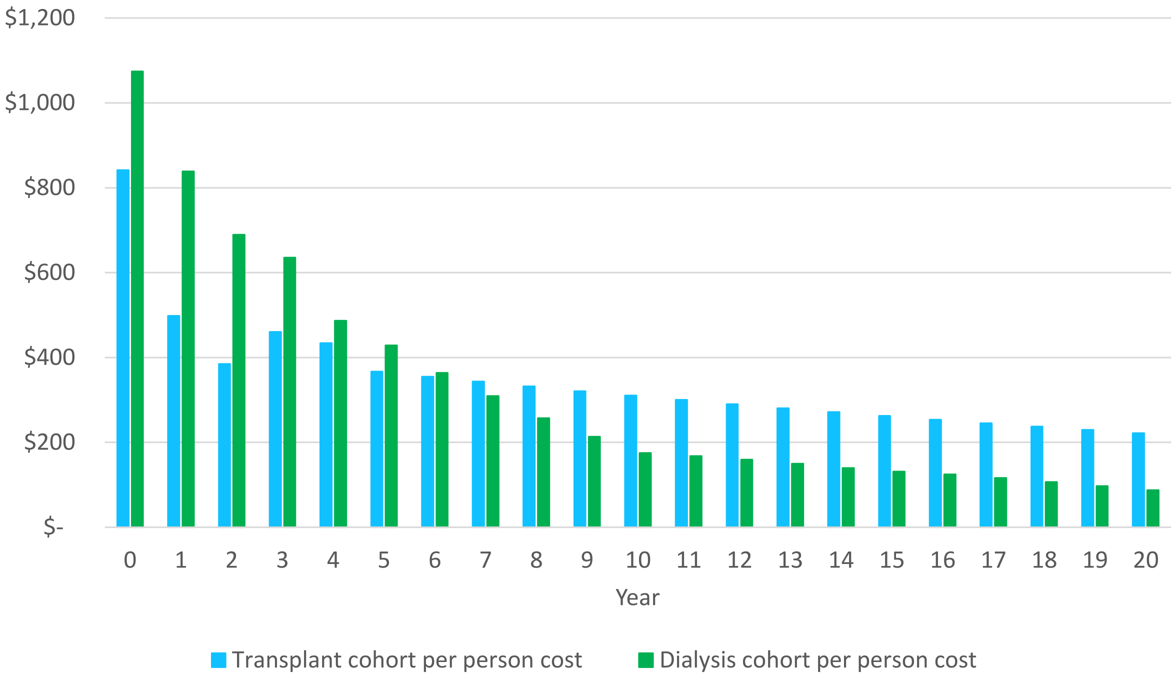
2015/16 to 2020/21

	Cost per dialysis cohort member	Cost per transplant cohort member	Difference
2015/2016	$1,074	$842	$232
2016/2017	$839	$498	$341
2017/2018	$689	$385	$305
2018/2019	$635	$460	$175
2019/2020	$487	$434	$53
2020/2021	$428	$367	$61
6-year total	$4,153	$2,986	$1,167

Source: NZIER

Over the 20-year follow-up, however, our model has an increasing number of transplant cohort members switching back to dialysis (and modelled as experiencing the same ED costs as dialysis cohort members from that point forward)[6], while dialysis cohort members are more likely to die (and cease to incur costs).

Figure 26 Transplant and dialysis expected ED costs per cohort member modelled over 20 years



Source: NZIER

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[6] Our data did not cover a long enough time period to analyse initial versus subsequent transplants. All transplants occurring in 2015/16 were included.

The result of these changes is that over 20 years, the expected ED cost is higher for a person having a kidney transplant than for a person starting dialysis.

Table 10 Expected ED costs over 20 years

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
0	$1,074	$842	$232
1	$839	$508	$331
2	$689	$395	$295
3	$635	$469	$166
4	$487	$442	$45
5	$428	$372	$56
6	$364	$360	$4
7	$310	$348	-$39
8	$257	$337	-$80
9	$213	$326	-$113
10	$175	$314	-$139
11	$168	$304	-$136
12	$160	$294	-$134
13	$150	$285	-$134
14	$140	$275	-$136
15	$131	$269	-$138
16	$125	$260	-$136
17	$116	$252	-$136
18	$107	$244	-$137
19	$97	$236	-$139
20	$88	$228	-$141
Total	**$6,753**	**$7,360**	**-$608**

Source: NZIER

Transplantation is expected to generate an additional $608 in ED costs per person transplanted over 20 years.

9.2 Inpatient admissions

To estimate the cost difference between dialysis and transplantation for inpatient admissions, we use the cost per day indicated by the Pharmac cost manual to capture average costs associated with inpatient admissions. Pharmac's cost manual indicates that the 2017 value of a day in an inpatient medical ward was $1,200. Inflated to 2022 values, this is worth $1,522. This cost is appropriate over a long period of time and multiple admissions as the cost per day are likely to be reasonably approximated by an average value such as this. However, this value is unlikely to capture the initial inpatient costs for transplant patients. For this, we make some adjustments to reflect:

- The surgical cost of transplantation
- The donor-related costs of work-up and organ retrieval.

9.2.1 Surgical cost adjustment

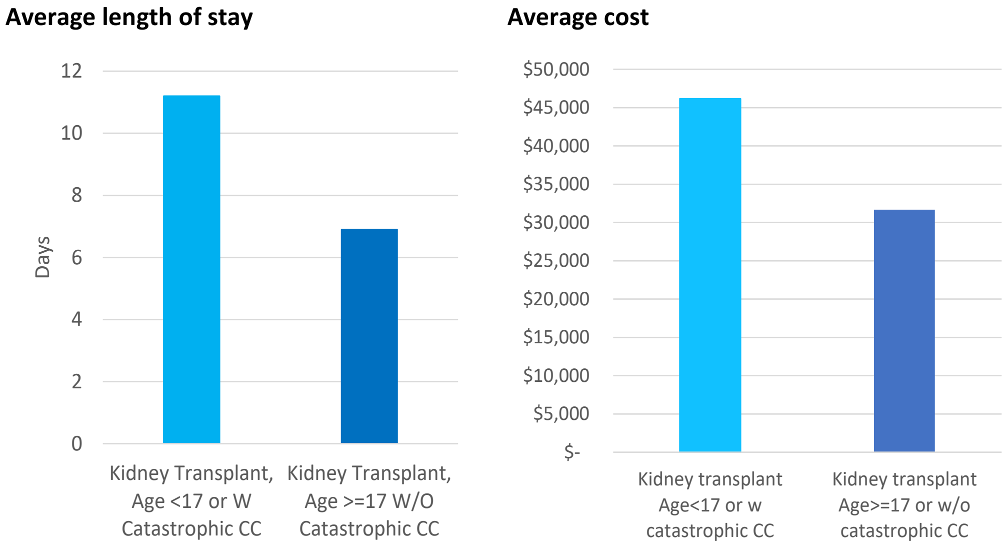
Costings for publicly funded casemix hospitalisations in 2019/20 were extracted for this report and showed that a kidney transplant in a patient aged 17 or over without catastrophic complications is associated with:

- An average length stay of 6.9 days
- An average cost of $31,669 – equivalent to $34,989 in 2021/22.

Kidney transplants in people aged 16 or younger and kidney transplants in people aged 17 or older who experience catastrophic complications are associated with:

- An average length of stay of 11.2 days
- An average cost of $46,187 – equivalent to $51,030 in 2021/22.

Figure 27 Average length of stay and average cost of kidney transplant surgery discharge



Source: NZIER, Ministry of Health data

Ministry of Health data indicates that in 2019/20, there were 106 transplants in people aged 17 and over without catastrophic complications (low cost) and 71 transplants in people aged 16 or under or people aged 17 or older with catastrophic complications (high cost). The weighted average cost of the transplant surgery admission is, therefore, $37,493.

Adjusting this figure to reflect only surgical costs and excluding ward costs (based on the 2021/22 value of the Pharmac cost manual estimate of $1,522 and the weighted average length of stay of 8.58 days) indicates the maximum adjustment for surgical costs not reflected in the estimate is $24,434.

Table 11 Ward and surgical cost breakdown of transplant discharge costs

	Low cost transplant[1]	High cost transplant[2]	Weighted average transplant
Number	106	71	
Discharge cost	$31,669	$46,187	$37,493
Average length of stay	6.9	11.2	8.58
Ward cost			$1,522
Non-surgical cost			$13,059
Surgical cost			$24,434

1 Transplants in people aged 17 and over without catastrophic complications.

2 Transplants in people aged 16 or under or people aged 17 or older with catastrophic complications.

Source: NZIER

9.2.2 Donor cost adjustment

There are no New Zealand estimates of the cost of donor work-up and donor care. Even surgery to remove the kidney is coded in a way that does not readily allow these procedures to be distinguished from kidney removal for other reasons.

A Canadian study (Habbous et al. 2018) identified the health system costs (all reported in 2017 $CAD) of the donor work-up process (excluding reimbursement of lost income, travel and accommodation costs) and found that:

- Previous studies had estimated the total cost of living donor-related care as CAD $15,462 in France and CAD $15,850 in Spain.
- The average cost to the health system attributable to a living kidney donor was estimated at CAD $16,290.
- Most costs were incurred in the perioperative period (CAD $11,694).
- Costs associated with the evaluation of the potential donor amounted to CAD $3,596.
- Donor candidates who only completed a portion of their evaluation incurred an average cost of $1,633. There was a nearly linear relationship between the proportion of the evaluation completed and the cost of the donor evaluation.

Based on the average cost to the Canadian health system attributable to a living kidney donor (2017CAD $16,290), a possible estimate for this cost in the New Zealand context in 2021/22 would be $24,395[7].

But some kidney recipients would not receive a kidney from the first donor identified and assessed. We assume an average additional cost equivalent to the average cost of partially completed donor evaluation (as reported in Habbous et al. 2018) for each transplant. This means an additional cost of $2,446. In reality, some donors will be rejected at an earlier

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[7] Converted to New Zealand dollars using OECD purchasing power parities for 2017 and inflated using the Treasury CBAx tool.

stage, so this amount allows for more than 2 potential donors being assessed for each transplant that occurs. This brings the total donor-related cost adjustment to $26,841.

9.2.3 Results

In the year that transplants occur, members of the transplant cohort unsurprisingly have higher inpatient costs than members of the dialysis cohort, but in subsequent years, a patient who initiated dialysis in the same year is expected to have higher inpatient costs on average.

Table 12 Inpatient admission costs per cohort member

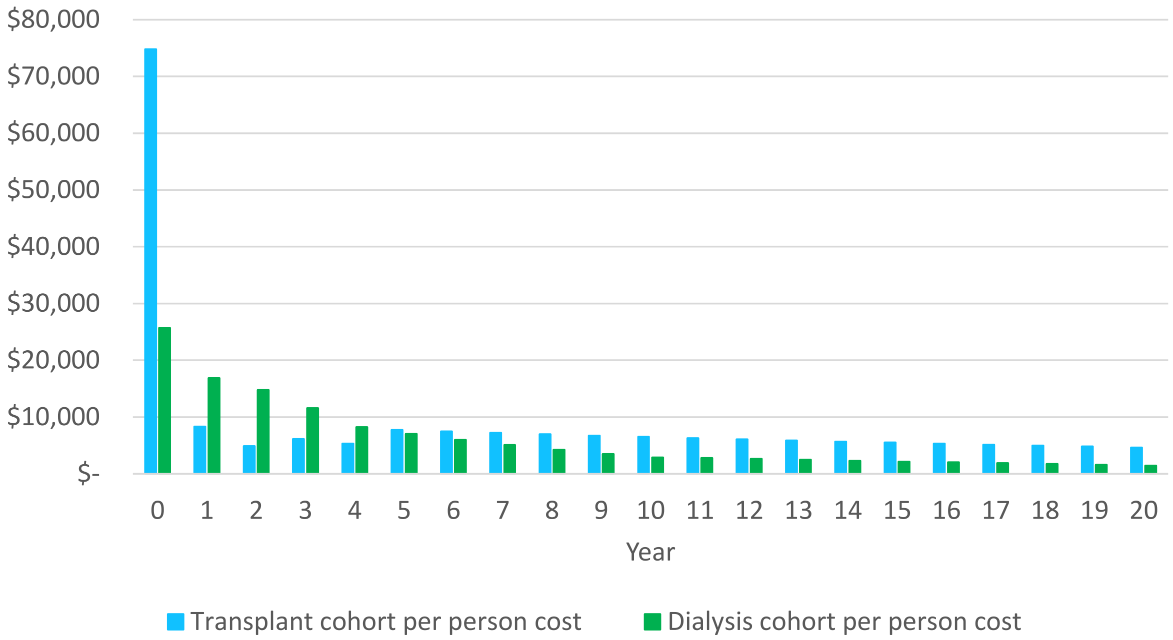
2015/16 to 2020/21

	Cost per dialysis cohort member	Cost per transplant cohort member	Difference
2015/2016	$25,690	$74,805	-$49,115
2016/2017	$16,864	$8,320	$8,544
2017/2018	$14,785	$4,881	$9,905
2018/2019	$11,549	$6,139	$5,410
2019/2020	$8,209	$5,337	$2,872
2020/2021	$7,055	$7,711	-$656
6-year total	**$84,153**	**$107,193**	**-$23,041**

Source: NZIER

However, over time, due to a higher mortality rate in the dialysis cohort and a rising rate of non-fatal graft failure in the transplant cohort, the expected inpatient cost associated with dialysis falls while the expected inpatient cost associated with transplantation increases.

Figure 28 Transplant and dialysis expected inpatient costs per cohort member modelled over 20 years



Source: NZIER

The result of these changes is a rising excess cost associated with transplantation, amounting to $69,601 over 20 years.

Table 13 Expected inpatient costs over 20 years

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
0	$25,690	$74,805	-$49,115
1	$16,864	$8,320	$8,544
2	$14,785	$4,881	$9,905
3	$11,549	$6,139	$5,410
4	$8,209	$5,337	$2,872
5	$7,055	$7,711	-$656
6	$5,997	$7,457	-$1,460
7	$5,097	$7,211	-$2,113
8	$4,231	$6,973	-$2,742
9	$3,512	$6,743	-$3,231
10	$2,883	$6,520	-$3,638
11	$2,767	$6,305	-$3,538
12	$2,629	$6,097	-$3,468
13	$2,471	$5,896	-$3,425
14	$2,298	$5,701	-$3,403
15	$2,162	$5,513	-$3,351
16	$2,054	$5,331	-$3,277
17	$1,910	$5,155	-$3,245
18	$1,757	$4,985	-$3,228
19	$1,599	$4,821	-$3,221
20	$1,441	$4,662	-$3,220
Total	**$126,963**	**$196,564**	**-$69,601**

Source: NZIER

9.3 Outpatient attendances

To estimate costs associated with outpatient attendances, we split outpatient attendances into two categories:

- Dialysis
- Non-dialysis attendances.

For attendances that do not involve dialysis, a standard cost of $413 per attendance (The Treasury 2021) is used. But this cost would be too low to capture the cost of dialysis and could not be applied due to coding of dialysis in Ministry of Health data (NNPAC), which involves coding each attendance for some dialysis services but coding only annual enrolment for other dialysis services. So, to estimate dialysis costs, we make an adjustment.

9.3.1 Adjustment to outpatient costs to reflect the cost of dialysis

There are three adjustments required to estimate the cost of outpatient attendances better:

- An adjustment to the dialysis cohort costs reflects that most of this cohort's outpatient attendances throughout the years were dialysis attendances.
- An adjustment to the transplant cohort to reflect that dialysis costs would have been incurred prior to transplants for at least some transplant patients. These costs should not be counted as a cost of transplantation as the ideal scenario is a pre-emptive transplant.
- An adjustment to the transplant cohort to reflect the return to dialysis for patients who experience non-fatal graft loss.

Dialysis cost estimate

In 2005, Auckland District Health Board, Waitemata District Health Board and Counties Manukau District Health Board undertook cost modelling of RRT interventions based on 2003/2004 Counties Manukau DHB data[8] to inform renal service planning in the Auckland region. The costs published were reported separately for in centre dialysis, satellite haemodialysis, home-haemodialysis and peritoneal dialysis. The cost estimates for 2004 are shown in the table below, along with inflated costs (calculated using the Treasury CBAx tool).

Table 14 Estimated cost of dialysis based on previously published estimates

	2004 cost[1]	2022 cost[2]
In centre dialysis	$64,318	$152,415
Satellite haemodialysis	$48,172	$114,153
Home haemodialysis	$33,585	$79,586
Peritoneal dialysis	$36,614	$86,764

1 Cost based on 2003/2004 Counties Manukau data.

2 Cost inflated to 2022 using the Treasury CBAx tool, which inflates values using annually calculated GDP inflators.

Source: NZIER and Auckland District Health Board, Counties Manukau District Health Board, Waitemata District Health Board (2005)

These costs are clearly much higher than the outpatient costs of the dialysis cohort estimated using a standard outpatient visit cost. This is not surprising, considering the outpatient visit cost is based on a very short attendance for a follow-up appointment with a specialist rather than on an extended attendance with a procedure included.

NNPAC does not distinguish between dialysis types in the same way as the cost estimates published in 2004. Instead, it identifies:

- In centre-haemodialysis
- Self-managed haemodialysis

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[8] Auckland District Health Board, Counties Manukau District Health Board, and Waitemata District Health Board (2005).

- Home haemodialysis
- Continuous ambulatory peritoneal dialysis (CAPD)
- Automated peritoneal dialysis (APD).

Those dialysis types were used in the proportions shown below in 2020/21.

Table 15 Percentage of patients using dialysis, by type

Dialysis type	2020/2021 percentage
APD	5.3
CAPD	21
Home haemodialysis	11.3
In centre Haemodialysis	56.3
Self-managed dialysis	6.1

Source: NZIER, NNPAC data

To map the Ministry of Health data to previously published costs, we assume people coded as using self-managed dialysis are a category of home dialysis users. The impact of this assumption being wrong will be an underestimation of the weighted average cost of dialysis.

As the Ministry data does not describe satellite haemodialysis separately, we also assume the proportions reported by the NRAB apply to the in-centre dialysis figure derived from the Ministry of Health data.

These assumptions produce the following proportions and weighted average cost.

Table 16 Weighted average cost of dialysis in 2021/2022

Ministry of Health dialysis type	2004 published dialysis type	2020/21 %	2021/2022 cost
In centre haemodialysis	In-centre dialysis	38.6	$152,415
	Satellite dialysis	17.7	$114,153
Home haemodialysis, self-managed dialysis	Home haemodialysis	17.3	$79,586
APD, CAPD	Peritoneal dialysis	26.4	$86,764
All dialysis weighted average			**$115,712**

Source: NZIER

9.3.2 Results

The results of the 6-year cohort comparison indicate that dialysis costs are the major driver of any potential cost savings associated with transplantation. Over six years, the average transplant results in cost savings of $472,028.

Table 17 Comparison of total outpatient costs for dialysis and transplant cohort members

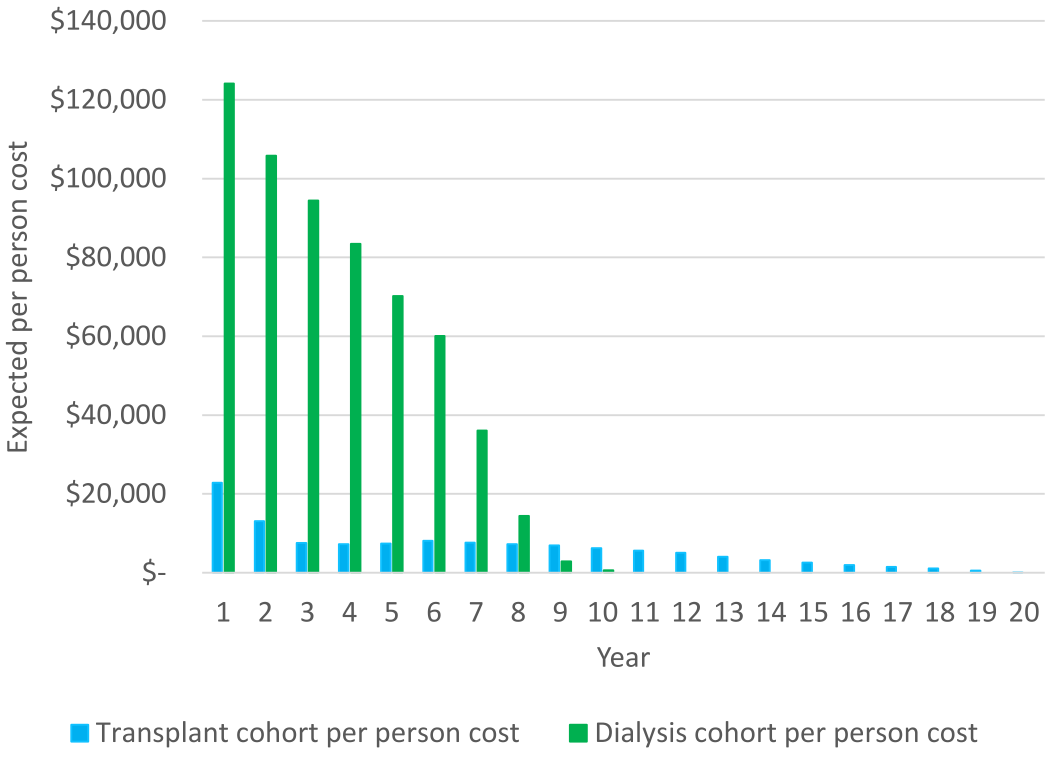
	Cost per dialysis cohort member	Cost per transplant cohort member	Cost difference
2015/2016	$124,115	$22,825	$101,289
2016/2017	$105,803	$13,078	$92,724
2017/2018	$94,478	$7,528	$86,950
2018/2019	$83,482	$7,258	$76,224
2019/2020	$70,216	$7,398	$62,818
2020/2021	$60,081	$8,059	$52,022
6-year total	**$538,174**	**$66,146**	**$472,028**

Source NZIER

> **On average a transplant will generate over $470,000 in savings over six years just as a result of reduced outpatient costs, mainly due to the reduced use of dialysis.**

Our 20-year follow-up model shows that the significantly lower survival rate in the dialysis cohort rapidly reduces expected costs in the first ten years. However, due to every surviving dialysis patient continuing to require dialysis every year, the expected per person outpatient costs for the dialysis cohort remain above the expected per person outpatient costs for the transplant cohort.

Figure 29 Expected outpatient cost per person modelled over 20 years



Source: NZIER

After 20 years of follow-up, the transplant cohort is expected to incur $187,747 in outpatient costs per person, while the dialysis cohort is expected to incur $902,671 in costs per person, indicating expected savings of $714,924 over 20 years per person transplanted. This is expected due to the considerably lower outpatient costs of transplant patients: Every year that a dialysis patient survives, their total outpatient costs are over $120,000 due to the need for $115,210 worth of dialysis just to stay alive. This compares to ongoing outpatient costs of around $8,500 per annum (approximately 21 outpatient visits) for a person who has had a transplant.

Table 18 Expected outpatient costs over 20 years

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
0	$124,115	$22,825	$101,289
1	$105,792	$15,295	$90,497
2	$94,469	$9,824	$84,645
3	$83,475	$9,534	$73,940
4	$70,211	$9,647	$60,564
5	$60,076	$9,170	$50,906
6	$51,065	$8,907	$42,158
7	$43,405	$8,652	$34,753

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
8	$36,026	$8,406	$27,620
9	$29,902	$8,168	$21,734
10	$24,547	$7,720	$16,828
11	$23,565	$7,497	$16,069
12	$22,387	$7,281	$15,106
13	$21,044	$7,072	$13,971
14	$19,571	$6,871	$12,700
15	$18,410	$7,262	$11,148
16	$17,490	$7,074	$10,415
17	$16,266	$6,893	$9,373
18	$14,964	$6,718	$8,247
19	$13,618	$6,548	$7,070
20	$12,274	$6,384	$5,890
Total	**$902,671**	**$187,747**	**$714,924**

Source: NZIER

Ongoing outpatient costs for surviving transplant patients have very little impact on the expected savings associated with transplantation due to these costs being tiny in comparison with dialysis costs. Over 20 years, savings in outpatient costs amount to over $700,000 per transplant.

9.4 Medication costs

The cost of medication for transplant patients was estimated based on the weighted average cost of immunosuppressant medication (calculation described in Appendix A), equal to $8,888.72 per person per year.

Factoring in both mortality and graft loss for transplant patients, our 20-year follow-up model indicates that the expected medication cost of transplantation is $146,403 over 20 years.

Table 19 Expected immunosuppressant medication costs over 20 years

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
0	n.a.	$8,889	-$8,889
1	n.a.	$8,711	-$8,711
2	n.a.	$8,533	-$8,533
3	n.a.	$8,296	-$8,296
4	n.a.	$8,296	-$8,296
5	n.a.	$8,267	-$8,267
6	n.a.	$7,991	-$7,991
7	n.a.	$7,724	-$7,724
8	n.a.	$7,466	-$7,466
9	n.a.	$7,217	-$7,217
10	n.a.	$6,994	-$6,994
11	n.a.	$6,761	-$6,761
12	n.a.	$6,535	-$6,535
13	n.a.	$6,317	-$6,317
14	n.a.	$6,106	-$6,106
15	n.a.	$5,855	-$5,855
16	n.a.	$5,658	-$5,658
17	n.a.	$5,467	-$5,467
18	n.a.	$5,283	-$5,283
19	n.a.	$5,105	-$5,105
20	n.a.	$4,932	-$4,932
Total	**n.a.**	**$146,403**	**-$146,403**

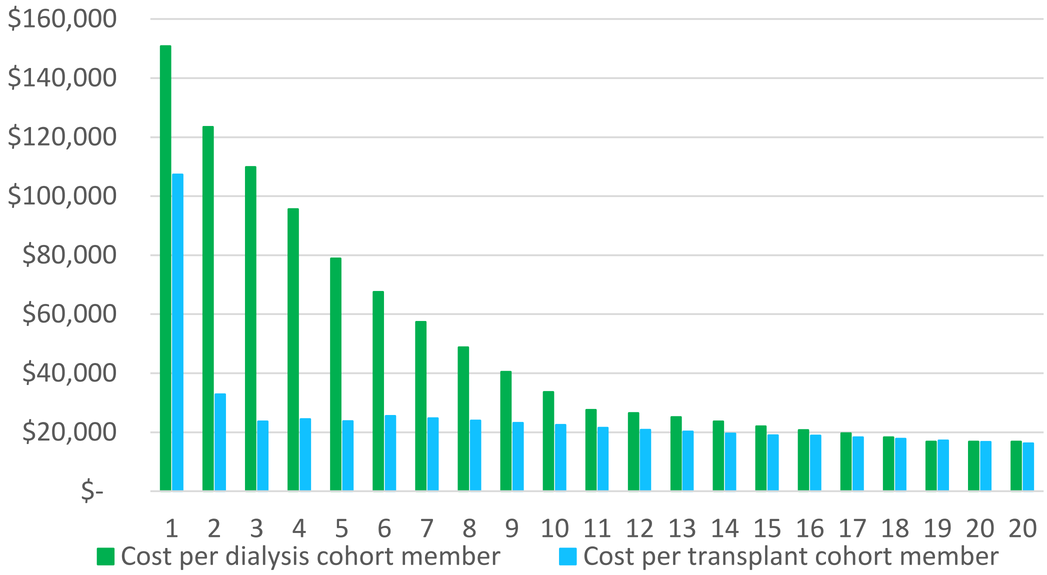
Source: NZIER

9.5 Total costs compared

In total, the 6-year costs of a person in the dialysis cohort amounted to $626,443, while the 6-year costs of a person in the transplant cohort amounted to $237,508 – a difference of $388,935 in favour of transplantation.

Modelling costs to 20 years shows that a typical dialysis patient is expected to have very similar costs to a typical transplant patient after 10 years, but it is important to bear in mind that after ten years, the probability of still being alive is 3 to 6 times higher for a typical transplant patient.

Figure 30 Expected total cost per person modelled over 20 years



Source: NZIER

In total, over 20 years, the expected costs of a dialysis patient amount to $1,040,927 while the expected costs of a transplant patient amount to $538,074, generating savings of $502,854, all while outliving the dialysis cohort by a wide margin (see Table 20).

Table 20 Expected total costs per person over 20 years

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
0	$150,878	$107,361	$43,517
1	$123,495	$32,834	$90,661
2	$109,944	$23,632	$86,312
3	$95,659	$24,439	$71,221
4	$78,907	$23,722	$55,184
5	$67,560	$25,520	$42,040
6	$57,426	$24,714	$32,712
7	$48,812	$23,935	$24,877
8	$40,514	$23,182	$17,332
9	$33,627	$22,453	$11,173
10	$27,605	$21,548	$6,057
11	$26,501	$20,866	$5,635
12	$25,176	$20,207	$4,969
13	$23,665	$19,570	$4,095
14	$22,009	$18,954	$3,055

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference (Dialysis cost – Transplant cost)
15	$20,704	$18,899	$1,805
16	$19,669	$18,324	$1,345
17	$18,292	$17,767	$524
18	$16,828	$17,229	-$401
19	$16,828	$16,709	$119
20	$16,828	$16,206	$622
Total	**$1,040,927**	**$538,074**	**$502,854**

Source: NZIER

These results are presented in present value terms (discounted) in Appendix C.

9.6 Sensitivity analysis

For sensitivity analysis, we consider an alternative first-year cost for transplant patients. In 2006, the National Renal Advisory Board reported that the cost of transplantation was $105,000. This was based on a personal communication from a source named as J. Patterson, and no details were provided as to how this figure was calculated. Nevertheless, the figure has been used to compare costs between dialysis patients and transplant patients, with an implicit indication that the figure represents the cost of transplantation over the full year in which the transplant is provided (including donor work-up, organ retrieval, and patient care).

We inflate the 2006 value to 2021/22, resulting in a value of $223,379 and substitute this value into our cost analysis, replacing our estimated adjusted year 1 elective inpatient cost for people in the transplant cohort.

The result of this adjustment is that first-year costs for transplant patients do become much higher than the first-year costs for dialysis patients. The cost differential on first-year costs is now $105,056 in favour of dialysis.

However, despite having a major impact on first-year costs, the total 6-year average costs of the two cohorts still indicate that substantial savings are associated with live donor transplants compared with dialysis: A total of $386,082 in health system savings is still expected to result from transplantation over six years and although this figure drops slightly in the 20-year follow up model, the result is still significant savings from transplantation: $354,280 over 20 years (see Table 21).

Table 21 Sensitivity analysis: Comparison of total expected costs per person for dialysis and transplantation

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Savings associated with transplant
1	$150,878	$255,935	-$105,056
2	$123,495	$32,834	$90,661
3	$109,944	$23,632	$86,312

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Savings associated with transplant
4	$95,659	$24,439	$71,221
5	$78,907	$23,722	$55,184
6	$67,560	$25,520	$42,040
7	$57,426	$24,714	$32,712
8	$48,812	$23,935	$24,877
9	$40,514	$23,182	$17,332
10	$33,627	$22,453	$11,173
11	$27,605	$21,548	$6,057
12	$26,501	$20,866	$5,635
13	$25,176	$20,207	$4,969
14	$23,665	$19,570	$4,095
15	$22,009	$18,954	$3,055
16	$20,704	$18,899	$1,805
17	$19,669	$18,324	$1,345
18	$18,292	$17,767	$524
19	$16,828	$17,229	-$401
20	$16,828	$16,709	$119
21	$16,828	$16,206	$622
Total	**$1,040,927**	**$686,647**	**$354,280**

Source: NZIER

These results are presented in present value terms (discounted) in Appendix C.

9.7 Transplants pay for themselves in the short run

Based on our estimates, transplants begin generating savings relative to dialysis at between one and three years. Transplants pay for themselves in terms of health system savings (become cost-neutral) within two (base case) to seven (sensitivity analysis) years.

Table 22 Time required for transplants to generate health system savings

Base case and sensitivity analysis

	Year	Cost per dialysis cohort member	Cost per transplant cohort member	Annual savings	Cumulative savings
Base case	1	$150,878	**$107,361**	$43,517	$43,517
	2	$123,495	$32,834	$90,661	$134,178
	3	$109,944	$23,632	$86,312	$220,490
Sensitivity analysis - high transplant cost	1	$150,878	**$255,935**	-$105,056	-$105,056
	2	$123,495	$32,834	$90,661	-$14,396
	3	$109,944	$23,632	$86,312	$71,916

	Year	Cost per dialysis cohort member	Cost per transplant cohort member	Annual savings	Cumulative savings
	4	$95,659	$24,439	$71,221	$143,137
	5	$78,907	$23,722	$55,184	$198,321
	6	$67,560	$25,520	$42,040	$240,361
	7	$57,426	$24,714	$32,712	**$273,073**

Source: NZIER

Our base case results are remarkably consistent with an earlier New Zealand study (P. Martin 2011) that found that, on average live transplants pay for themselves by 18 months to two years through health system savings with estimated savings of up to $53,000 per year per patient (worth $90,135 in 2022 dollars, assuming the original figure is in 2011 dollars).

With our 20-year follow-up after the year of transplantation, our analysis found that health system savings will ultimately average to approximately $17,000 (sensitivity analysis) to $24,000 (base case) per year for each transplant, with the highest annual savings achieved between years 2 and 4 – while survival remains high for dialysis patients and graft loss remains low for transplant patients. This may indicate that our follow-up is longer than what was used to generate the 2011 estimate.

9.8 The investment value of increased kidney transplantation

Based on our cost modelling, over its life, a kidney transplant costs less than keeping a patient on dialysis, even after taking into account graft loss and the additional health system costs associated with extended life.

The whole life costs for a kidney transplant are estimated at $538,074 to $686,647, whereas the whole of life cost for a patient on dialysis is $1,040,927, resulting in savings of $354,280 to $502,854 per transplant.

In 2019, there were 221 renal transplants in New Zealand, against a demand of nearly 600 (the active deceased donor waitlist plus approximately 50 percent more who are not waitlisted but who could benefit from transplantation). Assuming a similar level of kidney transplantation has occurred in 2021, based on our estimated health system cost savings, we estimate that for an achievable goal of lifting the combined renal transplant rate by 5 percent year on year, an investment of at least $4 million to $5.5 million in the first year, rising to $6 million to $9 million in 2031 would be financially justifiable, purely from a health system perspective (see Table 23 below). If a societal perspective were used, the justifiable investment would be even higher.

Table 23 Investment value of increased renal transplantation

Value of 5% year on year increase

Year	Number of kidney transplants	Additional transplants from 5% increase on previous year	Base case health system savings from additional transplants	Low estimate health system savings from additional transplants
2019	221			
2020*	-	-	-	-
2021*	-	-	-	-
2022	232	11	$5,556,533	$3,914,792
2023	244	12	$5,834,360	$4,110,532
2024	256	12	$6,126,078	$4,316,058
2025	269	13	$6,432,382	$4,531,861
2026	282	13	$6,754,001	$4,758,454
2027	296	14	$7,091,701	$4,996,377
2028	311	15	$7,446,286	$5,246,196
2029	327	16	$7,818,600	$5,508,505
2030	343	16	$8,209,530	$5,783,931
2031	360	17	$8,620,007	$6,073,127

*Due to service disruptions associated with Covid-19 pandemic restrictions we model the increase in transplants using the number of transplants in 2019 as the base.

Source: NZIER

9.9 Health outcomes

The two major benefits of kidney transplantation compared with dialysis are:

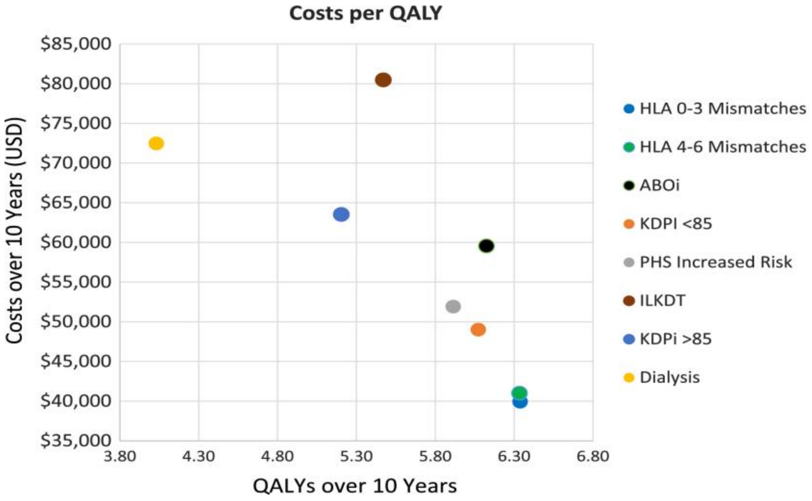
- a significant improvement in quality of life
- a longer life.

A major health economic study (Axelrod et al. 2018) of the 10-year costs and benefits of transplantation versus dialysis in a US population found that people who are on dialysis experience on average 4.03 QALYs over 10 years while people who receive a living donor transplant experience more than 6 QALYs over 10 years – a difference of at least 1.97 QALYs over 10 years, an improvement that is equivalent to nearly two additional years of life in perfect health. This estimate includes those who had a compatible, well-matched living donor transplant (6.34 QALYs) and those who had an incompatible living donor transplant (6.12 QALYs).

Moreover, that study found that even deceased donor kidney transplants with a high Kidney Donor Profile Index (KDPI) provided 5.2 QALYs (an increase of 1.17 QALYs over ten years). A high KDPI is associated with a higher risk of graft failure but results of the analysis suggest at least some elevated risk does not mean such transplants should not be considered.

Although the economic analysis of transplantation and dialysis conducted as part of that study included US health care costs which are not transferable to New Zealand, the study nevertheless showed that transplantation is usually not only more effective but less costly than dialysis even when the transplant is not from a living, compatible donor (see Figure below).

Figure 31 Expected Costs and QALYs over 10 years from a deceased donor and an incompatible living donor transplant compared with dialysis



HLA 0-3 mismatches are living donor transplants with a higher level of compatibility. HLA 4-6 mismatches, ABOi and ILDKT are types of incompatible living donor transplants. KDPI<85 is a low risk of graft failure deceased donor transplant, KDPI>85 is a high risk of graft failure deceased donor transplant, PHS Increased Risk is a deceased donor transplant with organs deemed at increased risk of viral disease transmission.

Source: Axelrod 2018

The Treasury value for a QALY represents the New Zealand value of a year in full health. In the 2022 version of the Treasury's cost-benefit analysis tool (CBAx), there are two possible values:

- A QALY value based on Pharmac's funding decisions: $36,363 (central estimate)
- A QALY value based on the value of a statistical life (VoSL): $59,897 (high estimate).

Based on the Axelrod (2018) estimates of QALY gains of 1.17–1.97 over ten years for a kidney transplant, we estimate that the quality-of-life value of a transplant is between $57,090 and $94,038 on average and up to $117,997 within the first ten years.

Deceased donor transplant recipients have a 15-year life expectancy, and live donor recipients have a 20-year life expectancy, compared with a 6-year life expectancy for dialysis patients. Additional value for QALYs related to extended life beyond ten years is likely to be in the range of $377,810 based on the higher QALY value (more appropriate for comparisons involving extended life, not just improved quality of life) and the total average QALYs for transplant patients (Axelrod 2018) if these extend to the second ten-year period.

Based on these estimates, even if a transplant offered no health system savings relative to dialysis, and in fact, cost the system $495,808 more over twenty years, it would still be considered a cost-effective intervention.

9.10 Employment outcomes

An additional benefit of transplantation over dialysis is the ability to return to full-time employment. People who use dialysis often travel to a dialysis unit to obtain care three to four times per week for several hours each time. This can make balancing dialysis, family life and employment impossible for many people.

A major systematic review and meta-analysis (Kirkeskov et al. 2021) found that employment rates are not high for dialysis patients or transplant patients and that employment did not always increase post-transplantation, depending on the context, patient variables (such as age and previous employment status) and study follow-up time. However, dialysis patients experienced a significant drop in employment after the initiation of dialysis, whereas transplant patients sometimes experienced an increase in employment post-transplant.

New Zealand based research is needed to identify the employment and income impacts of dialysis and transplantation. Without such research, the true benefit of transplantation cannot be known. However, every person who gives up full-time employment and becomes unemployed due to their need for dialysis is expected to incur the following costs:

- $53,831 in lost employment income and associated productivity
- $13,988 in lost income tax and ACC levy
- $8,815 in lost wellbeing from withdrawing from the labour force
- $19,097 to $25,220 in supported living payments
- $7,818 in accommodation supplements.

(Values obtained from the Treasury CBAx Impacts Database)

That is, for every person who had given up employment and is able to return to full-time employment post-transplant, additional benefits of transplantation amount to up to $53,831 in productivity, $8,815 in wellbeing directly related to labour force status, and up to $47,026 in additional fiscal savings (over and above health system savings).

10 Optimal system settings for increased kidney transplants

10.1 Objectives

The objectives of increasing the renal transplant rate and reforming the system to support this should include improvement on three key considerations:

- improved outcomes
- value
- equity.

While these considerations underlie all health and disability system reforms, they are not only jointly but independently critical in this case because simply increasing funding to support more transplants may deliver value and improved outcomes but may also risk widening disparities between Māori and Pacific New Zealanders with ESKD compared with non-Māori, non-Pacific New Zealanders who are currently far more likely to be waitlisted and to get a transplant.

Efforts to achieve transplant equity are typically focused on access to deceased donor kidney transplantation. This is due to the process of obtaining a live donor transplant being reliant on a single patient finding a potential donor, who is assessed for medically compatibility and general suitability to undergo the operation to donate a kidney. Due to the reliance of live donor transplantation on the willingness of friends or family to voluntarily donate a kidney, achieving transplant equity for live donor transplantation is more difficult to achieve. Of course, this does not mean improvements in live donor transplant rates for under-represented groups could not be achieved.

However, achieving transplant equity for deceased donor transplantation is more fully within the control of the system. Similarly, an effective system can ensure that everyone who meets legitimate clinical criteria is waitlisted and has a fair opportunity to receive the next available deceased donor kidney.

The system changes we suggest should apply to both live and deceased organ donation to deliver maximum value *and* maximum equity.

The final report of the Health and Disability System Review indicated that in a reformed health and disability system *"…hospital and specialist services would operate as a cohesive network working across all care settings and locations, and work collaboratively with Tier 1. The focus would be on providing care in the most appropriate setting with the right team of people engaged in delivering that care, to improve access and deliver more equitable health outcomes for New Zealanders*" (Health and Disability System Review 2020, 159). The following sections describe how this might be achieved for renal services.

10.2 System settings

10.2.1 A wider renal services perspective across settings of care

Kidney failure and the path to dialysis or transplantation is a textbook example of the need for integrated and coordinated health services. Improving care for people with kidney failure, including increasing their chances of a pre-emptive or early transplant and a longer healthier life, will require a range of changes across the system and these must be supported by strong leadership and governance, not left to chance as part of a wider system redesign.

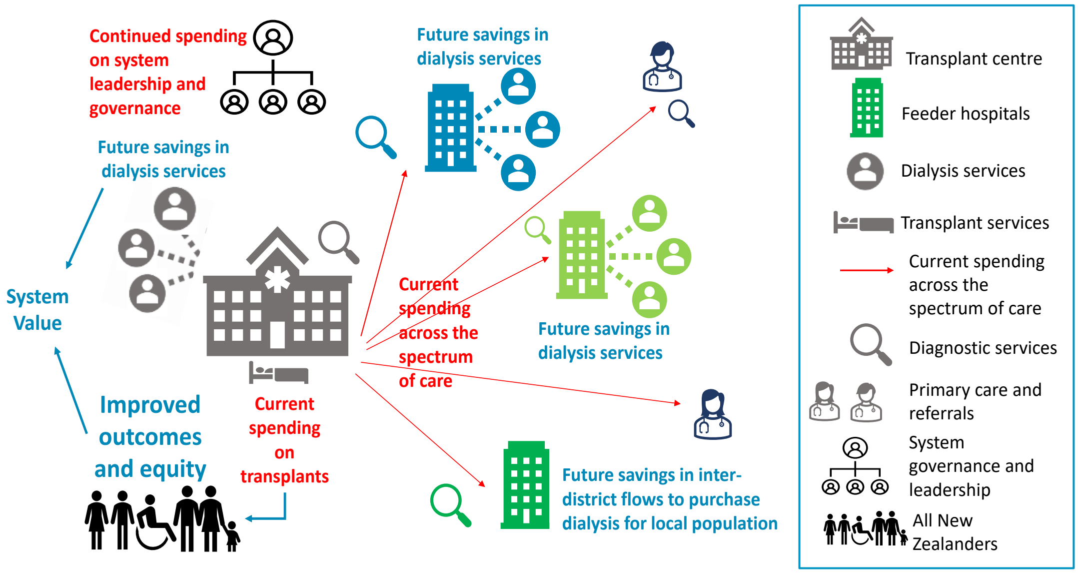
The system changes to ensure New Zealand can substantially increase transplantation rates to provide maximum value and to ensure Māori and Pacific New Zealanders have better access to transplants require a whole system view of care for people with chronic kidney disease. This means barriers across the spectrum of care all need to be addressed, including:

- Access to primary care, which is reduced for people on low incomes so that people with CKD may not always be well managed.
- Access to essential medicines, which is critical to delaying the onset and progression of CKD and the development of ESKD and can provide a longer window in which to coordinate services to enable pre-emptive or early transplantation.
- Referrals to secondary care, which must occur early enough to ensure optimal patient care and early initiation of processes to access transplantation.
- New listing guidelines to allow more patients access to the deceased donor waitlist.
- Criteria for being waitlisted for deceased donor transplantation.
- Criteria for live donors to be considered suitable for live transplantation.
- Faster access to diagnostic and patient assessment services for potential live donors.
- Access to services and procedures (e.g. bariatric surgery for weight loss) that can improve the chances of potential donors being considered suitable for donation or potential recipients being considered eligible for transplantation.

10.2.2 Access to funding over time and space

In addition to the spectrum of care, the system structure also needs to be reformed to better incentivise and enable increased transplantation. The key change needed is to remove funding constraints that currently make it difficult for DHBs to “borrow across time and space” – to access increased funding to invest in increased transplantation as a means of reducing population need for dialysis in the future and to reduce (often other hospital’s as well as their own) future liability in dialysis services (see Figure 32 below).

Figure 32 Borrowing across time and space



Source: NZIER

This solution is consistent with the general direction of health and disability system reforms: The health and disability system review final report indicated that in an improved system, Health NZ would fund the majority of secondary Tier 2 services using a population-based funding formula, but that for a small number of highly specialised services (provided by a small number of providers), funding should be from a Health NZ service agreement with clear service expectations. The report indicated that these agreements would be "*negotiated on a three- to five-year basis and would include a transparent analysis of costs of service provision*" (Health and Disability System Review 2020, 158).

10.2.3 Workforce investment to support increased transplantation

As the dialysis tsunami grows, there will be a need to increase the nephrology workforce. This is also needed to support access to transplantation.

But investment also needs to support an adequate workforce to improve deceased organ donation rates and the coordination of transplant pathways for both deceased and live donor kidney transplantation. This includes ICU coordinator roles which are currently often part-time, limiting opportunities to increase deceased donation, and donor coordinators and reducing the effectiveness of coordination services for the donor work-up process.

10.3 Responsibilities across the system

From the Ministry of Health down to clinical teams, there is a need for change to support increased renal transplantation rates. The responsibilities for these changes can be summarised as:

- Implementing effective structures and funding models to support change
- Developing and supporting the implementation of strategy
- Aligning incentives and payments with integrated care models
- Prioritising value in service planning and delivery

- Implementing improvements and reducing variation

10.3.1 Implementing effective structures and funding models to support change

As the health and disability system steward, the Ministry of Health plays a vital role in developing policy to support the implementation of effective structures and funding models.

Its primary contribution to increasing the rate of renal transplantation would be to consolidate leadership by establishing a National Renal Service (NRS) with a long-term planning horizon and tasking the NRS with the development and implementation of a renal services strategy.

Additional roles for the Ministry of Health include:

- Align workforce investment to support the strategy to increase renal transplantation rates
- Work with Treasury to ensure funding arrangements can readily support investments that can deliver savings in the future without the need to cut back other services
- Hold Health NZ and the Māori Health Authority accountable for optimising the use of transplantation nationally as a cost-saving and quality of life enhancing service
- Improve National Travel Assistance to remove financial barriers for RRT patients and potential donors.

10.3.2 Developing and supporting the implementation of strategy

The establishment of a National Renal Service (NRS) within Health NZ would centralise and consolidate leadership for the organisation and delivery of renal services across the country and across the spectrum of care. The NRS would be charged with:

- Developing a national strategy and framework for integrated renal services
- Developing integrated models of care that support access to pre-emptive and early transplantation
- Building capability across renal services, including increased clinical governance
- Improving coordination of renal services
- Defining good practice and how best to achieve it across the care spectrum
- Developing renal KPIs, including KPIs with an equity focus
- Informing the service planning and decision-making regarding allocation of resources for Renal Services across the spectrum of care and over time and space.

10.3.3 Aligning incentives and payments with integrated care models

Health NZ and the Māori Health Authority more generally should be responsible for aligning incentives and payments with integrated care models. This means:

- Working in collaboration with Māori and Pacific communities to develop system-wide approaches
- Monitoring and acting on geographic and ethnicity-based variations in decision-making

- Holding providers across the care spectrum accountable for pre-emptive, early and late transplantation using renal KPIs, including KPIs with an equity focus
- Aligning payments to incentivise pro-active and efficient identification and assessment of potential live and deceased donors
- Aligning payments and performance measures to prioritise high-value services
- Supporting data sharing between tier 1 and tier 2 renal services to improve service planning.

10.3.4 Prioritising value in service planning and delivery

The mandate may come from the top and incentives and funding mechanisms may be enabled by Health NZ and the Māori Health Authority, but transplant centres must also play a key role in system change. This should include:

- Collaborating in the development of integrated care systems for people with CKD to support improved service planning. This includes identifying and facilitating a coordinated and streamlined patient journey from their local service provider to the transplant centre for both organ recipients and organ donors.
- Working with dialysis providers to streamline processes across organisational boundaries.
- Supporting and facilitating innovative solutions to improve eligibility of borderline live donors. For example, bariatric surgery may be offered to facilitate weight loss. Transplant centres could be given the ultimate responsibility for ensuring eligible patients have access to such services, including, if needed providing them when the patient's local hospital does not or cannot.

10.3.5 Implementing improvements and reducing variation

Clinical teams handle the day-to-day operations and procedures that ultimately affect a patient's journey. They also have first-hand knowledge of patient needs, clinical safety, and opportunities for improvement. Clinical teams should be adequately resourced and engaged to:

- Collaborate across the care spectrum to ensure opportunities to initiate discussion or process of live transplantation are identified and acted on early for all patients who might need RRT. This may include improving the education of patients and referring clinicians to encourage kidney transplantation as the primary treatment for renal failure.
- Provide all patients with culturally appropriate support to empower informed decisions and ensure patients have the tools and resources needed to pursue live kidney transplantation.

The system changes described in this section are summarised in Figure 33 below.

Figure 33 Increased renal transplantation: System settings in a nutshell

Ministry of Health	**Implementing effective structures and funding models to support change** • Align workforce investment to support the strategy to increase renal transplantation rates • Work with Treasury to ensure funding arrangements can readily support investments that can deliver savings in the future without the need to cut back other services • Hold Health NZ and the Māori Health Authority accountable for optimising the use of transplantation nationally as a cost-saving and quality of life enhancing service • Improve National Travel Assistance to remove financial barriers for RRT patients and potential donors
National Renal Service	**Developing and supporting the implementation of strategy** • Develop a national strategy and framework for integrated renal services • Develop integrated models of care that support access to pre-emptive and early transplantation • Build capability across renal services, including increased clinical governance • Improve coordination of renal services • Define good practice and how best to achieve it across the care spectrum • Develop renal KPIs, including KPIs with an equity focus • inform the service planning and decision-making regarding allocation of resources for Renal Services across the spectrum of care and over time and space
Health NZ (with the Māori Health Authority)	**Aligning incentives and payments with integrated care models** • Work in collaboration with Māori and Pacific communities to develop system wide approaches • Monitor and act on geographic and ethnicity-based variations in decision-making • Hold providers across the care spectrum accountable pre-emptive, early and late transplantation using renal KPIs including KPIs with an equity focus • Align payments to incentivise pro-active and efficient identification and assessment of potential live and deceased donors • Align payments and performance measures to prioritise high value services • Support data sharing between tier 1 and tier 2 renal services to improve service planning
Transplant centres	**Prioritising value in service planning and delivery** • Collaborate in the development of integrated care systems for people with CKD to support improved service planning • Work with dialysis providers to streamline processes across organisational boundaries • Support innovative solutions to improve eligibility of borderline live donors
Clinical teams	**Implementing improvements and reducing variation** • Collaborate across the care spectrum to maximise opportunities live transplantation • Provide all patients with culturally appropriate support to empower informed decisions and ensure patients have the tools and resources needed to pursue live kidney transplantation

Source: NZIER

11 Recommendations

New Zealand is facing a veritable tsunami of demand for dialysis – a second wave, so to speak, tracking closely behind the type 2 diabetes tsunami that is a well-accepted challenge for health services. Māori and Pacific New Zealanders are most affected by the effects of end-stage kidney disease and the life-limiting nature of dialysis. They are also the least likely to benefit from renal transplantation.

It is well-accepted that renal transplantation offers a longer, higher quality of life, and this report demonstrates that in one to three years, transplants begin generating significant health system savings relative to dialysis, even after factoring in donor work-up and organ retrieval costs, and the risks and costs associated with graft failure.

There are few examples of opportunities for investment in health services that can deliver both substantially improved outcomes and health system savings. Transplantation even has the potential to reduce private costs, increase employment and income, and reduce welfare dependency. With clear equity targets, funding to address the particular barriers for Māori and Pacific New Zealanders, and an emphasis on deceased donor transplants, there is significant potential for equity gains. It is a golden opportunity, and international rates indicate that lifting the rate of renal transplantation in New Zealand is achievable.

But system barriers currently make this possibility remote. Siloed funding arrangements, across the fragmented geographic distribution of renal services, a lack of opportunity to and a lack of ownership of the problem owing to similarly fragmented leadership and governance are two critical barriers that health and disability system reforms must address if New Zealand wishes to address this problem. As of July 2022, DHBs will be rolled up into Health NZ, and many DHB boundaries will no longer exist, but regional planning challenges and variation in access to transplantation will continue unless specific steps are taken to address these issues.

A 5 percent lift in the combined renal transplant rate would be sufficient to ensure growth in renal transplantation outstrips growth in dialysis. Achieving this would generate savings sufficient to justify an investment of $4 million to $5.5. million in the first year.

We recommend:

- Setting a target of increasing the combined renal transplant numbers by five percent year on year to ensure growth in renal transplantation outstrips growth in dialysis.
- The consolidation of national leadership and governance of renal transplantation with a clear objective of lifting the combined (live and deceased) transplantation rate and ownership of the problem.
- The establishment of a National Renal Service within Health NZ with a planning horizon of 20 years to support the national commissioning of renal services across the spectrum of care.
- An adequate budget allocated to the National Renal Service to:
  - Develop and support the implementation of a national strategy to increase renal transplantation rates, including research to inform strategy with a focus on equity.
  - Develop a national strategy and framework for integrated renal services.

- Develop integrated models of care that support access to pre-emptive and early transplantation.
- Build capability across renal services, including increased clinical governance, training and funding of more ICU coordinators to improve the rate of deceased organ donation, increasing the capacity of the donor coordination team at Organ Donation New Zealand (ODNZ) to support increased transplantation, and improving GP knowledge of how to identify and best manage CKD in primary care.
- Improve coordination of renal services.
- Define good practice and how best to achieve it across the care spectrum, including supporting consensus building towards the development of a national health pathway to support timely referrals to secondary care.
- Develop renal Key Performance Indicators (KPIs) across the spectrum of care, including KPIs with an equity focus, to drive service improvement and track progress.
- Inform the service planning and decision-making regarding allocation of resources for Renal Services across the spectrum of care and over time and space.

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Appendix A Cost estimates for immunosuppressant medication

Table 24 below shows the two medication plans that informed the weighted average cost of immunosuppressant medication used in the cost model.

Table 24 Calculation of immunosuppressant drug cost for cost model

	Medication	Dose	Cost per 100	Annual cost	Proportion of patients
Typical Medication Plan A	Tacrolimus	2.75mg/2x/day	$267.90	$3,857.76	
	Mycophenolate	750mg/2x/day	$107.70	$1,550.88	
	Prednisone	6.75mg/day	$8.00	$28.83	
Plan A total				$5,437.47	55%
Typical Medication Plan B	Cyclosporin	225mg/day	$800.50	$11,527.20	
	Mycophenolate	750mg/2x/day	$107.70	$1,550.88	
	Prednisone	6.75mg/day	$8.00	$28.83	
Plan B total				$13,106.91	45%
Weighted average				$8,888.72	

Source: Kidney Health NZ

Appendix B Health system utlisation

To provide a basis for estimating the cost difference between dialysis and transplantation, we compared patients who had a transplant in 2015/16 with patients who started dialysis in 2015/16. This involved following:

- 760 people who started dialysis in 2015/16 (determined by the NHIs for these individuals not appearing in any dialysis service anywhere in New Zealand in 2014/15)
- 150 people who obtained a transplant in New Zealand in 2015/16 (identified through renal transplant diagnosis-related groups (DRGs) in inpatient data).

The 760 individuals who started dialysis and the 150 individuals who had a renal transplant were tracked over the first year in dialysis or the year of the transplant (2015/16) through to 2020/2021 – six full financial years. We were limited to six years due to the data provided by the Ministry of Health, including only seven years and the first year being used to establish which patients were new to dialysis the following year, to form a true dialysis cohort.

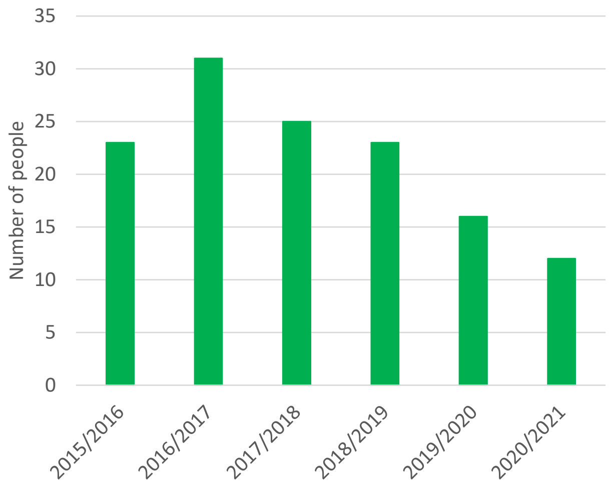
Over six years, we identified and compared:

- The number and rate of emergency department presentations
- The number and rate of outpatient attendances
- The number and rate of acute and arranged admissions
- The number and rate of elective admissions
- The average length of stay in inpatient admissions

B.1 Some dialysis patients get a transplant

Over the six years of follow-up, some dialysis patients went on to have a transplant (see Figure 34 below).

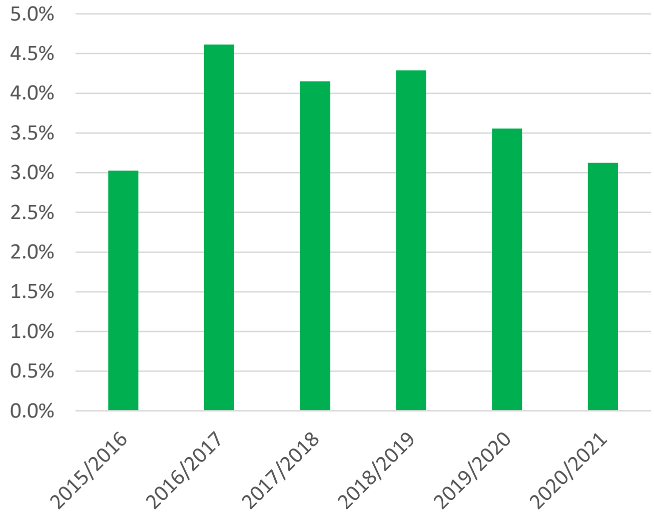
Figure 34 Number of 2015/16 new-to-dialysis cohort who were transplanted



Source: NZIER, NNPAC and NMDS data

The number of dialysis patients transplanted each year translates into a probability of obtaining a transplant at between three and five percent each year, peaking in year 2 and declining thereafter (see Figure 35 below).

Figure 35 Probability of a transplant for surviving dialysis patients



Source: NZIER, NNPAC and NMDS data

In total, 130 of the 760-strong cohort of new dialysis patients in 2015/16 had received a transplant by the end of 2020/2021 (17 percent).

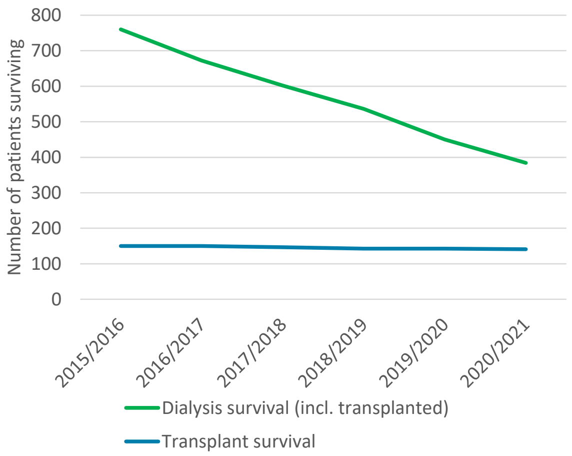
The year after initiating dialysis is the most likely time for dialysis patients to obtain a transplant. The probability of a dialysis patient having a transplant in any given year is between 3 and 5 percent.

B.2 Later transplantation increases the survival odds for the dialysis cohort

The survival rate of the 2015/16 cohort of new dialysis patients is skewed upwards by the increasing inclusion of patients who get a transplant. However, despite the increasing inclusion of transplant patients in the dialysis cohort, the 2015/2016 transplant cohort has a higher survival rate in every year over the following five years. This is consistent with the published literature.

It is possible that we underestimate the survival of transplant patients in this analysis as people who have had a transplant and are well are probably more likely to move overseas than dialysis patients, but this is likely to be relatively rare and, in any case, will not affect the calculated rates. The number of patients in the 2015/16 dialysis cohort and the 2015/16 transplant cohort surviving in each subsequent year is shown in Figure 36 below.

Figure 36 Number of 2015/16 dialysis and transplant cohorts surviving

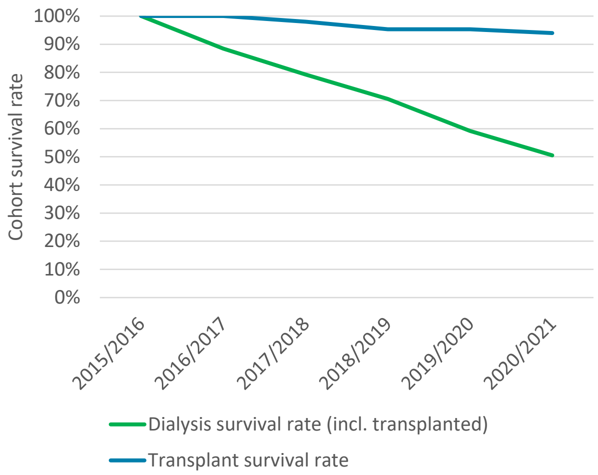


Source: NZIER, NNPAC and NMDS data

By 2020/2021:

- 94 percent of the transplant cohort is surviving.
- 51 percent of the dialysis cohort is surviving, with one-third of survivors being the ones who were lucky enough to have a transplant.
- Without the 17 percent of the dialysis cohort who had been transplanted, the probability of surviving to 2020/2021 for a patient who initiated dialysis in 2015/16 would have been less than 35 percent – twice as likely to be dead than alive.

Figure 37 Survival rate of 2015/16 dialysis and transplant cohort



Source: NZIER, NNPAC and NMDS data

A key takeaway from this analysis is that dialysis patients who are not transplanted are twice as likely to be dead than alive 5 years later, while transplant patients have a 94% survival rate over the same timeframe.

B.3 Health service utilisation

The following section summarises the analysis of health service utilisation over six years that informed the cost model described in the report.

B.3.1 Emergency department presentations

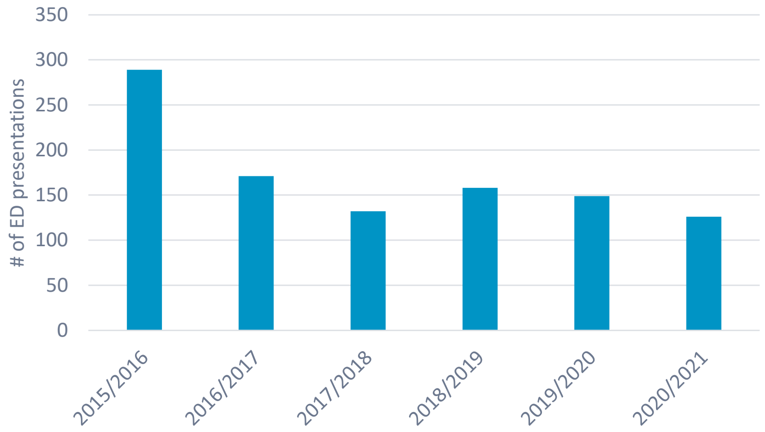
In the year that dialysis was initiated, the 760 people who started dialysis in 2015/16 had 1,868 ED presentations (see Figure below). This number amounts to an ED presentation rate of 2.53 presentations per person. Over the years that follow, the number of ED presentations for this cohort drop to less than 800 in 2020/2021 (a 60 percent reduction).

Figure 38 Emergency department presentations by 760 patients starting dialysis in 2015/16

Source: NZIER, NNPAC data

In contrast, the 150 people who had a renal transplant in 2015/16 had 289 ED presentations that year. This number amounts to an ED presentation rate of 1.93 presentations per person. Over the following years, the number of ED presentations for this cohort drop to 126 (a 56 percent reduction).

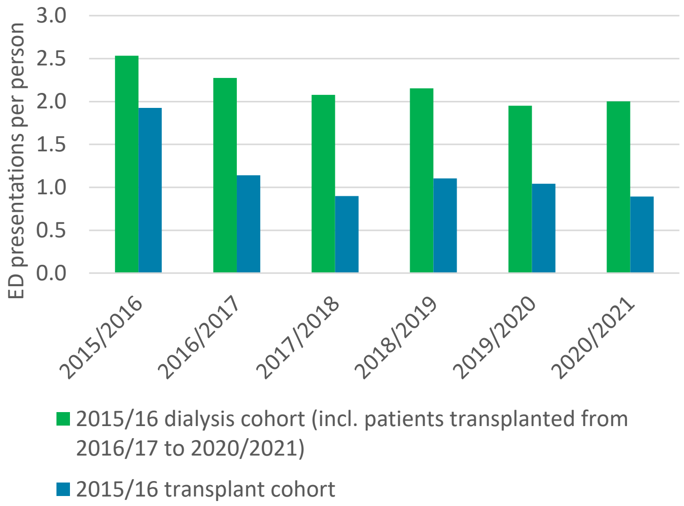
Figure 39 Emergency department presentations by 150 patients transplanted in 2015/16



Source: NZIER, NNPAC data

In both cases, the number of ED presentations is partly a function of the number of people surviving. Figure 40 below shows the ED presentation rate for each group based on the number of people in each cohort surviving in each subsequent year.

Figure 40 Emergency department presentation rates by RRT type



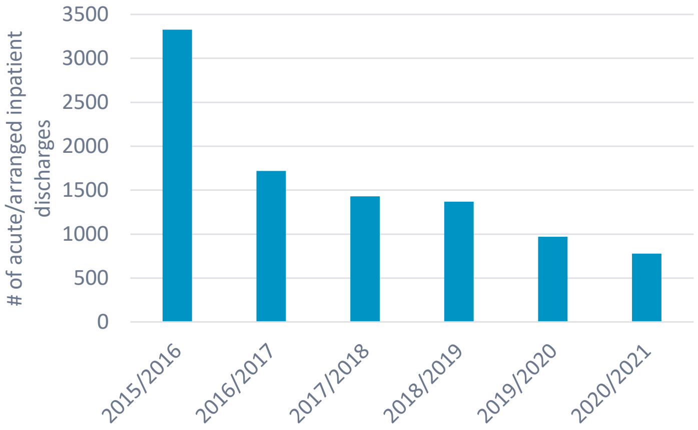
Source: NZIER, NNPAC data

In the year that patients begin RRT, dialysis patients use the ED over 30 percent more than transplant patients. Over the next five years, dialysis patients have double the rate of ED presentations compared with transplant patients. The actual number of acute events that might normally necessitate and ED presentation could be even greater for the dialysis cohort as acute events that occur in the dialysis unit are often dealt with in the unit and may not be coded as such.

B.3.2 Acute and arranged inpatient admissions

In 2015/16 the 760 patients who started dialysis had 3,328 acute and arranged inpatient admissions, a rate of 4.52 per person. Over the years that followed, this cohort's number of acute and arranged inpatient admissions dropped to less than 800 in 2020/2021 (see Figure below) – a 77 percent reduction.

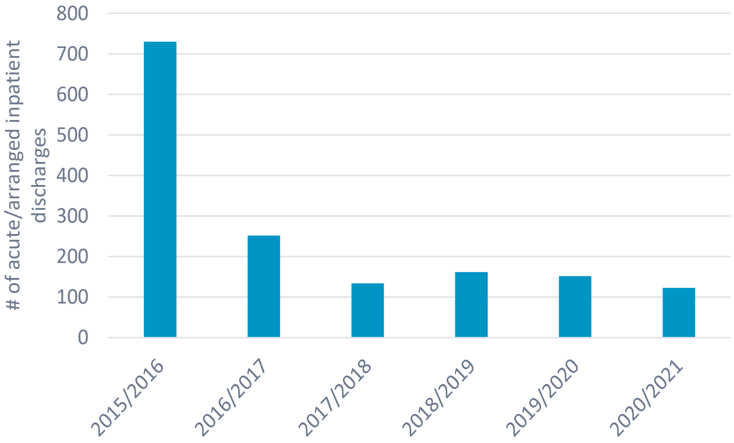
Figure 41 Acute and arranged admissions for the 2015/2016 dialysis cohort



Source: NZIER, NMDS data

The transplant cohort had 730 acute and arranged inpatient admissions in the year of the transplant – a rate of 4.87 admissions per person, but this number dropped to 123 by 2020/2021 (see Figure 42 below) – an 83 percent reduction.

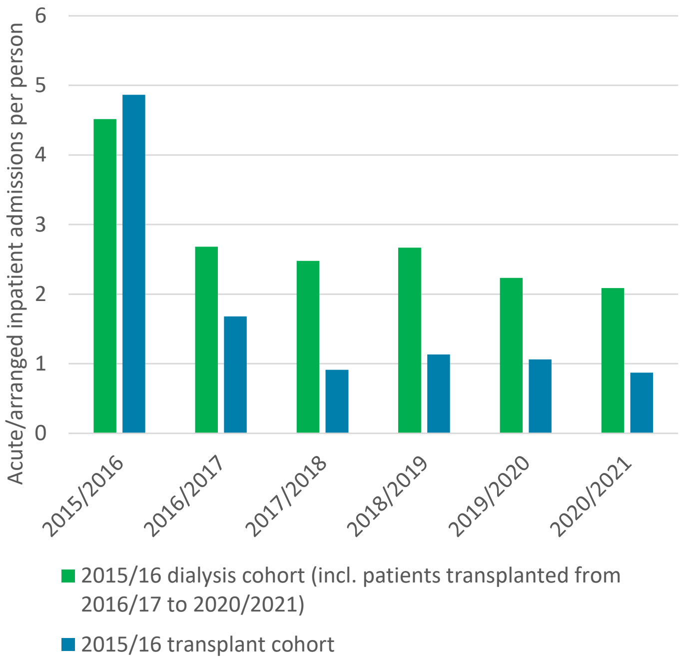
Figure 42 Acute and arranged admissions for the 2015/2016 transplant cohort



Source: NZIER, NMDS data

Figure 43 below shows that although the transplant cohort had a slightly higher acute and arranged inpatient admission rate in the year of the transplant than the group who started dialysis in the same year, the transplant cohort’s admission rate dropped substantially, the year after the transplant and remained lower through to 2020/2021.

Figure 43 Acute and arranged inpatient admissions by RRT type

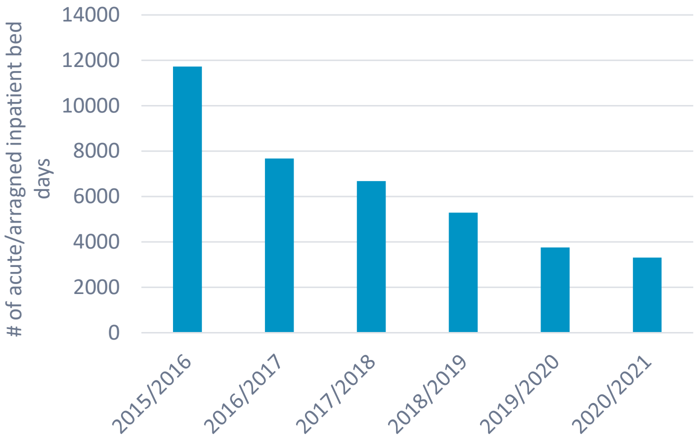


Source: NZIER, NMDS data

The admission rate was not the only difference between the groups in acute and arranged inpatient admissions.

The total number of bed days associated with the dialysis cohort's acute and arranged admissions was 11,725. This dropped to 3,308 bed days for the dialysis cohort in 2020/2021 (see Figure 44 below) – a 72 percent reduction.

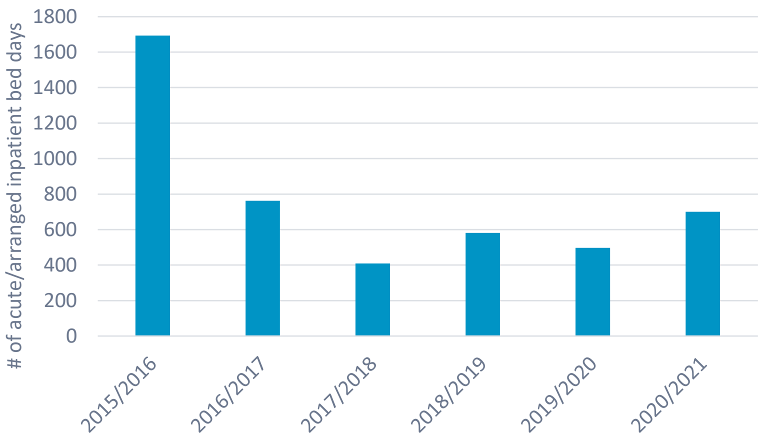
Figure 44 Dialysis cohort total bed days from acute and arranged inpatient admissions



Source: NZIER

The total number of bed days associated with the transplant cohort's acute and arranged admissions was 1,693. This dropped to 700 bed days for the transplant cohort in 2020/2021 (See Figure 45 below)

Figure 45 Transplant cohort total bed days from acute and arranged inpatient admissions

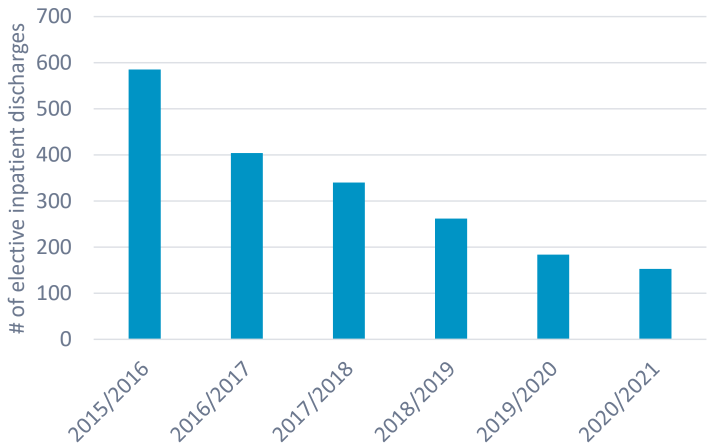


Source: NZIER

B.3.3 Elective admissions

In 2015/16 the 760 patients who started dialysis had 585 elective inpatient admissions, a rate of 0.79 per person. Over the years that followed, the number of elective inpatient admissions for this cohort dropped to 153 in 2020/2021 (see Figure 46 below) – a 74 percent reduction.

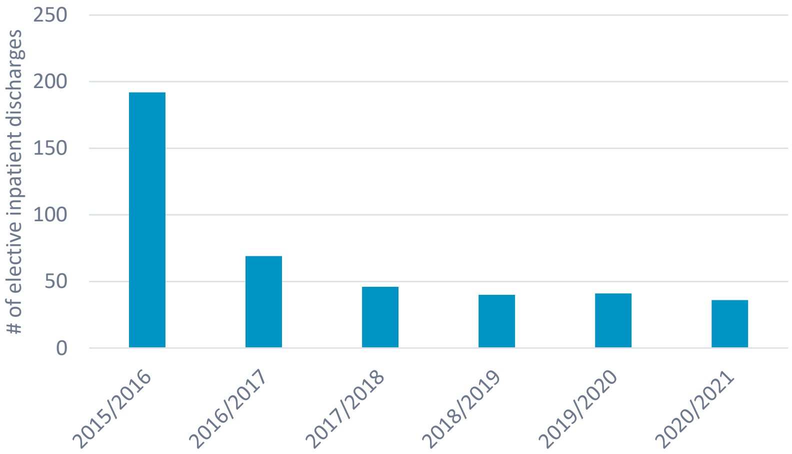
Figure 46 Elective admissions for the 2015/2016 dialysis cohort



Source: NZIER

Meanwhile, the transplant cohort had 192 elective inpatient admissions in the year of the transplant – a rate of 1.28 admissions per person, but this number dropped to 36 by 2020/2021 (see Figure 47 below) – an 81 percent reduction.

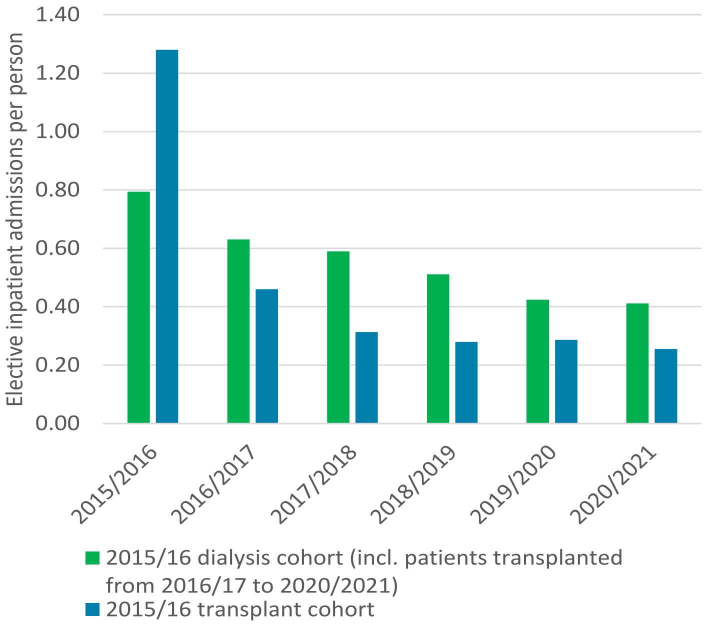
Figure 47 Elective admissions for the 2015/2016 transplant cohort



Source: NZIER

Unsurprisingly, the transplant cohort had a significantly higher elective admission rate in the year of the transplant than the dialysis cohort had in the year of dialysis initiation, due to nearly half of the transplants identified in 2015/16 being elective admissions. On average, transplant patients had 1.28 elective inpatient admissions that year. Figure 48 below shows that apart from the year of transplantation, the elective admission rate was higher for the dialysis group than for the transplant group. Both cohorts saw a reduction in the rate of elective admissions over time to 2020/2021.

Figure 48 Elective inpatient admissions by RRT type

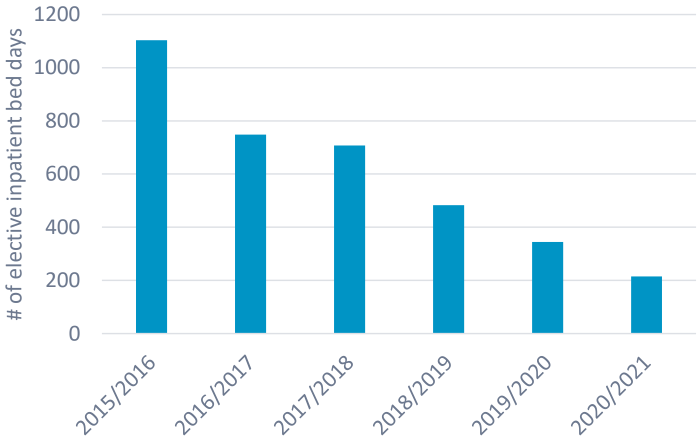


Source: NZIER

The admission rate was not the only difference between the groups in elective inpatient admissions.

The total number of bed days associated with the dialysis cohort's elective admissions was 1,103. This dropped to 215 bed days in 2020/2021 (see Figure 49 below)– an 81 percent reduction.

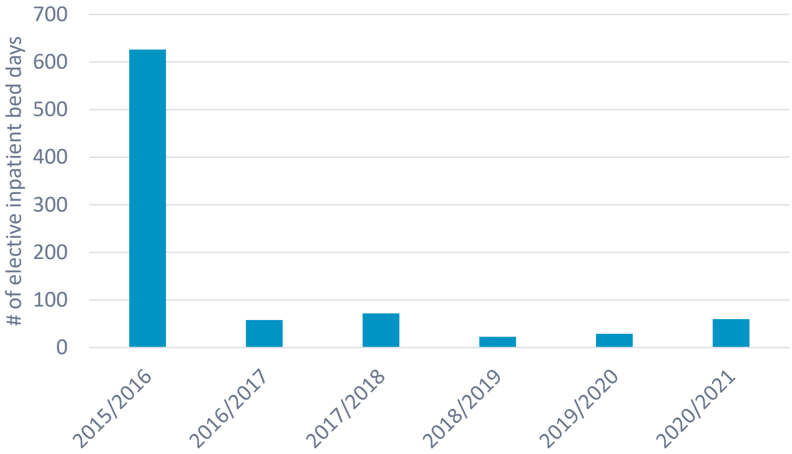
Figure 49 Dialysis cohort total bed days from elective inpatient admissions



Source: NZIER

The total number of bed days associated with the transplant cohort's elective admissions was 626. This dropped to 60 bed days in 2020/2021 (See Figure 50 below)

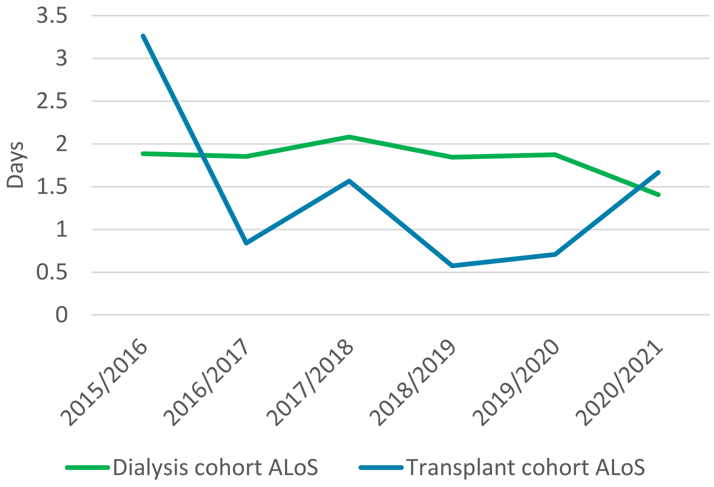
Figure 50 Transplant cohort total bed days from elective inpatient admissions



Source: NZIER

The average length of stay for the transplant cohort was shorter than for the dialysis cohort in every year except 2020/2021. On average, over six years, the dialysis cohort spent 11 days in an inpatient ward as a result of elective admissions, compared with 9 days on average for the transplant cohort, even when the transplant surgery admission is included.

Figure 51 Average length of stay in elective admissions by RRT type



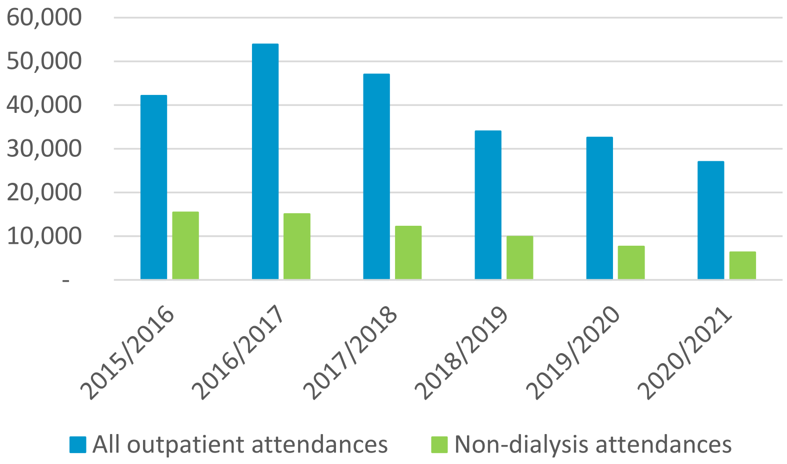
Source: NZIER

B.3.4 Outpatient attendances

In the year that dialysis was initiated, the 760 people who started dialysis in 2015/16 had 42,101 outpatient attendances (see Figure 52 below). This number amounts to an outpatient attendance rate of 57.1 attendances per person. Outpatient attendances include dialysis as well as visits to specialists. Over the years that follow, despite the number of people surviving in this cohort dropping significantly, the number of outpatient attendances for this cohort increased substantially before dropping to 27,022 in 2020/2021 (a 36 percent reduction).

It is important to note that the number of outpatient attendances underestimates the frequency of dialysis because some dialysis services are coded as a once per year patient enrolment rather than on a per use basis. For this reason, our cost analysis differentiates between dialysis and non-dialysis attendances.

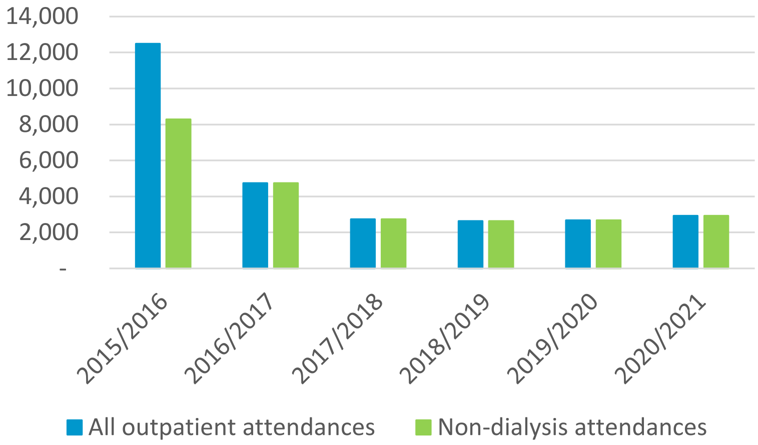
Figure 52 Outpatient attendances by 760 patients starting dialysis in 2015/16



Source: NZIER

The 150 people who had a renal transplant in 2015/16 had 12,481 outpatient attendances that year. This number amounts to an outpatient attendance rate of 83.2 attendances per person. Over the following years, the number of outpatient attendances for this cohort drop dramatically to 2,927 (a 77 percent reduction), owing to the cessation of dialysis. No dialysis attendances were identified for the transplant cohort over the 6 years of data, indicating that return to dialysis after non-fatal graft loss had not yet occurred.

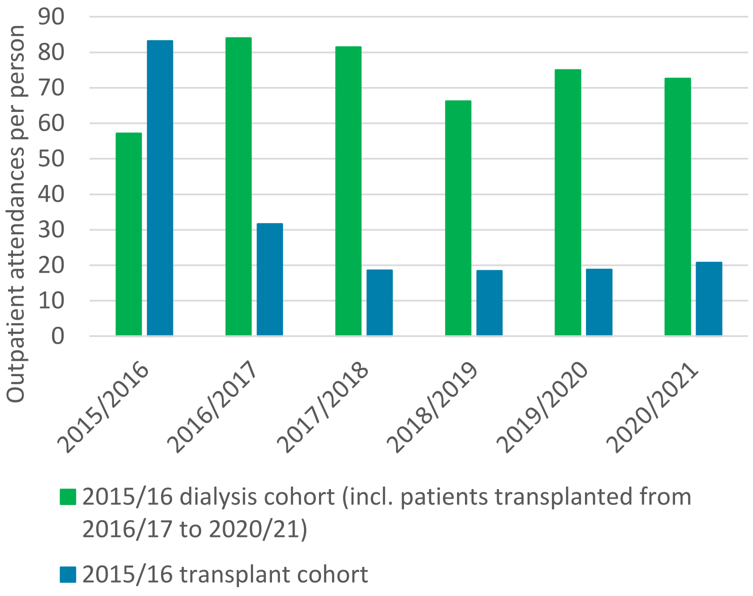
Figure 53 Outpatient attendances by 150 patients transplanted in 2015/16



Source: NZIER

In both cases, the number of outpatient attendances is partly a function of the number of people surviving. Figure 54 below shows the outpatient attendance rate for each group based on the number of people in each cohort surviving in each year.

Figure 54 Outpatient attendance rates by RRT type



Source: NZIER

In the year that patients begin RRT, transplant patients use outpatient services 46 percent more than dialysis. But over the next five years, dialysis patients will use up to four times the outpatient services that they would have used if they had had a transplant.

Appendix C Cost comparisons with discounting

The following tables describe the comparison of total costs described in section 9.5 with discounting at a rate of five percent per annum.

Table 25 Total expected costs per person, base case with discounting

5% per annum discounting

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference
1	$150,878	$107,361	$43,517
2	$117,614.35	$31,270.75	$86,344
3	$99,722.48	$21,435.17	$78,287
4	$82,633.97	$21,110.98	$61,523
5	$64,916.75	$19,516.53	$45,400
6	$52,934.91	$19,995.45	$32,939
7	$42,852.07	$18,442.12	$24,410
8	$34,689.77	$17,010.29	$17,679
9	$27,421.44	$15,690.40	$11,731
10	$21,675.99	$14,473.67	$7,202
11	$16,947.14	$13,228.61	$3,719
12	$15,494.53	$12,200.15	$3,294
13	$14,018.86	$11,252.16	$2,767
14	$12,550.21	$10,378.33	$2,172
15	$11,115.90	$9,572.83	$1,543
16	$9,958.89	$9,090.80	$868
17	$9,010.43	$8,394.35	$616
18	$7,980.66	$7,751.89	$229
19	$6,992.58	$7,159.21	-$167
20	$6,660	$6,612.43	$47
21	$6,342	$6,107.95	$235
Total	**$812,411**	**$388,055**	**$424,356**

Source: NZIER

Table 26 Total expected costs per person, sensitivity analysis results with discounting

5% per annum discounting

Year	Cost per dialysis cohort member	Cost per transplant cohort member	Difference
1	$150,878	$255,935	-$105,056
2	$117,614.35	$31,270.75	$86,344
3	$99,722.48	$21,435.17	$78,287
4	$82,633.97	$21,110.98	$61,523
5	$64,916.75	$19,516.53	$45,400
6	$52,934.91	$19,995.45	$32,939
7	$42,852.07	$18,442.12	$24,410
8	$34,689.77	$17,010.29	$17,679
9	$27,421.44	$15,690.40	$11,731
10	$21,675.99	$14,473.67	$7,202
11	$16,947.14	$13,228.61	$3,719
12	$15,494.53	$12,200.15	$3,294
13	$14,018.86	$11,252.16	$2,767
14	$12,550.21	$10,378.33	$2,172
15	$11,115.90	$9,572.83	$1,543
16	$9,958.89	$9,090.80	$868
17	$9,010.43	$8,394.35	$616
18	$7,980.66	$7,751.89	$229
19	$6,992.58	$7,159.21	-$167
20	$6,660	$6,612.43	$47
21	$6,342	$6,107.95	$235
Total	**$806,069**	**$530,521**	**$275,548**

Source: NZIER