A Model for Home Dialysis

Australia - 2012

KIDNEY HEALTH AUSTRALIA

Acknowledgements

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Information contained in this report has been obtained from many sources, published, written and anecdotal. References to providers of dialysis are not endorsements of their products. KHA do not accept any responsibility for the outcomes of development of home dialysis programmes related to this document. The document is intended to promote discussion and evaluation of home dialysis programmes throughout Australia, leading to development of and improved options for the patient. Every programme must carefully consider the best option for development based on information available at the time.

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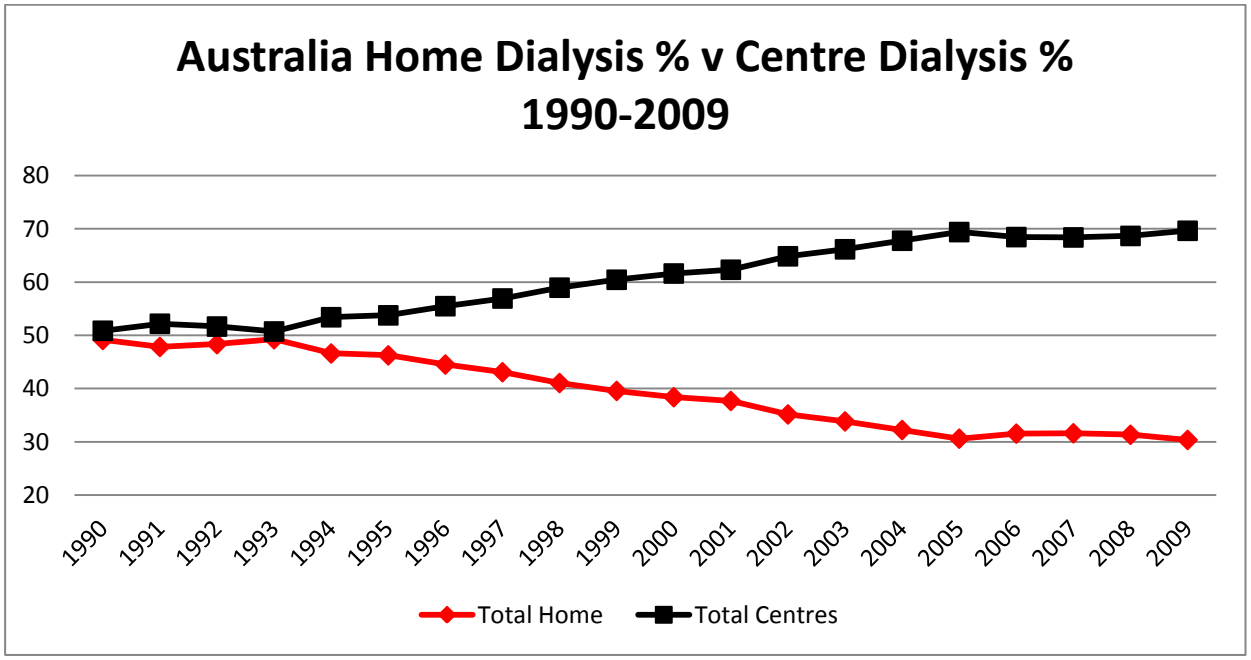
Executive Summary

Kidney Health Australia, (KHA) formerly known as the Australian Kidney Foundation, is a national not for profit organisation focused on saving lives and reducing the need for dialysis. Our work focuses on awareness, detection, prevention and management of kidney disease in Australia and surrounding regions.

Chronic Kidney Disease (CKD) refers to all conditions of the kidney, lasting three months or more, where a person has had evidence of kidney damage and/or reduced kidney function, regardless of the specific diagnosis of the disease or condition causing the disease.[1] Dialysis or a kidney transplant is needed when the kidneys have stopped working, stage 5 CKD.[2] KHA support the provision of high quality home dialysis as a treatment option for all of those with CKD who would prefer this treatment option.

In December 2009 there were 10,341 individuals on dialysis in Australia with 1293 (12.5%) on Automated Peritoneal Dialysis (APD); 894 (8.6%) on Continuous Ambulatory Peritoneal Dialysis (CAPD); and 963 (9.4%) on Home Haemodialysis (HHD).[3] Prevalent growth averages 6% per annum.[3] The utilisation of home dialysis is highly variable by State and by jurisdiction within those States. New Zealand operating on a home first policy has the highest rate of home dialysis in the world. Home dialysis as a percentage in Australia is decreasing.



Data courtesy of ANZDATA (3)

The incident rate for treated end stage kidney disease, considering diabetes and an aging population is projected to increase from 11 per 100,000 population in 2009 to 19 per 100,000 in 2020.[2] This equates to an 80% increase. To manage this increased growth all renal replacement therapy programmes including home dialysis programmes will expand. Effective expansion of these services will require detailed planning, considering all relevant factors.

Consumers with kidney failure enter a system that offers the treatment options of home dialysis, transplant, centre-based dialysis or conservative treatment. Currently there are many factors determining which options may be available or encouraged. Consumer preferences are pivotal to a system if adherence to treatment regimes and maximised quality of life is to be achieved. The KHA consumer survey determined that education about, and the option to choose, certain modalities is not equal across Australia.[6] Perceptions of life-style advantages and quality of life remain the primary factors that influence the choices of the consumer. How health professionals provide education and information influences these choices.

Concurrent with life-style considerations known health outcomes influence the recommendations for health care treatment options. Clear and consistent benefits of more intensive haemodialysis have been demonstrated in 100 abstracts and peer-reviewed journal articles.[5] Observational data, retrospective analysis and qualitative research underpin most home dialysis studies. Whilst some benefits of home dialysis occur regardless of the hours on dialysis, or the modality, the best medical advantages of enhancing haemodialysis hours and dialysing at home are becoming widely accepted.

Budgets and funding also influence the provision of health care options, including dialysis. Consistently during cost analysis of dialysis the cost of HHD is the lowest for all the dialysis modalities. CAPD is a similar price to HHD and APD or satellite is about 25% more expensive depending on the providers' contracts. Hospital HD is the most expensive. HHD starts at $49,137, compared to $79,072 for hospital dialysis.[4] KHA estimates 'that increasing the use of home dialysis over the next 10 years would lead to an estimated net savings of between $378 and $430 million for the health system'.[4]

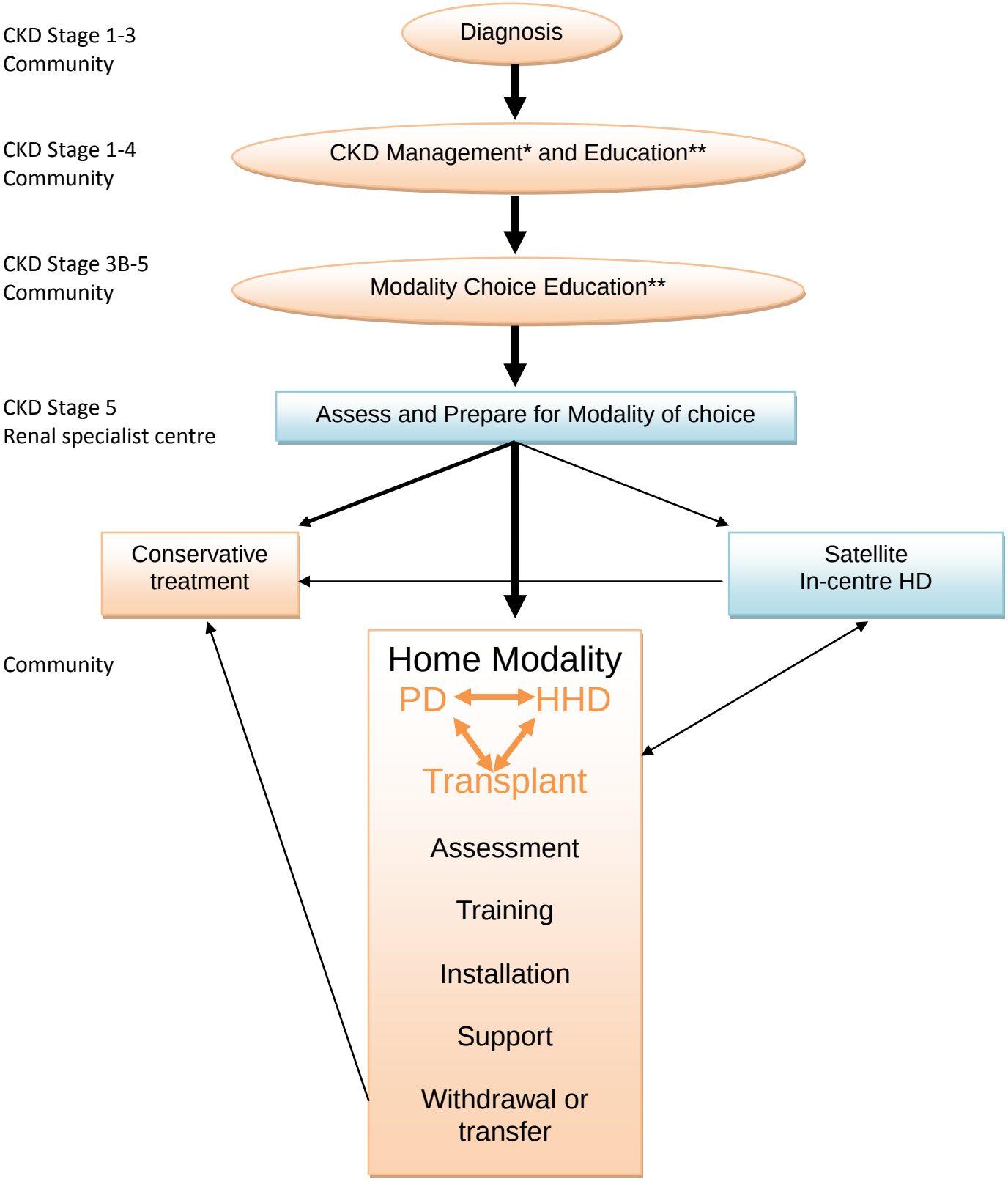
It is clear that the most economically viable options with positive health outcomes are home dialysis and transplant. In a fiscally responsible system, that recommends treatments with best outcomes these would be prioritised for all of those with end stage CKD. The reality is that only 30% of consumers are at home and there are barriers that prevent maximum uptake.

Potential, perceived and actual barriers to home dialysis all contribute. Barriers range from system level barriers to those at an individual unit level and those directly linked to the consumer. Identification of barriers followed by implementation of solutions by all stakeholders is the identified pathway forward. Stakeholders include all of those who are advantaged by an increase in access to and uptake of home dialysis; Government, State renal executive groups, health systems, nephrologists, nurses and all direct health care professionals, industry providers of dialysis equipment and importantly the consumers supported by Kidney Health Australia. Strong leadership from health care leaders is critical.

To identify all barriers a complete model of dialysis has been developed and explored. It includes the overarching areas of funding, government and unit philosophy and targets, clinical governance, quality and leadership, home dialysis models, infrastructure of home dialysis units and the environment. For the consumer focusing on a patient centred approach it involves multiple facets and considerations of the journey from diagnosis through planning, training, installation at home and ongoing support until withdrawal of home dialysis occurs. Home dialysis throughout relies on education that maximises self-management skills, promoting autonomy and control. The majority of the care and pathway occur in the community.Diagram 1

A successful home dialysis programme has many facets and involves system factors as well as local factors. Many barriers exist that have reduced the uptake of home dialysis over the last decade. All barriers have a solution that will allow them to be tackled and removed or at minimum reduced. To overcome the barriers will require a comprehensive approach with commitment from the entire population who contribute both to policy and to the renal health workforce. When this is achieved the consumer will have equity in choice and the option to choose the dialysis modality that will best enhance their quality of life.

Pathway to Home Dialysis (Diagram 1)



Transition between home modalities is anticipated
Home Dialysis units can be hospital, satellite or community based
Home Dialysis is the primary treatment modality
***CKD management should be GP based with renal specialist (Dr or NP) support**
****Primary education should be provided by a skilled renal practitioner**

Introduction

Home dialysis is currently a widely debated topic in renal around the globe. A common theme is that it is the way of the future to meet the growing demand for renal services.[i] The USA, UK, Finland, Asia and Australia as examples all have active groups, committees and reports expressing and working to increase this intended growth area.[8,9,10,11,12,13,14,15]

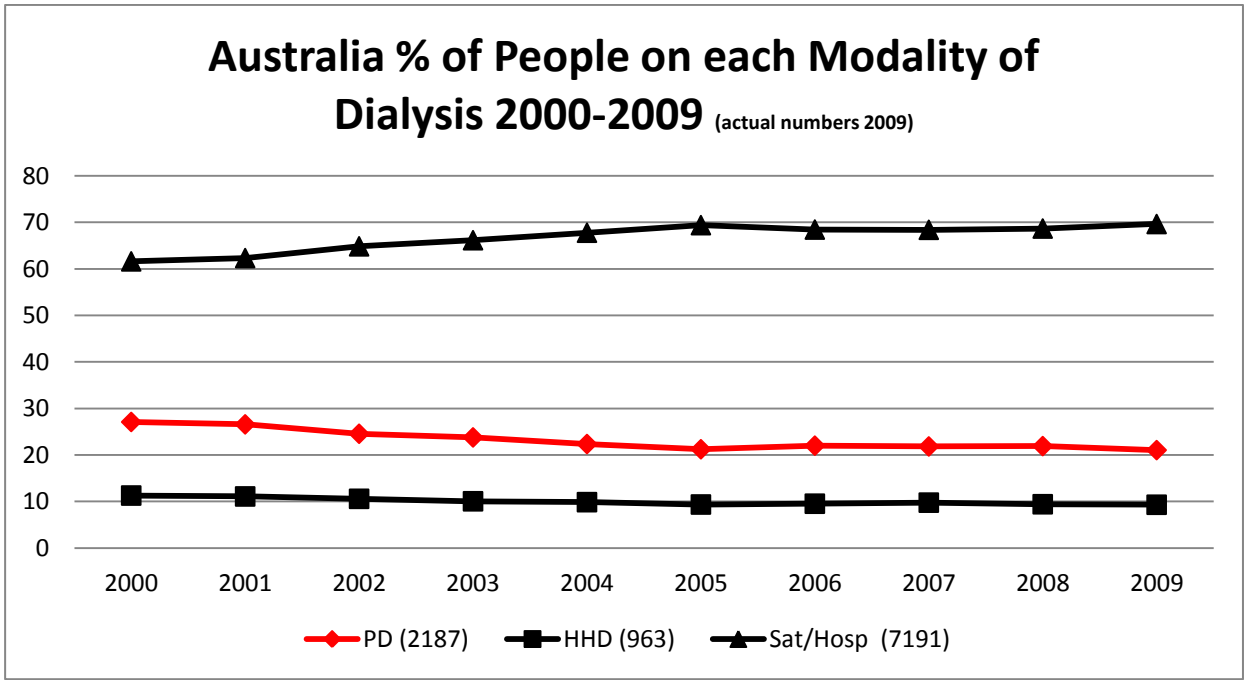
History of home dialysis

HHD accounted for nearly 50% of Australian patients in the 1970s.[15] The advent of PD in the 1980s and development of satellites contributed to a transition away from HHD.[16] Concurrently Government policies and funding models were not promoting home dialysis. From the year 2000 the growth in satellite facilities removed the drive to prioritise any modality of home dialysis as the first option. PD rates stabilised by 2005, down to 21%, and HHD at 10% with a wide variance between States.[15, appendix 1] Senior renal staff developed dialysis programmes concurrent with regional variances, personal experience or preferences and available resources for modalities. In many jurisdictions this did not favour home dialysis, but despite this in some home dialysis programmes flourished. The overall result was a system with an overwhelming demand for in-centre or satellite dialysis, the most resource and cost intensive modality. Consequently there was reduced equity in choice for the consumer.[6]

Current Statistics

In December 2009, 10,341 individuals were on dialysis in Australia with 1293 (12.5%) on APD, 894 (8.6%) on CAPD and 963 (9.4%) on HHD.[3] Prevalent growth averages 6% per annum.[3]

Diagram 2: Australia % of People on each modality of Dialysis



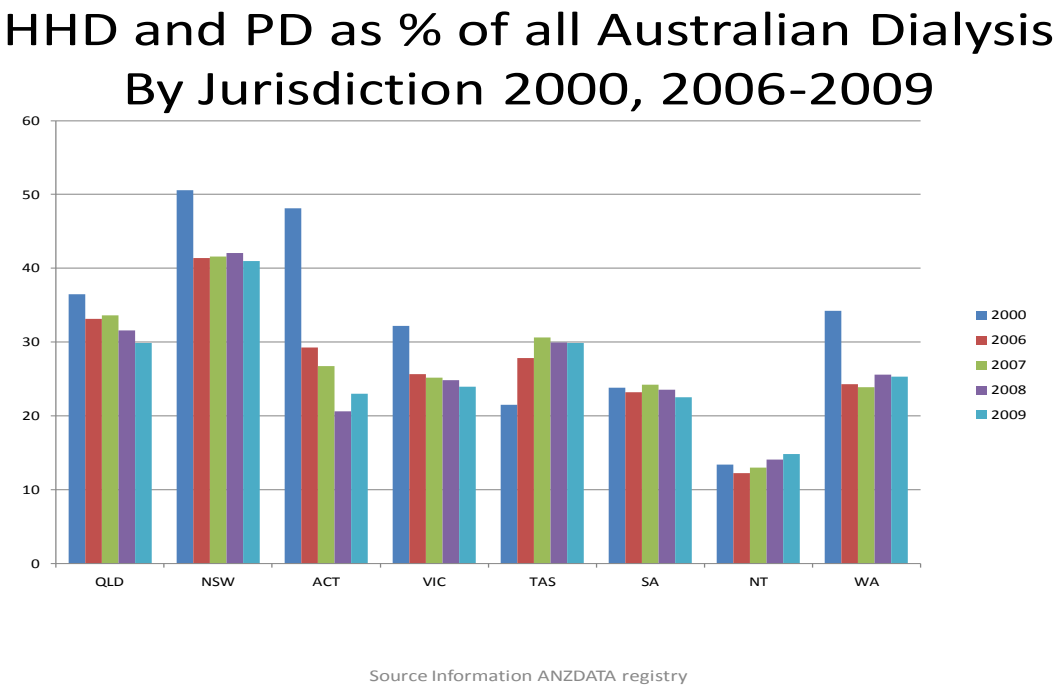
Data source ANZDATA registry (3)

In Australia 43 home training units provide the training and support for those at home.[appendix 2]

Recent Australian Trends

Between 2000-2006 home dialysis decreased from 38% of the dialysis population to 31% caused principally by a 6% decrease in PD.[diagram 3] HHD has remained reasonably static. Since 2005 the prevalence of home dialysis in Australia as a percentage has remained constant with 30% overall at home. PD numbers are now static around 21% in Australia with APD increasing from 45% to 60% of PD between 2005 and 2009. State variance and trends continue though within each modality. [append 1, diagram 3]

Diagram 3: HHD and PD as % of all Australian Dialysis By Jurisdiction, 2000, 2006-2009



Source Information ANZDATA registry

International statistics and trends

Internationally HHD rates vary from 0.1 to 77 per million population in comparative demographic populations across the world fluctuating up and down widely over the decades. Current percentages of renal replacement therapy RRT on HHD vary from 0 - 15.6% (New Zealand).[16] PD rates show similar variance. Identified factors that influence rates of home dialysis include government policy and funding, available technology and individual passion from nephrologists or nurses to promote the therapy.[14,17] Individual choice and ability is not demonstrated to be the main influence.[17]

In New Zealand the percentage at home between 2000-2004 fell from 65% but since 2005 has remained around 50%. Of note is that the satellite HD is around 48% in Australia and only 19% in New Zealand.[3] Home peritoneal dialysis however is currently decreasing world-wide despite discussion that it should increase. The UK now has only 17% on PD.[18] Opposing the world-trend is Hong Kong with a PD first policy which is achieving high rates of 80% with 2 year patient survival of 84%.[19] Factors considered to influence PD choice are perceived negative health outcomes by health care workers, availability of satellites and physician preference.[12,17]

Future of home dialysis

The Australian goal of growth for home dialysis is aligned with many countries, and is based on the identified limited physical, human and finite funding resources, that will be required to meet the annual 6-7% increases in demand for dialysis.[15] Consumer rights are also identified.

Growth of a successful home dialysis programme requires supportive health policy, a formal infrastructure, committed individuals, home dialysis expertise, and a supportive approach from all health care workers who connect with the patient providing a patient centred approach as they travel on their renal journey.

Kidney Health Australia (KHA) support growth of the home programme to improve access for individuals and adopt cost-efficient dialysis provision.[20]

The KHA national CKD strategy recommended:

- Recommendation 16:
  To provide all people with advanced CKD with appropriate access to all modalities of RRT and opportunities for active involvement in the identification of preferred treatment options
- Recommendation 22:
  All State/territory governments undertake ongoing reviews of dialysis service delivery to ensure health systems plan for and resource adequately the number of people dependent on dialysis.
- Recommendation 26:
  To maximise opportunities for home dialysis by identifying and addressing current impediments to this form of treatment.
- Recommendation 45:
  To develop, implement and monitor for effectiveness initiatives to minimise the health and social disruption associated with relocation to access treatment for Aboriginal and Torres Strait Islanders with renal disease. [8]

The Home Dialysis model

This model for home dialysis provides information to support that the option of home dialysis should be widely available and be expanded.

It outlines a framework to identify all factors to be considered for an ‘effective and complete home dialysis programme’. Barriers and potential actions to reduce these are provided. The resources required to facilitate existing services or plan new programmes are identified. Where available references are made to existing literature but there is limited information regarding complete home dialysis models.

Dialysis Modality Definition

The two dialysis treatment modalities considered are haemodialysis (HD) and peritoneal dialysis (PD):

- HD uses a dialysis machine to circulate blood from the patient's body through an artificial kidney (dialyser) for purification and then returns it to the patient. An alternative version of HD is Haemodiafiltration (HDF) that aims to increase the range of molecules that are removed during the purification process. HDF is traditionally an in-centre or satellite therapy.
- PD involves filling the peritoneal cavity with dialysis solution through a catheter. Waste and extra fluid are exchanged across the membrane and then transferred to the dialysis solution. After a pre-determined period, the solution is then drained out of the body and replaced with a fresh solution. Each repetition of this cycle is called an exchange.

These therapies can be delivered by different locations:

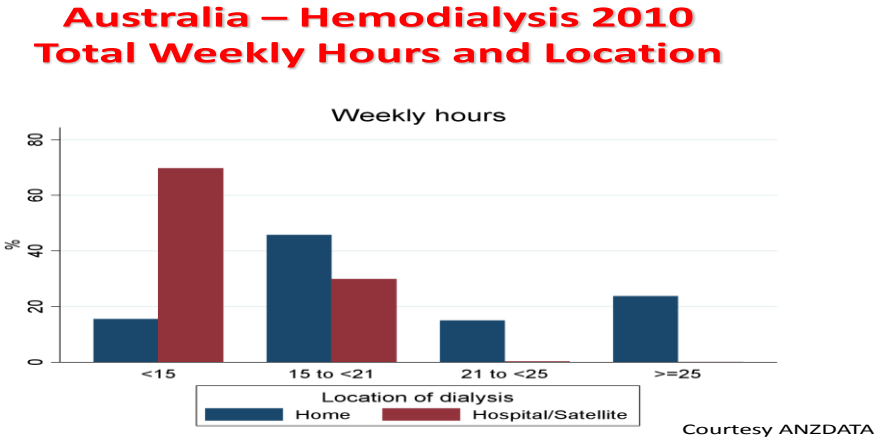
- In-centre or hospital HD and HDF
- Satellite, or stand-alone unit HD (SHD and SHDF)
- Self-care units or community centre HD (independent but not at own home)
- Home HD (HHD)
- Home Continuous Ambulatory PD (CAPD)
- Home Automated PD (APD)

These therapies can be delivered by different regimes:

Haemodialysis:

- Standard HD: HD is performed 3 times per week for 4-5 hours. This is the usual regime for hospital and satellite units and some individuals at home
- Enhanced HD: Additional sessions i.e. alternate daily or 4-5 times per week. This includes nocturnal and short daily with all regimes improving efficiency. [22]
- Short Daily HD: HD is performed 6 times a week for an average of 2-3hours (also known as enhanced HD)
- Nocturnal Haemodialysis: HD is performed overnight for an average of 8hrs. This is done up to 6 times per week.

Diagram 4: Currently in Australia 45% of patients still receive below 13.5hrs of HD per week [14]



Peritoneal Dialysis

- CAPD, a simple manual bag exchange is usually performed four times a day taking about 30 minutes to complete each 2-3 Litre exchange.
- APD involves the use of an automated cycler to perform the fluid exchanges. The dialysis is completed by a machine overnight that performs six to eight exchanges whilst the individual is asleep. During the day, dialysis solution can be left in the peritoneal cavity to optimise dialysis.

Benefits and Barriers for Home Dialysis

The opportunity to conduct large, prospective, randomised controlled trials in home dialysis has been limited. However over 100 abstracts and peer-reviewed journal articles demonstrate clear and consistent benefits of more intensive haemodialysis.[5] Whilst some benefits of home dialysis occur regardless of the hours on dialysis, or the modality, the best medical advantages of enhancing haemodialysis hours is the signal in the literature. It is acknowledged that randomised controlled clinical trials are needed for further evidence.

Individual Benefits:

Control of health and treatment regimes

All home dialysis provides patients with autonomy and flexibility. The option for when to dialyse is determined by the individual within the parameters that are required for good dialysis outcomes. Attending a family function can be a life situation that does not require permission, with agreement for appointment changes, from a dialysis unit.

Quality of Life

Home dialysis patients have proven improvement in quality of life and have more family engagement.[22,23] Patient testimonies support this fact.[appendix3] Improvement in patient mood, interactivity and cognition is noted by carers.[22] Sexual drive, an often over-looked but important aspect of life for many, is also increased.[22]

Dialysis does not require relocation

Patients residing in rural and remote locations are able to stay in their own homes. For the indigenous this ability to be at home is vital pertaining to their strong connection to culture and the land. This has socio-economic benefits for the individual allowing them to remain an integral part of their family and community at a time when support is critical.

Travel and Holidays

PD allows travel to any region that can provide the necessary supplies. HHD with new technology may allow travel similar to PD.[23] A HHD patient may also find agreement to dialyse as a holiday patient in a satellite unit is easier gained if they can care for themself.

Reduced travel to have treatment (saved time and cost)

Many patients have to travel many kilometres to a dialysis unit. Just a 30 minute 10km journey one way is 156 hours and 3120km per annum. Parking difficulties, fees and the inability to drive oneself to or home from dialysis add to this burden and then involve other family members or community resources. Home dialysis, once training is complete eradicates this need.

Improved diet and fluid allowances with reduced medications

HHD with increased hours offers reduced dietary restrictions and reduced medications.[5,21] For those on nocturnal dialysis for 5-6 nights dietary restrictions can be removed. If completing 4-5 nocturnal sessions a week phosphate binders are not required and BP medications are removed for most patients.[5,21] The Freedom study found a reduction from 79% of patients to 53% over 12 months on short daily dialysis.[25] Short or frequent daily dialysis also demonstrates reduction in phosphate levels.[5,26,27,28] Erythropoetin use (EPO) a very costly medication is also reported in some cases to be reduced in enhanced dialysis therapy.[5]

PD allows a liberal diet with gentle continuous electrolyte removal. Most commonly patients are encouraged to increase their potassium input, a commonly restricted element of the diet for those on standard HD. Protein is encouraged and fluid can usually be consumed at 1-2 litres per day.

Ability to work

Patients receiving HHD or PD are more likely to work.[28] The flexibility of regimes and improved sense of well-being promotes this.

Extended Hours/sessions of HHD

81% of nephrologists agree HHD patients can perform more frequent or extended-hours of haemodialysis which may have improved medical outcomes.[24]

Improved morbidity and mortality

Those using HHD have lower mortality rates, experience less hospitalization, and have less dialysis-related complications than satellite or hospital based HD patients.[5,28] Mortality and cardiac related hospital admissions increase during the long (two day) inter-dialytic interval inherent with standard dialysis regimes.[29] Relative patient mortality risk adjusted for demographics and co-morbidities in 26,016 Australian patients were:

Table 1[26]

	HHD (Conventional)	Facility HD (extended)	HHD (extended)	Peritoneal Dialysis	Facility HD (conventional)
Risk of death	0.51	1.16	0.53	1.10	1.0

For those on a programme over 4 years increased survival was demonstrated for extended hour therapies. Reduced infections risks and treatment adherence were the only determined plausible explanations for the variance in survival rates and better outcomes for home.[26] Reductions in left ventricular mass, improved blood pressure and lower circulating catecholamines are all factors which have been identified that may contribute to lower mortality caused by cardiovascular disease and these outcomes have all been found in various studies on enhanced dialysis hours patients.[5,27,29,30]

Haemodialysis versus Peritoneal Dialysis morbidity and mortality

The Cochrane library concluded that PD versus HD has not been adequately researched and there is no demonstrated difference in survival between HD and PD.[31] Another study found the risk for death in patients with ESRD undergoing dialysis depends on dialysis type after the first year and that further studies are needed to evaluate a possible survival benefit of a timely change from PD to haemodialysis.[32] HD and PD mortality outcomes are reported annually in ANZDATA. To date HHD patients are included as part of the HD report. [appendix 4, 3]

Reduced depression, improved sleep and decreased restless leg syndrome

The Freedom study found that depression decreased significantly using short daily dialysis over 12 months in 239 participants. The Beck depression inventory score (BDI) of >10 decreased from 41% to 27% (P=0.03).[33] Post-dialysis recovery time decreased from an average of 476 minutes to only 63 minutes. The symptom of restless leg syndrome decreased from 35% to 26% of participants, with similar associated improvements in sleep disturbances.[33] Sleep is also reported to be improved for those on nocturnal dialysis.[21]

Reduced non-dialysis related infection rate

Attendance at a community or hospital facility increases exposure to pathogens and potentially diseases.[26]

Individual Barriers

Negative considerations that impact the individual are rarely documented and negative health outcomes have not been found in the literature reviewed. However there are known barriers that may prevent an individual commencing home or decrease the time they can remain at home.

Fear of cannulation and coping at home with dialysis

Fear of cannulation and worries regarding how to cope with problems at home are often discussed as a barrier. It is a challenge for the pre-dialysis educator and home dialysis team to support the individual to overcome the majority of these fears. Home visits, on-call systems, extensive training and support materials have meant that those who appear unsuitable for home dialysis: frail, non-English speaking, and illiterate individuals, can succeed. Personal drive is often a critical factor. Fears should be determined early allowing them to be addressed and home training to be attempted. Possibly early self-care at a satellite facility will allow time to overcome initial fears.

Social Isolation

The barrier that can be difficult for home dialysis patients and support systems to overcome is de-socialisation and a feeling of abandonment. Despite this it is rare that a home dialysis patient seeks to return to in-centre care.[7] Support groups and volunteers, and regular respite dialysis are potential solutions to this concern.

Out of Pocket Costs

Currently there are costs to many home patients, dependable on State energy and water costs or concessions and also related to additional costs that are determined by State or hospital contracts. This should not remain a disadvantage as the solution is for the health system to ensure that all out of pocket costs are identified and reimbursed. Victoria has established a solution regarding this issue for home dialysis.[appendix 5]

Access Infections

Button-hole cannulation is used more widely at home. There are concerns regarding an increased infection rate, especially in those who cannulate more frequently. Appropriate staff training and strict attention to hygiene can reduce this problem and regular reassessment of cannulation technique should be an integral part of ongoing programmes.[107]

Carer burn-out

This barrier is a real concern. Respite programmes that either provide direct dialysis support or even other supports at home can reduce the overall burden. Ensuring that the individual manages as much of their own dialysis as possible also will reduce this risk. It is acknowledged that the elderly at home will require a greater support from carers and the home dialysis team should remain mindful of the workload they are taking on, ensuring that it is appropriate and not going to cause major stress very early on. Social work interventions that ensure that carers are made aware of how to access and how to use all relevant resources, is a critical part of any home dialysis programme.

Commencing at satellite and reluctance to transfer to home

Good pre-dialysis pathways, dialysis training units with adequate capacity and therefore short waiting lists, and a unit culture that does not allow the patient destined for home to be allowed to settle into a 'being cared for' role are strategies to prevent this barrier.

System Benefits and Considerations

Predicted Population and Prevalence of dialysis Growth
Based on current growth trends in the Australian population anticipated growth is:
Table 2:

	Population over 65	**Incident (new) dialysis pts annual**	**Prevalent Home Dx (based on current 30%)**	**Prevalent Home Dx (based on target 40% in 2020)**
2010	2.52 million	1100	963 HHD 2177 PD	NA
2020	3.94 million	2000	1750 HHD 3958 PD	2333 HHD

If HHD and PD percentages remain constant HHD could increase from 963 to 1750 patients by 2020. PD numbers will increase from 2,177 to 3,958.[35] An estimated 13,318 will be on HD at satellite or in-centre. Many models have attempted to predict this growth and whilst rates may vary the trend is consistently upwards. Whilst many factors may affect the predictions the increase in diabetes with its close link to renal disease, an ageing population, an increasing population and no current cure for CKD indicates that growth will occur.

Infrastructure and Workforce
Satellite and hospital dialysis units operate with a ratio of nurses to patients of 1:3 or 4. Home dialysis operates with ratios of 1:15 HHD or 1:25 PD. Each satellite dialysis chair accommodates 4 patients per week for three treatments each. For infrastructure predicted population and incidence growth could equate to 460 new dialysis units and 24,000 new dialysis machines.[35] Calculating workforce using current models up to 18,000 new renal nurses may be required.[35]

The advantage to home dialysis is that whilst for every 1% Australia-wide increase in home dialysis an additional 217 patients will need to be accommodated the resources to support this growth for both workforce and infrastructure are far less than growth of the satellite model.

Environmental Issues
The carbon footprint of dialysis increases with each treatment.[36] If completing three treatments on HHD the carbon footprint remains lower than treatment away from home, enhanced by the reduced travel. However increased treatment numbers increase the carbon footprint.
This can be overcome with:

- New technology that use about 10% of the energy and has greatly reduced water requirements
- Use of the home environment rather than creation of new units
- Recycling and re-use of grey water and waste water from the reverse osmosis plant[37,38]
- Renewable energy sources

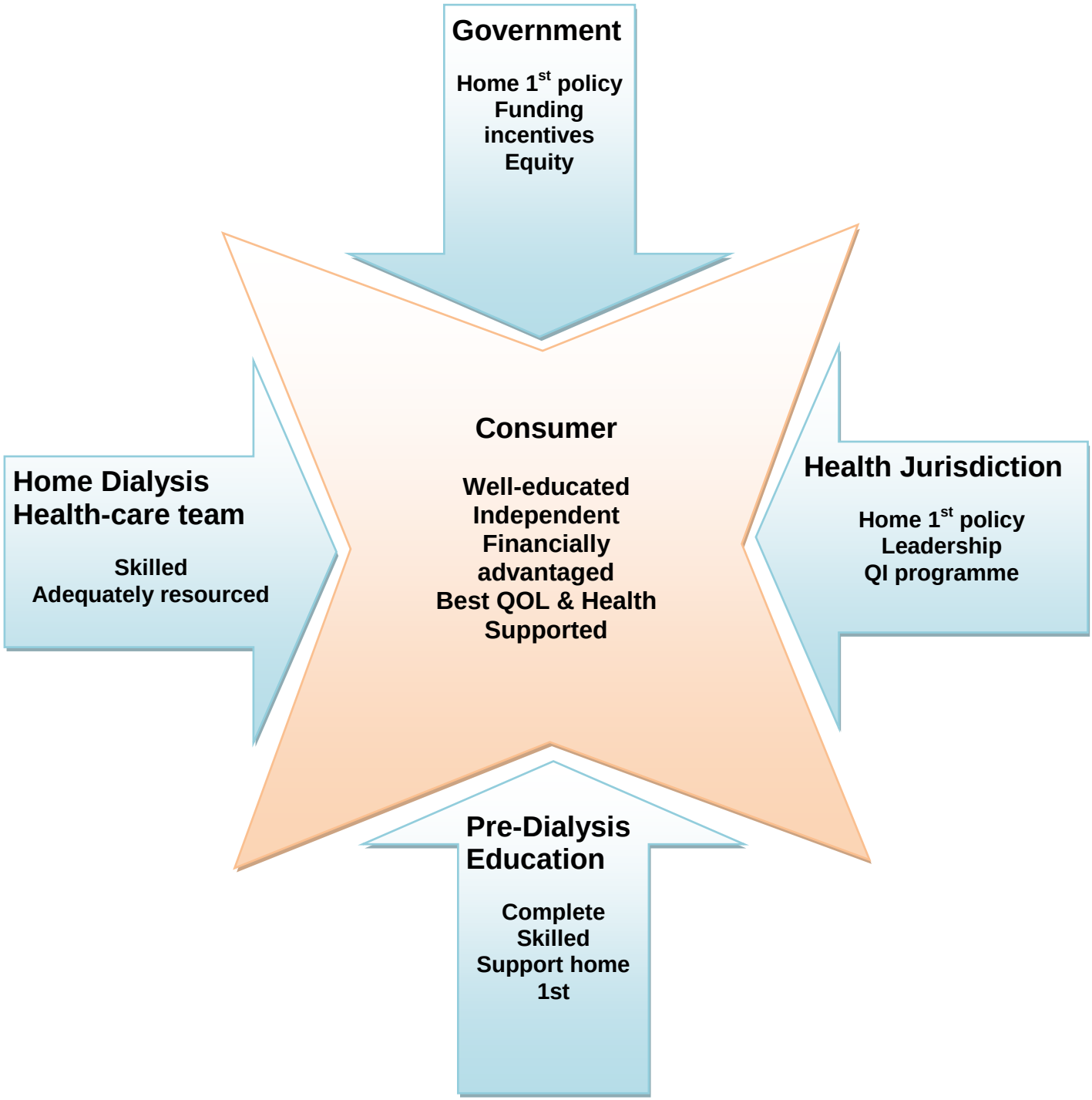
Cost Benefits of increasing HHD for the health system
KHA estimates 'that increasing the use of home dialysis over the next 10 years would lead to an estimated net savings of between $378 and $430 million for our health system. Further discussion is provided in the funding aspect of this report.

Defining a Home Dialysis Model

A comprehensive home dialysis model considers multiple inputs who are all consumer focused.

Diagram 5: A Comprehensive Dialysis Model

Primary Functions of Stakeholders and Consumer Outcomes



Funding for Home Dialysis

Funding to support home

An active funding model that favours home dialysis may be controversial in a society that values right to choice but it can be effective. An example is the Hong Kong PD first model where reimbursement is only available for HD if PD is medically contraindicated.[11] The government in Ontaria increased home care funding, assisted PD was introduced and thus increased PD rates.[39] In Australia funding models vary by State depending on current governments or health authorities and contract design. It is important that senior health professionals remain aware of funding opportunities and access these. As new funding avenues or structures are developed finance should be directed towards home dialysis instead of traditional dialysis chairs and institutional nursing staff.[13]

Current funding arrangements

Australian funding is derived from a mix of Commonwealth funds and grants, State funds, private health insurance companies, veteran's affairs and personal costs.[appendix 4] Victoria has an example of a clear funding model developed to improve equity in funding.[appendix 5] A positive federal government initiative to give home dialysis funding equity (2005) was the introduction of medicare rebate for medical support of home patients.[40] Limiting this initiative, reimbursement has not yet been extended to rural medical practitioners who also perform the role of a supporting nephrologist. Only limited funding reimbursement for Nurse Practitioners is currently available.[41] There is no absolute perfect funding model but the key issue is equity and support for all aspects of home dialysis and no favour for hospital or satellite models.

Diagnostic related groups (DRG's) and activity based funding (ABF) is the current Commonwealth funding strategy.[42] From 2012 ABF will be rolled across the whole of health and this has commenced in some States already.[43] In July 2012 the pricing umpire will fix costs within the Commonwealth and State pricing agreement. Capturing PD and HHD activity will be essential to obtain funding. This is an opportunity for renal to secure funding that favours home dialysis.

Cost advantages of Home Dialysis

There is clearly proven data regarding the cost effectiveness of home dialysis in Australia and overseas. KHA estimates 'that increasing the use of home dialysis over the next 10 years would lead to an estimated net savings of between $378 and $430 million for our health system'.[5] 'In the US If the PD share of total dialysis was to decrease from the current 8% to 5%, Medicare spending for dialysis would increase by an additional $401 million over a 5-year period. Alternatively, if the PD share of total dialysis were to increase to 15%, Medicare could realise potential savings of greater than $1.1 billion over 5 years'.[44]

Geelong hospital determined that nocturnal dialysis for 6 nights had a 10.75% saving on standard SHD.[46] International research supports this when reduced hospitalisations and medications are including in costing.[47,48] It is recognised that initially training and installation costs are high and HHD is most cost-effective after one year indicating patient selection for HHD may be necessary.[8] All analyses indicate positive cost benefits to home dialysis.

Consistently the cost of HHD is significantly less than satellite and hospital HD. CAPD is a similar price to HHD with APD positioning itself between CAPD and satellite HD depending on the providers' contracts.[table 3] Costing usually includes the nursing component, infrastructure, equipment and consumables. Hospitalisation is more difficult to capture and not always included. Approximately for every ten persons on SHD sixteen could be financed for HHD or PD and only seven can have HD in-centre.

Table 3: Examples of weighted costings with the most common modality SHD as 1.0:

	HHD	CAPD	APD	SHD	HD (in-centre)
WA	0.46	0.57-0.62	0.83-0.99	1.0	1.7
NSW	0.55	0.55	0.55	1.0	1.23
UK	0.59	0.44	0.61	1.0	1.0
Canada	0.71	0.64		1.0	1.21
NT	0.64	0.77		1.0	1.19

WA – Draft Home Dialysis report, 12,14, 45,47

Future Funding

Assuming dialysis modality percentages remain constant, future funding must allow for the average 6% increase in prevalence, plus annual CPI, which is an estimated growth in renal expenditure of 10% per year. If this budget growth is not desirable then cost saving models such as increased home dialysis must be introduced.

Funding costs for actual programmes

Programmes include set-up costs, specifically infrastructure and maintenance costs, labour, overheads and consumables. Detailed funding analysis and considerations for HHD versus SHD have been completed in Geelong and America.[46,47,48,49] The cost of starting a HHD programme in Canada gives clear guidelines for cost considerations.[48] The central Australia renal study details modality costs by equipment, consumables, staff and overheads.[45] There is a completed report for NSW regarding funding for dialysis.[13] All indicate and detail cost savings for home.

Influence of Contracts

Funding models within actual dialysis contracts vary. All include capital and recurrent costs. Outright purchase of machines and consumables with care provided by health department nursing staff was the traditional model. A move towards price per treatment options that may include machines, consumables and or staffing are models that allow a pay as you go system. In WA a completely outsourced price per treatment model which includes all aspects of home dialysis was put in place in 2007. This overcame the barrier of funding for HHD and in 3 years the rate of HHD doubled.

Funding Barrier 1: Home dialysis has a cap or funding limitation preventing those who are choosing home dialysis from being placed onto the home programme.

Funding Barrier 2: The funding stream and costings are not clearly identified

Funding Activity 1: Determine if there are any limitations and if so are those capital, recurrent or policy/contract based.

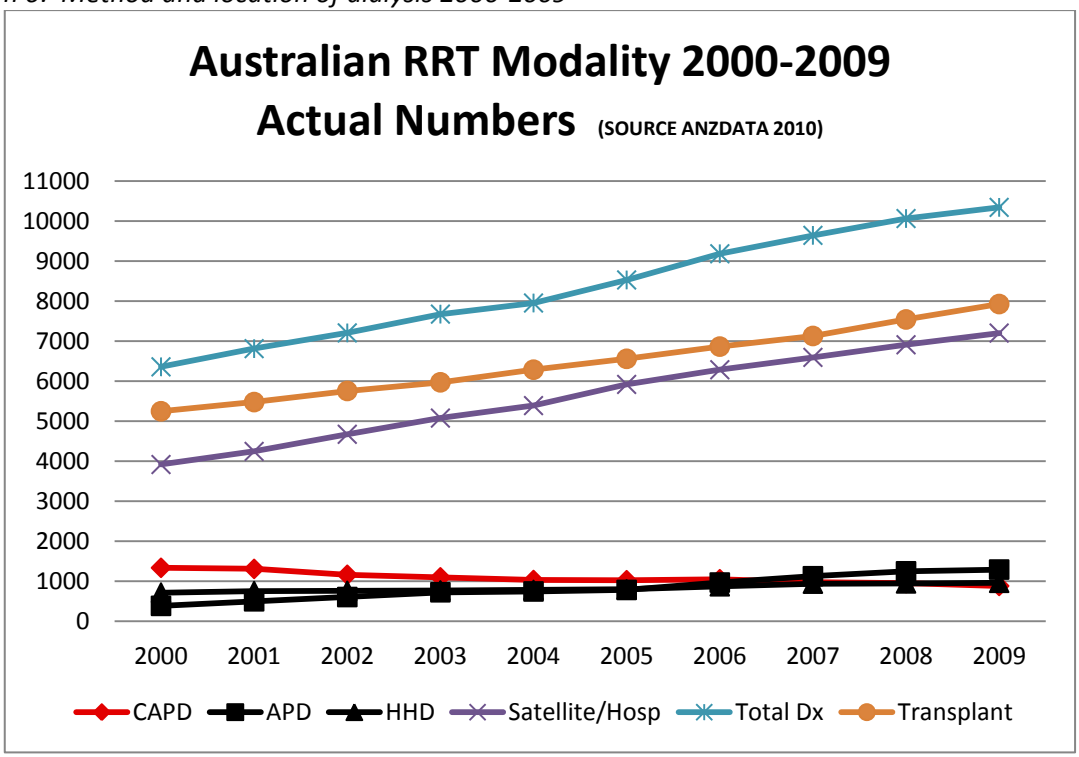
Funding Activity 2: Determine current model and potential appropriate models for the health districts concerned.

Funding activity 2: Develop a business case to lobby for a change in funding arrangements.

Government/State/Organisation Philosophy and Targets

Historically Australian State and worldwide models are clearly linked to the rates of home dialysis.[13] Government policy, both Commonwealth and State impact on home dialysis programmes. Demonstrating this in 2009, PD ranged from 8% in the NT to 27% in NSW. HHD ranged from 2% in SA to 14% in NSW.[3] In 2007, in NSW individual units varied between 12-41% for PD and 6-31% for HHD.[13] Socio-economic factors that may influence this are local physician preferences and access to training facilities. Demographics do vary by hospital and State but do not account for the variance. Over supply of satellites does decrease rates of home dialysis although satellites that promote self-care can contribute to a positive HHD programme. If home dialysis programmes are to grow the individuals, who work in renal health care and support the patient on their journey, must understand why and believe in the principle that home dialysis is the best choice when appropriate. The ethical debate between patient choice and the ability of a State to use health dollars effectively must always be considered.

Diagram 6: Method and location of dialysis 2000-2009



Home Dialysis First

A recommended philosophy is home dialysis first; either PD or HD, with hospital or satellite only offered when home is contraindicated for any reason.[13, 50] New Zealand (35% PD), and Hong Kong (80% PD) have developed high home ratios following this policy.[3,17] PD first operates in 34% of surveyed Australian units with 87% encouraging home dialysis.[24] Prominent figures in the US now support a home first policy with the targeted education option of home or hospital not PD or HD.[50]

Renal Health/Clinical Networks

All States except the NT, ACT and Tasmania have a renal health network. The role of the network is to provide strategic planning and overarching direction and leadership for the provision of renal services in each State. The networks include nephrologists, renal nurses and consumer representation. To achieve goals and benchmarks for renal care a combinations of meetings, workshops, commissioning of reports and working parties are used. Renal health networks are not the fund-holders but are advisory on health policy and pathways. Linkage with other health networks sharing common goals including chronic disease management, aboriginal affairs and palliative care is now occurring.

Documentation of philosophy

To achieve the appropriate State philosophy and targets the first step is for the home dialysis target to be written into endorsed models of care or health service plans.[8,9,12,45] The current trend is for renal health networks to document philosophy and targets within State models of care.

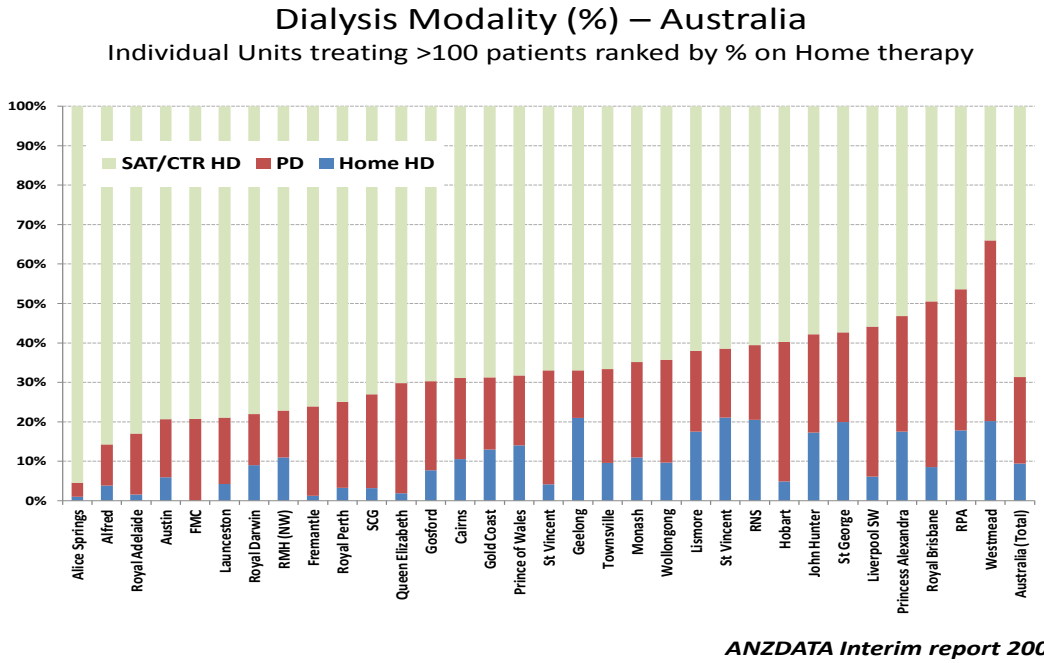
Once a philosophy is agreed upon all mission and values, educational materials, training programmes, and orientation programmes should reflect this. The QLD government have linked funding to home dialysis targets specified in the State model of care in a bid to drive a State home philosophy.[9]

Table 4: Documented State Targets (current achieved 2009) [8,9,12,13]

	NSW	Vic	QLD	WA	NT	Tas	SA	ACT
By Year	2015	Draft	2017	2013	Not found	Not found	Not found	2022
PD	30 (27)	(16)	(20)	25 (22)	(8)	(25)	(20)	25 (11)
HHD	20 (14)	(8)	(10)	8 (4)	(7)	(5)	(2)	20 (12)
Combined	50 (41)	35 (24)	50 (30)	33 (26)	(15)	(30)	(22)	45 (23)

In reality home dialysis rates achieved by individual units show wide variance, often not meeting targets.[3] Determining targets can be controversial and not accepted by all stakeholders. The ultimate target is for each hospital to achieve the national average or the New Zealand rate of 50%. Realistic targets may be less and for achievable targets a structured plan that aims for 1-2% per year, each year for a 5 year period is more attainable. Projected calculations when determining how to reach a target need to consider additional training to replace exits from programmes.

Diagram 7: Dialysis Modality (%) By Individual units. - Australia



ANZDATA Interim report 2009

Non-traditional home models

Whilst physical parameters may render a home unsuitable social issues may also preclude an individual from dialysis at home. Optional models for HHD still require the person to be independent in their care but the site for the dialysis is not their own home. Difficulties with water, power and cramped living conditions in housing have been overcome with community housing models as in Auckland, and WA, and self-care units as in QLD and Tasmania. Yorkshire in the UK has adopted a shared care strategy utilising a room elsewhere when HHD at home is not feasible.[52] An alternative model could include use of satellite machines out of hours.

Auckland's shared houses allow several HHD patients attend a community house on a roster and complete their dialysis independently. The cost of the house is funded by local organisations with the cost of dialysis funded as per usual home patients by the renal programme. WA use community buildings, often aboriginal health care clinics and provide one dialysis machine for each individual that attends these premises. The cost of the infrastructure is provided by the owners of the building. QLD have self-care units. The individuals are all trained to be independent and do not require staff supervision but are housed together on a site that may be independent or attached to a satellite dialysis unit. Tasmania are also commencing this model within their training unit in Hobart.

Supported Care models

Home dialysis models utilising paid support require costing and consideration for future planning. Social restrictions can be addressed for PD or HHD with innovative care models. In an Australian consumer survey non-home dialysis respondents indicated that they were willing to consider dialysis at home if they received nursing support (47%) or professional carer support (35%) relating to the dialysis.[6] Availability of home care was found to increase the potential PD pool from 65% to 80% of a Canadian population.[39] For HHD supported care may be for cannulation, one patient barrier to HHD.[39] Nursing homes are another option and several States have residents in nursing homes on PD.

Expertise

State philosophy and training must consider that lack of nephrologist expertise and nurse expertise can limit home dialysis programmes. [14] Effective PD nurses develop over years.[53] Renal registrars may not readily encounter home dialysis of either modality during training instead focusing on in-centre, satellites and transplantation. Therefore once they are nephrologists it is harder to advocate for home modalities. Formal nephrologist training curriculums in Australia now include home dialysis, and it is important they see well home patients and not the hospitalised patients.[54]

Marketing

Marketing regarding home dialysis may be underutilised. Recent marketing by NxStage in the USA to both dialysis professionals and patients demonstrates success in building home dialysis programmes.[10,55] The strategies include a website that markets home dialysis to the consumer, and consumer networks.[appendix 7] To support the philosophy that home dialysis is a good product all units should consider if they would benefit from marketing.[56] Supporting tools for marketing include electronic media and written materials. Web searches in Australia link first to home dialysis central from the USA, a deliberately designed one-stop website for home dialysis needs and information in the USA. Geelong however is prominent in searches for nocturnal haemodialysis.[21]

Philosophy Barrier 1: Individuals or organisations may prevent a positive home dialysis philosophy.
Philosophy Barrier 2: Realistic targets have not been determined and written into the State philosophy.
Philosophy Barrier 3: Lack of flexibility in contracts or models to meet the individual needs of the local population.
Philosophy Barrier 4: Local lack of expertise in home dialysis.
Philosophy Barrier 5: No marketing strategy to support home dialysis.

Philosophy Action 1: Determine who the barriers are. Consider and address these individually.
Philosophy Action 2: Determine and agree upon the State/organisation home dialysis philosophy with benchmark targets.
Philosophy Action 3: Incorporate the home dialysis philosophy with benchmark targets into all relevant written documentation.
Philosophy Action 4: Determine local barriers and develop a model to address these.
Philosophy Action 5: Education for nephrologist, registrars and nurses in home dialysis.
Philosophy Action 6: Develop a marketing strategy based on fact for home dialysis.

Clinical Governance, Quality and Leadership

An effective programme requires clinical governance and leadership. For large programmes a dedicated nephrologist and senior nurse will be able to lead a programme with evidence based clinical outcomes and monitoring.[13,52] Additionally a financial manager is an asset. In business a budget of multi-millions with potential savings of millions for alternative models would be underpinned with tight financial control. For smaller programmes individuals with passion and time specifically allocated could take the leadership roles. QLD advocate a hub and spoke model of service network and governance framework.[8]

The role of clinical leads is to;

- Support, advocate for and promote home dialysis education for all renal health care staff
- Provide financial management (with a financial manager) of the home programme
- Lead procurement processes incorporating machines and consumables
- Identify new technologies for PD and HHD and plan for timely inclusion of these[55,57]
- Standardise policy and guideline development based on evidence based research. In 2010 only 33% of nurses agreed that their unit had a standard unit policy regarding home dialysis.[58]
- Manage the quality programmes including clinical indicators (CI) and key performance indicators (KPI)
- Be a communication resource and link for metro, rural and remote
- Participate in future planning for appropriate home dialysis services
- Lead implementation and development of information technology/database systems
- Act in an advisory capacity to health department
- Develop strategies to identify those who are not yet on home programmes but could be (13% of HD patients were willing to transfer in a consumer survey)[6]
- Develop and support a patient centred philosophy

Basic data collection (for CI or KPI):

- Cost per treatment/programme
- Prevalence and Incidence with 5 year trends
- Dropout rate from programme
- Reasons for dropout
- Peritoneal dialysis – peritonitis rates
- Peritoneal Dialysis – access complications
- Haemodialysis – access complications
- Morbidity and mortality
- Time to training/Training time to home

Optional data collection:

- Did the patient have true choice
- Clinical parameters – haematology and biochemical
- Weight management
- Nutritional markers
- Adequacy
- Quality of Life indicators
- Access to conservative care or palliative care support

Standardised and appropriate national KPIs or CI's would allow for benchmarking Australia wide.

Quality Improvement

ANZDATA allows for easy national benchmarking and target determination although it is 1-2 years retrospective.[3] Caring for Australians with Renal Impairment (CARI), Kidney Disease Improving Global Outcomes (KDIGO) and National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKFKDOQI) are examples of guidelines that may provide guidance to appropriate KPIs, monitoring and best practice in a wide range of topics related to CKD management and treatment.[59,60,61] The International Society Peritoneal Dialysis (ISPD)have detailed guidelines regarding peritonitis and PD management.[63] Currently limited information is available specific to home haemodialysis.

Patient centred care

Home dialysis by nature has a greater focus of patient centred care than satellite or in-centre HD. For total patient centred care the focus must remain so that the patient works with the health care teams to determine the best RRT solution for themself. At all stages commencing with diagnosis and education through to final withdrawal of dialysis the patients should sense they are being listened to and actively involved in their own care decision making and care administration. This improves patient satisfaction, reduces complaints and leads to improved recovery and emotional health.[63]

Information Technology (IT) and databases

An effective IT system will support every role within leadership. It is also a desired and recognised tool to support effective clinical care, clinical monitoring and streamlined transition for the consumer on the renal journey.[64, 65,66] In most jurisdictions a comprehensive shared IT system is still on the wish list.

Leadership Barrier 1:	Inadequate funding
Leadership Barrier 2:	Lack of interest to hold this role by individuals
Leadership Barrier 3:	Politics weaken the power of the leadership team
Leadership Barrier 4:	No structure IT/database system
Leadership Barrier 5:	The model does not have a complete patient focus
Leadership Barrier 6:	No clear policy procedures and guidelines to ensure best practice

Leadership Activity 1:	Determine a business case: use the cost analysis of saving based on targets expected to cover funding
Leadership Activity 2:	Determine and recruit potential candidates for senior roles
Leadership Activity 3:	Assign the appointed leader the power to determine the future of the programme based on objective policy development
Leadership Activity 4:	Develop a business case for a database based on efficacy, effective clinical follow-up and capacity to produce KPIs leading to quality programmes
Leadership Activity 5:	Develop a patient centred focus and consult consumers for opinion
Leadership Activity 6:	Access relevant information to ensure programme is based on best practice and monitored appropriately for best outcomes

Pre-Dialysis Education

Pre-dialysis education is the most significant process in determining choice of dialysis modality. The role of pre-dialysis educators is clearly established in most programmes but time limitations may reduce the impact of this role. Only 54% of surveyed patients in 2010 chose their current modality.[6] The recommended FTE for nurse pre-dialysis educators is not yet defined and actual rates vary widely. QLD have not determined a figure in their workforce recommendations. WA in the draft home dialysis report has determined that 1:50 new patients per year would be appropriate. Central Australia recommends 1:100 incident patients.[45]

Nephrologist and Health Professional Influence

Patients are influenced by their nephrologists. This is demonstrated by the wide range in uptake of various modalities in different hospitals and even within the practising group at each site. Interestingly 7000 world-wide nephrologists felt that the most important driver for increasing home dialysis was patient motivation.[24] The variability in prevalence of home therapies suggests otherwise. Careful examination of programmes to determine whether co-morbidities, patient choice or personal bias influences the uptake of home is required for objective data. Personal biases and beliefs should be addressed.

A commonly held belief amongst health professionals is that age is a barrier to HHD. State HHD for over 65 year olds varies from 1.1% in W.A. to 5.6% in the ACT.[3] A total of 52, over 85 year olds are at home across Australia.[3] For future planning 50% of patients are in the over 65 demographic and as they are not suitable for transplantation they are an ideal static home population. With the predicted growth in this demographic they are an essential target for home.[8]

Health professional roles within education

Nephrologists have limited time for one-on-one education but importantly their role includes determining if a modality is not appropriate for medical reasons. A high proportion of pre-dialysis and also CKD education is now performed by specialist nurses. A small proportion are nurse practitioners.

A CKD or pre-dialysis educator requires:

- Good communication skills especially listening and non-verbal skills
- Intermediate knowledge of best-practice health care management (nurse practitioners holding those role have advanced knowledge)
- Advanced knowledge of the objective advantages and disadvantages of each modality
  CARI guidelines details evidence re starting HD versus PD but not home dialysis [appendix 6]
- No subjective personal bias re a specific therapy
- Strong links and acceptance within the renal team
- Flexibility re style of teaching and willingness to use/access multiple resources
- Knowledge of relevant cultural issues and culturally specific communication skills
- Good database skills
- Membership of professional groups

Referral into Education

An official referral pathway is required to capture patients at a time deemed appropriate by the individual units. If the capacity for health education is present referral may occur at stage 2. Most units accept stage 4 or 5 with limited capacity to educate stage 3. CKD educators, specifically employed for promotion of positive health outcomes in earlier CKD are utilised in some States and these positions are increasing with many practising as nurse practitioners.

Timing of Education:

- Stage 2-3: Healthy lifestyle with renal failure
- Stage 3-4 Healthy lifestyle and introduce all options for treatment
- Stage 5 Confirmation regarding dialysis choice

Pre-education regarding modality choice should be given at stage 4-5, or 6-12 months prior to commencing treatment option.[67] In a recent survey covering 66 Australian renal units only 16% commenced dialysis with no education compared to previous statistics of 30%.[67] 92% of patients starting home dialysis had been referred over three months from their start date whereas 71% starting in-centre were late referrals. International guidelines support the notion that information is given 6-12 months prior to commencement.[67]

Late Referral

Late referral is a key issue that prevents timely education. It may be late presentation by the patient, GP delay in detection and referral or a delay between the nephrologist review and pathway to the pre-dialysis educator. A pathway can solve referral delays within the hospital system. To reduce delayed referral by GPs it is important that they have access to information that can assist them to identify the appropriate referral time, WA has a referral tool.[68] Easy access to website information is important. Education of the community health professional contacts is also important. KHA administer extensive GP education programmes, operating under the umbrella of KCAT.[69]

Time required for delivery of basic education:

- Minimum of two sessions of any type per individual
- Use of written, computer etc for individual to refer to after education sessions

Content of Education

Education must be delivered to promote patient choice.[67,70] The educator needs to offer hope and find out about the patient's priorities and expectations.[71,72] Patients and family caregivers highly value treatment that enhances survival and can be performed at home.[67] Understanding why RRT is required or the consequences of no treatment is an inevitable part of education. The practical aspects, advantages and disadvantages of each option then need discussion with positive marketing for the ideal modality to achieve best outcomes. Costs to the individual for each treatment type should be detailed. For satellite and in-centre this will be travel. For home it may be a chair and ongoing costs. Information regarding any incentives provided by the State should be available.

Education can be delivered:

- Solo with an individual and their significant others
- Group as lectures and interactive workshops
- Using media i.e. teleconferencing. webinar
- Utilising a combination of verbal, written and demonstration
- Personal experience - networking or visiting others who are experiencing home dialysis

Solo is the most prevalent method of education.[51] Group can have advantages over written material but education should be one hour blocks.[51] Networking and use of human resources are positive outcomes of group education. Patient narratives do influence treatment decision making.[72] Attendance by a care partner increases home dialysis uptake.[51] WA pre-dialysis educators group and KHA are currently offering co-joined 3 monthly workshops regarding modality choices which are well attended, cost effective and receive positive feedback.[73]

Additional education sources (group and solo):

- Anaemia coordinators
- Bone coordinators
- Vascular access nurses
- Dieticians
- Social Workers
- Home training team

Recommended training materials/tools:

- Simple tool for decision making regarding suitable modality i.e. Match-D [74]
- Written information regarding normal kidney function and how peritoneal and haemodialysis replace these
- Written information regarding transplant and choosing no dialysis
- DVDs or computer links re the above
- Models/posters/demo models of dialysis machines/peritoneal dialysis equipment
- Written materials or computer links for materials that are culturally/linguistically specific
- Risk assessment tool for home dialysis

Cultural considerations:

Only 11 of 273 chronic disease programmes that were examined to determine cultural appropriateness met benchmarks.[75] Programme and education materials should be examined for and aligned with culturally appropriate resources and communication. The message to consider home must be based on the value and belief system of the individual. Many cultures say yes because they believe they should so understanding and true feelings must be checked for. Health trained interpreters must be used if the message cannot be sent and received in English.

Rural Considerations

Renal nurses in satellite units can perform the education role however they must be adequately educated in all modalities and have access to the training materials. Nurses in satellite units may have a biased interest towards increasing the dialysis numbers locally. Roving educators or teleconferencing can overcome the distance barrier. Nurse practitioners conducting remote CKD clinics would be a potential model for providing rural education and support.

Pathway via education to home dialysis

Either a paper record or electronic record is essential regarding all patients who are referred for education. This can be completed in the format of a pathway. A pathway would cover all the milestones of pre-dialysis education including social requirements, symptom management and dialysis access formation. This will allow the individuals are to receive a timely transition to home dialysis and not fall into the hospital/satellite system. MMEX and Audit 4 are IT systems that have pre-education pages or pathways.[65,66] Of note is that education often occurs over a 2-3 year period and therefore it cannot be assumed that the individual who commences the education process will complete it.

Lost to follow-up

All efforts should be made to keep in touch with those referred into the programmes. Databases can pick up those lost to follow-up. Another group lost to home dialysis follow-up are those who commence in-centre and are transferred quickly to a satellite centre, public or private. Home Dialysis as an option should be reintroduced to this group at a later stage.

Pre-education Barrier 1:	No pre-educator or inadequate hours available
Pre-education Barrier 2:	Biased educator/nephrologist not supporting home dialysis
Pre-education Barrier 3:	Late referrals
Pre-education Barrier 4:	Inadequate pathway and follow through
Pre-Education Barrier 5:	Lack of culturally specific education or educators
Pre-Education Barrier 6:	Limited computer or take home resources to consolidate teaching
Pre-Education Barrier 7:	Health care professionals inadequately informed regarding home dialysis

Pre-Education Action 1:	Educate appropriate community renal nurses at country sites. Partner with larger organisations for co-joined education
Pre-Education Action 2:	Identify biased educators and nephrologists. Promote State or district philosophy and provide objective education
Pre-Education Action 3:	Education and provision of tools to GP network to support timely referrals
Pre-Education Action 4:	Invest in a pathway either on paper or preferably electronic.
Pre-Education Action 5:	Identify the key cultures in the catchment and employ appropriate individuals or access appropriate tools
Pre-Education Action 6:	Establish an easily accessible list of training resources via sources including KHA websites, dialysis providers, overseas renal sites, pharmaceutical companies
Pre-Education Action 7:	Educate all health care professionals with accurate data

Preparing for Home Dialysis

Preparation for home dialysis will include access surgery, adaptations to home and pre-determining a suitable training time based on social needs.

Surgery - Access

It is critical for home dialysis that surgery is available in a timely fashion. Fistulae or graft that are appropriately created or placed and are able to be needled independently with good flows support a smooth and positive transition onto home dialysis. PD tubes are preferably placed 2 weeks prior to use, require effective flow and should be infection free at the time of commencement of dialysis.[76] The surgical technique by an experienced surgeon, use of antibacterial preparations, dressing techniques and timing of commencement should all follow best practice guidelines such as the CARI guidelines or ISPD guidelines.[59,76] Nephrologists perform surgery in some countries. Focused dialysis access theatre lists that are co-ordinated by a nurse access coordinator promotes effective use of surgical time.[6] Recommended FTE for an access coordinator in QLD is 1:200.[77]

Long-term central venous catheters are an option for home dialysis and if it can be determined that the infection risks can be minimised do not have to be a deterrent. Options of using buried peritoneal dialysis tubes have had success in remote areas in WA and the NT with indigenous populations, allowing the tube to be used immediately symptoms indicate a need for dialysis. Pre-sternal PD tubes are used in limited centres, including WA, but do require the expertise of a local surgeon.

Adaptations to Home or location options:

- Space to accommodate consumables and for the HHD or APD machine
- For HHD adequate water supply and drainage that must be directed to the dialysis room.
- For HHD a reclining chair or bed
- Permission for HHD alterations if a home is rented privately or from the State
- A move may be required to more suitable accommodation
- Source alternative dialysis location i.e. Community centre, bus, out of hours satellite

To promote home therapies for the consumer it should be cost neutral. Basic plumbing and electrical costs are an integral part of many home dialysis installations and require consideration regarding who is responsible for the costs. Victoria currently have a funding incentive of $503 per PD patient and $1,327 per HHD patient per annum.[78]

Role of Allied Health/support services

If rehousing is required the social work team are critical for support in this area. Individuals may also become eligible to access superannuation and new pensions and again social work can advise. One recommended FTE for social work is 1:125, with other supports being the dietician 1:150 and psychologist 1:200.[45,77] Determined by the needs of the local populations an allocation of allied health time, referral pathways and use of community resources to support this must be determined within the education model. Community resources must not be forgotten and GP referrals can be made for psychologists allowing up to six visits for example. Multidisciplinary CKD clinics are an optional model that may link all services.

Pre-determining a training time

For HHD particularly, but also for PD, training may be preferred considering school holidays and time off work for either the patient or their care partner. A structured introduction via a self-care satellite unit with a planned time for intense HHD training may shorten training time and interruptions to work schedules. Many individuals have a window of opportunity to start dialysis and if flexibility can be offered to them within this window it can increase their acceptance.

Pre-training

For HHD if the satellite and hospital units operate in close collaboration with the home training unit (HTU) they can commence self-care. Any procedures taught prior to training should mimic those of the home dialysis training unit. The advantage of prior training is reduced training time at HTU and a diminished fear of having the capability to learn. For the staff at the satellite sites training time is returned when the patient can perform certain functions for themselves saving staff time.

Rural Factor/Travel and Accommodation:

Rural patients rarely have a training unit close by due to lack of concentration of numbers. Family impact for a HHD train can be intense and this group can benefit the most from early training at local satellites. Patient assisted transport schemes can provide financial reimbursement for travel (15-19c per km) and accommodation ($30-60 per night).[79] The system varies by State and details are available via the KHA website (patients/financial assistance).[80] A novel solution in W.A. is the faith house leased by KHA and furnished by Lotteries West which can be used by home training patients when available.[80] The cost to the patient is covered by the WA PATS system.[79]

Transition to the Home Dialysis Unit

- Meet the home training staff and visit the HTU
- Pathway for transition including information regarding access and parking at the site
- Commence self-care at the current HHD facility if transitioning to HHD

Preparing Barrier 1:	Surgery waitlist and lack of access coordinator
Preparing Barrier 2:	Ineffective surgery
Preparing Barrier 3:	Cost of preparing home or relocating
Preparing Barrier 4:	Inadequate social work support
Preparing Barrier 5:	Lack of accommodation or travel assistance with anticipated cost to patient/carer during training i.e. travel, lost earnings
Preparing Barrier 6:	Waitlist for larger or appropriate rental housing/community centre
Preparing Barrier 7:	Poor planning and communication for transition

Preparing Action 1:	Collect data and lobby for increased surgical time, access coordinator based on cost savings if patients transitioned earlier
Preparing Action 2:	Collect and monitor data re access failure
Preparing Action 3:	Collect data and participate in lobbying for out of pocket expenses
Preparing Action 4:	Prepare business case to increase social work to appropriate levels
Preparing Action 5:	Obtain social work support to establish a local resource list and application forms for current financial, travel and accommodation support for training
Preparing Action 6:	Consider training models of care where patients commence training as per official curriculums at their current satellite/hospital dialysis unit with fine-tuning at HDU
Preparing Action 7:	Develop and implement a concise transition pathway

Infrastructure for Home Training Units and Home

Home Training Units Location Options:

- Co-located in-centre at hospitals
- Co-located with satellite in the community
- Stand alone in the community
- Train at home

These are the typical characteristics of many training units and State models of care across Australia. Distance from the parent hospital decreases the direct access to support resources but often improves the physical training space and access for the individual. For stand-alone units co-operative support partnerships with hospitals and satellites are required for best delivery of care. Australian nephrologists reported lack of physical infrastructure for training impeded their HHD (38%) and PD (26%) programmes.[24] Nurses reported higher rates for HHD (59%) and PD (40%), which may be influenced by them actually working in the environment.[58] Despite this Morton 2010 reported that only two PD and zero HD of 721 patients were not given information because there was no training facility, indicating that health care staff work around the inadequate facilities.[67] Improved outcomes have been reported in PD patients trained at home.[56] Training in the home can have risks and travel pressures for staff.

Table 5. Comparison of Location Options

Criteria/Access to	Hospital	Satellite	Specific stand alone	Home
Nephrologist on site	√√√	√√	√	
Training Nurses	√√√	√√√	√√√	√√
Allied Health on site	√√√	√	√	
Visibility of home training	√√√	√√		
Proximity to home (metro) & parking	√	√√	√√√	√√√
Proximity to home (rural) & parking	√	√√√	√√	√√√
Safety and security	√√√	√√	√√√	√√√
Specialist nurses i.e. anaemia	√√√	√	√√	
Appropriate train space	√	√√	√	√√√
Home like environment	√	√	√√	√√√
Options to commence training pre HTU	√√	√√√	√	√

√√√ - Constantly available
√√ Intermittently available
√ Occasionally available

Physical requirements:

- Training/clinic rooms – solo and group options are ideal
  Note minimal room sizes may apply according to State legislation
- Storage space including for spare equipment/wheelchairs
- Office space for nurses, nephrologists
- Dirty utility room
- Rest room/kitchen/lounge areas for staff and patients
- Reception/admin areas and storage
- Computers
- Safety systems i.e. fire and safety, to meet OH&S requirements and State licensing
- Training resources – DVD players, TVs, Whiteboards, written materials

Dialysis Equipment and Consumables

Complexity of equipment is an identified barrier to home dialysis[24]

Dialysis machinery for HHD and PD and water treatment equipment must be

- Proven to be safe and effective (Therapeutic Goods Administration governs this)[81]
- Cost effective – consider machine and consumables
- User friendly
- Be reliable and have ongoing efficient technical support for equipment failure
- For home preferably be portable

All equipment should be evaluated considering objective criteria. Alternative providers may excel in one area over another and therefore flexibility in choice of equipment will maximise outcomes. However contracts to one provider may be more financially competitive. Current Australian providers are Baxter (PD only), Gambro (HD only) and Fresenius (both HD and PD). NXstage is a new technology HHD machine developed to overcome traditional barriers[55] and following positive uptake in the USA is currently on trial in Australia. Sorbent technology is also currently under review for home haemodialysis.[82] It is anticipated that many of the dialysis providers will be offering new technology for HHD in the near future and as it becomes available this will expand programme options and consumer choice. Of note NZ has high home dialysis rates using all standard single pass dialysis machines successfully and no access to the most recent innovations.[7] In the UK a document has been written as a buyer's guide for home haemodialysis equipment.[83]

Contracts vary considerably, for example in Victoria every unit is responsible for their own equipment and has the freedom to purchase as preferred, Sydney dialysis centre purchase equipment on a contract for multiple areas and WA operate with a seven year contract to one provider for the State. If these contracts are exclusive to one provider and operate for a number of years there are limitations to the use of new products as they are released on the market. The longer and more exclusive contracts however may allow for agreement on a more favourable cost. The cost to the consumer of any consumables or equipment within the contracts should be zero. However different State contracts and inclusions within these contracts mean that consumers may have to purchase health monitoring equipment, hand hygiene solutions, dressings and pay to have additional deliveries.

Regulations - Electricity

Mandatory legislation, AS/NZS 3003:2011, that mandates individualised electrical circuits for HD and APD machines is potentially a barrier for all but especially for those in older properties, rental properties or units.[84] The requirement is for a separate circuit for all haemodialysis equipment plus a 10mAmp circuit breaker that can be reset by the person on dialysis. The new legislation took effect mandatory effect from April 2011 and may add up to $1,000 on the cost of installation for HHD and APD.[84] It does not apply to existing installations. The specifics regarding travel with a portable machine are not considered but common-sense suggests the use of a circuit breaker must be applied. Protocols and policies regarding home dialysis must consider this legislation. Training units must also apply this legislation.

Regulations – Water

There are no Australian national standards, with different States developing different policies based on the American, European or ISO guidelines and local expertise.[85,86,87,88] The training unit must complete water testing in line with State considerations and consider on-install and maintenance microbiological testing, hard water analysis, daily chlorine tests, and possibly endotoxin testing. A test for heavy metals is standard when a property is inspected for potential for home dialysis. Annual water testing can be achieved with annual machine maintenance in most cases. Trained technicians or nurses may perform this role.

Management requirements:
All home training units will require a structured management process to ensure there are systems and policies to promote best patient outcomes. It will include:

- Policy and procedures – dialysis, infection control, human resources, OH&S
- IT systems i.e. patient databases, risk management systems, clinical care system

Training Hours
Many units operate a business hours training unit. This is prohibitive to workers and those whose carers work. Patient centred units are innovative in how they offer training schedules. Small training units with a small training team will reduce the ability of a unit to be flexible and in many units unfortunately this is the norm. Co-location with a satellite unit may allow increased flexibility. Returning to satellite for one treatment a week also increases flexibility and has been done successfully.

HDU Barrier 1:	Lack of proximity and easy access for the patient
HDU Barrier 2:	Inadequate space and resources for effective and private training
HDU Barrier 3:	No direct access to nephrologists, allied health and specialist nurses
HDU Barrier 4:	Limited hours training available
HDU Barrier 5	Lack of relevant policies and procedures to meet legislation and maximise patient safety

HDU Action 1:	Review location of home training and considering above required factors determine if a move is feasible and advantageous
HDU Action 2:	Establish referral pathways, outpatient systems and possible multidisciplinary clinics for HDUs, either at the hospital or on-site.
HDU Action 3:	Consider the use of telemedicine, GP networks, home visiting teams to manage ongoing care.
HDU Action 4:	Think outside the square re hours for training with flexible rosters and staggered staff. Develop partnerships with satellite units for some treatments if required.
HDU Action 5:	Develop policy and protocols that incorporate current legislation

Environmental Factor and Carbon Footprint

The design of a home training unit or the style of a home installation can alter the carbon footprint that is created and be more environmentally friendly.

Geelong dialysis unit in Victoria have led the way with a green model for dialysis.[38] Green models may not increase programme uptake but it is a positive for the environment. Recycling of waste, water and buildings that minimise power costs or use reusable energy sources are all areas for consideration.[37]

Carbon footprint

HHD using standard energy sources creates a carbon footprint with emissions (37%), energy use (27%) and travel (20%).[36] In the UK it was determined that one in-centre HD patient has a carbon footprint of 3.8tonCO_2Eq per year. At home on standard dialysis equipment the carbon footprint increased determined by the hours on dialysis up to 7.2ton for a 6 nightly nocturnal regime. The lack of need for travel saves approximately 1 ton. The new technology of NxStage reduces the carbon footprint.[55] The electricity consumption is 0.1kWh compared to 1.29 kWh for a standard machine and water treatment equipment. For 6 nightly nocturnal it was estimated to require 2.1ton. This may be a future consideration when choosing dialysis equipment.[36]

Water

Water recycling is an important consideration and with minor modifications can be achieved. A typical dialysis patient uses 80 000l of water per year.[89] Recycling of reject reverse osmosis water alone can reduces water consumption by approximately 60%.[89] Alternative use of grey water for gardens is also a consideration although this may be inhibited by council regulations that assume dialysis water is contaminated. For individuals reliant on the use tank water, recycling is essential.

Energy

The use of solar or wind power to provide electricity is also the future. This is positive for the environment and the energy bills. Some councils and energy schemes provide rebates for use of solar power. This is a consideration for future home training dialysis units. Geelong in Victoria are using solar power and claiming government subsidies.[38]

Recycling

Recycling of plastic and paper waste should be accessed when possible. Local councils will advise on local regulations. Fresenius use biofine, a plastic free from DEHP in their PD consumables.[90]

Environment Barrier 1:	Lack of knowledge regarding environmental impact and how to minimise this
Environment Barrier 2:	Equipment that creates a high carbon footprint
Environment Barrier 3:	Recycling not available
Environmental Action 1:	Consult an expert and develop environmentally friendly installations
Environmental Action 2:	Consider the environmental impact of the equipment during tender processes
Environmental Action 3:	Approach councils or private companies re the option of recycling

Home Training Process

Ratios of nursing staff need to be adequate to allow one-on-one training where required. Commonly accepted ratios for HHD are 1:15 and for PD are 1:25 including:

- Training
- Ongoing support at home

It is recognised that indigenous and remote are factors that increase the need for lower patient ratios. QLD renal clinical network in 2010 determined a ratio of 1:10 for HHD and 1:15 for PD as desirable and for review in 2011.[77]

Staff characteristics

A home dialysis training nurse benefits from:

- Good communication skills particularly listening and non-verbal skills[53]
- Advanced knowledge of the modality of dialysis including trouble shooting
- Patience, empathy and approachability
- Knowledge of principals of adult learning and ability to use these[53]
- Knowledge of the different learning styles with reference to generational types
- Flexibility regarding style of teaching and willingness to use multiple resources
- Knowledge of relevant cultural issues and culturally specific communication skills
- A structured orientation, initial training and ongoing education[55]

Lack of nursing expertise is a barrier to home dialysis for 30% of units according to nurses.[58] Skills of a PD trainer are augmented over a period of years.[53]

Patient Training Components

- Demonstration and practice
- Visual pictures detailing how to perform the practical skills required
- Written/multimedia information re all aspects
- Theory to support rationale
- A check learning and competence component
- Trouble shooting
- Revision component

Training Curriculums

A structured training curriculum to encompass all of the above is the foundation of a good training programme.[53] A 2010 survey by the Australian HOME network revealed many gaps in resources and gaps by nurses in knowledge of existing education resources.[91] Industry are acknowledged as providing specific product training information and handouts. Training tools need to be intellectually, language and culturally appropriate.[53,75] Strategies are required to identify and support patients who are not literate. Documentation of progress is essential as multiple trainers are involved in many trains. It also provides back-up to demonstrate achievement of a skill if issues occur later. Training can be considered completed when competence is achieved.

Training Location

Options for training locations should be considered to maximise the learning opportunities for the individual.[53] The training unit may be appropriate for many and with clinic rooms, demonstration equipment and support for the trainer suit many training partnerships. However for the frail, aged, and those with transport difficulties or social dependents there may be occasions when a home train is more effective. The disadvantage for a home train is the travelling for the trainer and some environments that are not ideal for training. However the HTU should endeavour to have flexibility when it is thought the individual will benefit without detriment to the training team.

Possible Training fears:

- Fear of blood and blood spills
- Fear of needles
- Fear of giving themselves peritonitis
- Fear of machines
- Fear of being at home alone during emergencies

Any fear has the potential to be a barrier to achieving success at training. Early identification, acknowledgement and then strategies to overcome these fears will limit the negative impact. Sharing information such that it is rare to find a patient who can self-cannulate then allowing a nurse to insert the cannulae may foster confidence. Integration of peers, trusting relationships, gentle persuasion, hypnosis and assertive encouragement all supported with accurate information and a degree of autonomy are techniques that may overcome fears. Provision or recommendation of specialised equipment such as a blood monitors to detect needle dislodgement are practical solutions.

Care partners or support partners

Support is essential but dependence on another often has negative consequences. Support partner burn-out, and support partners becoming unavailable is a high risk. Loss of earnings can be significant. Nurses identified this as a primary issue for home patients.[58] To minimise dropout the patient should be made as independent as possible and in reality most can go solo with either HHD or PD.[7] Care partners can learn the trouble-shooting and how to support whilst their most important role may be socialisation. Care partners require referral to social workers to ensure they gain all relevant available financial support. Home dialysis patients often do not meet current centre-link requirements meaning their carers are ineligible for the carers' pension.[98]

Documentation and Consent

Electronic documentation is gold standard.[64] Generated data can also be used for reports and KPIs. Systems on the market include MMEX and Audit 4.[65,66] IT systems should be networked and secure with the ability to link all members of the multidisciplinary team. Ideally it will be the same database as for pre-dialysis and then training data can be uploaded and ongoing care continue. Options for laptops and remote access increase the potential for streamlined care.[64] Documented consent to treatment serves two purposes. A correctly executed consent ensures the individual is adequately informed and confirms that they have agreed to undertake dialysis at home with its risks. Whilst there have been no court cases related to home dialysis to date this may occur in the future.

Training Barrier 1:	Inadequately skilled staff
Training Barrier 2:	Cultural/language inappropriate staff
Training Barrier 3:	Ad hoc training curriculum
Training Barrier 4:	Difficult to use equipment or consumables
Training Barrier 5:	Fears that block learning
Training Barrier 6:	Inadequate documentation capacity or access to pre-training information
Training Barrier 7:	No consent process
Training Action 1:	Up-skill staff with formal orientation and ongoing training programmes
Training Action 2:	Recruit staff with appropriate skills
Training Action 3:	Establish a formal training curriculum and pathway
Training Action 4:	Collect data on equipment failures or difficult to use consumables. Report these to the providers. Use objective equipment analysis criteria
Training Action 5:	Identify any training fears and determine individual solutions
Training Action 6:	Determine and implement a suitable IT solution
Training Action 7:	Establish a consent form and policy with a strategy for renewal as deemed appropriate.

Transition to Home

Quality of care at home

Dialysis at home must be as safe as dialysis in a hospital. Attention to emergency procedures on dialysis, application of industry guidelines, ongoing monitoring and disaster planning should all be included. Canada have published guidelines for safe installation and operation of haemodialysis and peritoneal dialysis in a home setting in November 2010.[92] These guidelines cover all aspects of safety regarding dialysis at home including electrical, plumbing, quality management, waste management and disaster preparedness.

Deliveries and set up of supplies

Delivery of machines and consumables can be overwhelming and support to arrange stock will enhance a smooth transition. Purchase of items including scales, tables, chairs, and intravenous poles may be required depending on the contract each unit has. Many units provide these items for hardship cases at minimum even if it is via fundraising sources. Cost-neutrality for the patient is the goal in a programme encouraging home dialysis.

HHD Technical Installation

Prior to commencement of HHD an experienced technician will perform a home assessment. Availability of reliable power, water that reaches the required pressure and the ability to connect the machine to the sewage system are evaluated. Plumbers and electricians support the installation process which includes modifications to the water supply to deliver it to the required room, installation of a separate and protected electrical circuit and connection to a drainage outlet. Bore water, tank water, septic tanks, and old electricity circuits are all hurdles that can be overcome with time and money. The costs of installation are usually paid for by the health system but if costs exceed usual averages the individual may have to contribute to the cost. Given the savings gained by HHD it is recommended that this be made cost neutral.

Technique assessment

For peritoneal dialysis witnessing a minimum of one bag exchange in a home environment is mandatory. This allows for evaluation of peritonitis risk factors and has immeasurable benefits to understanding the family dynamics. Social issues will account for 42% of technique failure withdrawal. Peritonitis will account for 22%.[3] For haemodialysis a minimum of two treatments is usually recommended or until the patient can complete the dialysis without physical support from the home training nurse. For haemodialysis a carefully timed plan involving the technical installation and consumable delivery and the nurse supervision must be coordinated. Effective and extensive communication with a discharge to home pathway can smooth this transition.

Medications and Administration of specialist drugs

A supply system that avoids a return to the hospital is preferable. The cost of medications, especially the anticoagulants, to the patient should equate to costs for in-centre patients. IV iron and erythropoietin can be safely given on HHD. Alternatively local clinics or community nursing services may administer these solutions. The aim is to develop a policy and provide training to reduce the need for a return to an in-centre for routine drug administration.

Waste removal and sharps disposal

Council regulations govern this area and do vary so it is important to check local regulations at present. In some States dialysis waste can be placed in domestic waste for both PD and HD. WA have a detailed policy.[93] Council misunderstandings regarding the risks of PD waste can result in expensive disposal methods that are unnecessary. Remote clinics in WA and NT have developed incinerators or link into existing medical services for waste removal. Sharps can usually be disposed of via chemists or the HTU.

Each HTU clinic should have written and up-to-date information for its own regions. If a cost will be incurred this should be reimbursed.

Community Education

Education of local supports i.e. GPs, community nurses and local hospital emergency departments will extend the capacity of the support at home especially for remote and rural patients. The USA has a higher dropout rate attributed to variable support.[17] Indigenous are identified to have better outcomes with close and regular support networks.[75] The home dialysis nurse does not usually have resources for face to face checks with all home patients so clever use of alternative resources needs to be harnessed.

Transition barrier 1:	Poor planning and coordination
Transition barrier 2:	Inability to provide installation support
Transition Barrier 3:	Costs to the individual

Transition action 1:	Develop a clearly defined discharge to home pathway
Transition action 2:	Incorporate home install visiting into nursing FTE and develop business case if needed to obtain funding
Transition Action 3:	Reimburse all costs of dialysis

Support at Home

Best practice incorporates home visiting weighted towards those most at risk and the first year at home. Ongoing monitoring by qualified professionals who understand home dialysis is required. A formal guide to recommended ongoing surveillance can be found in the Hunter health care management booklet.[94] Options for daily assistance and support at home dialysis are also being considered by many programmes and lack of this has been identified as a major hurdle that may restrict home dialysis.[60]

Follow-up Options:

- Casual phone-calls to HTU as required
- Email or electronic support techniques
- HTU clinic visits to assess clinical criteria and bloods
- HTU clinic technique assessment
- Home visits for clinical criteria and bloods
- Home technique assessment
- Phone check-ups
- Teleconference
- Tele-monitoring (a debateable and expensive monitoring tool)
- Nephrologist visits
- Allied Health visits

On-call

Technical and nursing supports are equally important. Dialysis equipment providers usually have 24 hour 1800 help-lines for technical issues. For clinical issues a 24 hour nursing support is also required. Options are:

- Home dialysis nursing team (wards involve payment of an on-call allowance)
- Ward nurses specialised in renal
- In-centre dialysis unit nurses with skills in PD and HHD
- Centralised call service by a private provider
- Provider customer service for consumable requirements
- Attendance at emergency departments for urgent health issues

Gold standard is to have an individual on-call who knows the patient and has access to their medical records to personalise management of the call. Language barriers, fear of talking on the phone and lack of phone in remote areas or for economically disadvantaged groups are all barriers to on-call use.

Allied Health

Social workers, dieticians and psychologists should be a regular part of the programme. FTE ratios set by QLD include a 1:70 social worker; 1:100 dietician; 1:200 psychologist.[77] Aboriginal health care workers are invaluable for programmes with high ratios of indigenous clients allowing culturally supportive education and support.[75] Unfortunately allied health resources are often not built into home dialysis programmes and the role has to be filled by nurses. Multidisciplinary clinics that incorporate allied health would maximise good access to social support, dietetic support and strategies to cope with long-term maintenance dialysis as well as support those looking to end their time on dialysis. Occupational therapists are utilised by some programmes to overcome personal physical barriers to home dialysis.

Indigenous Factor

Lack of secure accommodation, insufficient services, lack of respite and lack of interpreters are all issues that may prevent transition to or reduce time at home.[45] It is therefore essential that nursing links with social work and aboriginal support services to address these needs and offer support.

Symptom Management
Any symptom which is impacting on life should be assessed utilising expertise and specific tools. Priority should be given to identification and implementation of a solution.[94] Pain, itching, restless legs and insomnia are symptoms that may be improved. Nephrologists, nurse practitioners and referral to a specialist symptom management team (palliative care) can support patients in this area.[95]

Healthy lifestyle
Promotion of healthy eating and moderate exercise are often overlooked, but with the co-morbidities of this group may have health benefits. Exercise will reduce the risk of falls. Annual dental check-ups and podiatry support for diabetics are simple factors that promote health, and that can be encouraged with attendance monitored by the home dialysis team.

Ongoing Delivery of consumables
Monthly is standard. A system must be developed with the provider that is user friendly, effective and accurate. Few components of dialysis are non-essential and backorders lead to stress and inability to dialyse. For remote patients delivery networks must be assessed as the consumables may have to transition via multiple haulage companies. Systems where excess consumables are delivered or additional deliveries required are costly for the providers and hospitals.

Financial Reimbursements and concessions
Ongoing carer payments, disability pensions, electricity and water rebates, medications costs, and dialysis consumables that must be paid for are all areas of concern that require attention.[11] KHA has detailed the current energy and water reimbursements by State.[97] If in-centre incurs none or minimal cost to the individual then home must provide a comparable structure. Health monitoring equipment, dressings, heparin, and EPO are amongst the items that may be of cost in some States. Carer pensions and payments are administered by centrelink.[98] Currently dialysis is not a criteria for eligibility but assistance with daily living is.[98]

Holiday Dialysis
PD affords an individual the freedom to dialyse at alternative accommodation. For HHD holiday dialysis can be more difficult. Patients must be educated about how to organise travel. Whilst all costs are covered within Australia additional costs may need to be paid by the individual for overseas. For HHD access to a satellite is usually the only option. KHA provide holiday dialysis information.[80] Dialysis equipment providers have lists of the destination options available for holidays, including international possibilities and restrictions, accessed via dialysis units and customer service. Dialysis escape line run two cruises per year for both HD and PD patients.[96] If portable technology HHD machines becomes available in Australia travel opportunities for HHD will change. Difficulty in obtaining insurance is an ongoing issue.[80]

Creative holiday models for home dialysis include dialysis machines in caravans and boats, use of a dialysis bus, dialysis houses that are State managed and funded by various sources.

Respite
Lack of respite was identified by nurses as a primary barrier to home dialysis.[58] Nursing homes can rarely provide this service and if available it does incur a daily cost equivalent to the aged pension. The potential resident must have an aged care assessment completed.

Few programmes offer nurses or a paid carer that could visit the home even on a temporary basis. With the growth of home care, silver chain services, funding for community programmes and DVA programmes there may be untapped resources in this area that should be investigated locally. Additional fee for service systems may also be an option that a number of patients would consider. Some new clinics are being built with the option for HHD respite in specially allocated chairs or by the use of training spots if available. It is still not a priority but requires increased consideration.

The function of respite may need to be widened and for families providing assistance with general living may allow them the time to focus on the dialysis with less stress. General home assistance would be easier to administer. Savings gained by the use of home dialysis can contribute to home dialysis respite.

Support groups

KHA offer a network of support groups that is growing.[99] The UK have similar groups.[100] These offer the individual friendship and support from others who are experiencing similar life challenges. It is important that home training teams acknowledge this need given the number of patients who stay in-centre for the company. Increasingly facebook groups and chat rooms are appearing with a dialysis focus.

Natural disasters

Home dialysis individuals must be considered in business continuity plans related to dialysis. Canada have Stated that each unit must have a disaster plan.[92] NxStage have released a downloadable booklet for consumers.[101] WA developed a complete collaborative business continuity plan for dialysis involving home dialysis.[102]

Support barrier 1:	Inadequate FTE for nurses, allied health
Support barrier 2:	No structured follow-up programme or on-call service
Support barrier 3:	No system to manage debilitating symptoms
Support barrier 4:	No respite/holiday plan or availability
Support barrier 5:	Perceived and actual financial disadvantage
Support barrier 6:	Lack of local support groups
Support barrier 8:	Home dialysis model does not allow for supported care at home
Support barrier 9:	No plan for natural disasters

Support action 1:	Develop business cases and lobby for appropriate FTE
Support action 2:	Develop and implement a structured follow-up pathway
Support action 3:	Establish a model of care and referral pathway for symptom management
Support action 4:	Lobby for respite, consider nursing homes, care in the home
Support action 5:	Determine and document actual financial burden and lobby for reimbursement
Support action 6:	Liaise with KHA re setting up support groups or motivate a local individual
Support action 8:	Consider home dialysis models that allow supported care in the home
Support action 9:	Develop a business continuity plan and brochures for individuals

Retention on the Programme – Minimising Risk Factors

Stock and flow and the influence on Home Dialysis Numbers

Of a total 10,135 patients in the programme in 2009, 2534 were new patients who entered the programme. 1671 died and 813 were transplanted. Dropout averages 25% for HHD and 40% for PD.[3] For PD this indicates that at minimum for every 2.5 patients in any programme one new patient will require training each year for numbers to remain static. For HD it is 1:4.

Table 6:

Figure 1.9

National and State Stock and Flow 1-Jan-2009 to 31-Dec-2009
( ) 31-Dec-2008 Figures

State	New Patients	Transplant Operations *	Deaths		Dialysis Dependent	Functioning Transplants # *	Total
			Dialysis	Transplant			
Queensland	486 (531)	136 (140)	310 (337)	27 (47)	1944 (1881)	1567 (1485)	**3511 (3366)**
New South Wales	717 (805)	222 (223)	489 (472)	53 (49)	3374 (3346)	2232 (2127)	**5606 (5473)**
Aust. Capital Territory	41 (61)	14 (14)	27 (35)	4 (3)	239 (235)	199 (197)	**438 (432)**
Victoria	541 (537)	211 (219)	346 (311)	18 (28)	2513 (2476)	2028 (1887)	**4541 (4363)**
Tasmania	53 (54)	20 (26)	27 (28)	1 (3)	194 (179)	190 (177)	**384 (356)**
South Australia	195 (185)	82 (106)	107 (102)	17 (21)	670 (629)	861 (829)	**1531 (1458)**
Northern Territory	72 (89)	5 (4)	43 (57)	4 (3)	418 (397)	68 (74)	**486 (471)**
Western Australia	232 (272)	82 (81)	176 (149)	51 (52)	989 (992)	781 (745)	**1770 (1737)**
Australia	**2337 (2534)**	**772 (813)**	**1525 (1493)**	**141 (178)**	**10,341 (10,135)**	**7926 (7521)**	**18,267 (17,656)**
New Zealand	**567 (497)**	**121 (122)**	**331 (360)**	**34 (28)**	**2260 (2102)**	**1379 (1325)**	**3639 (3427)**

Patients lost to follow-up are not included * Resident State

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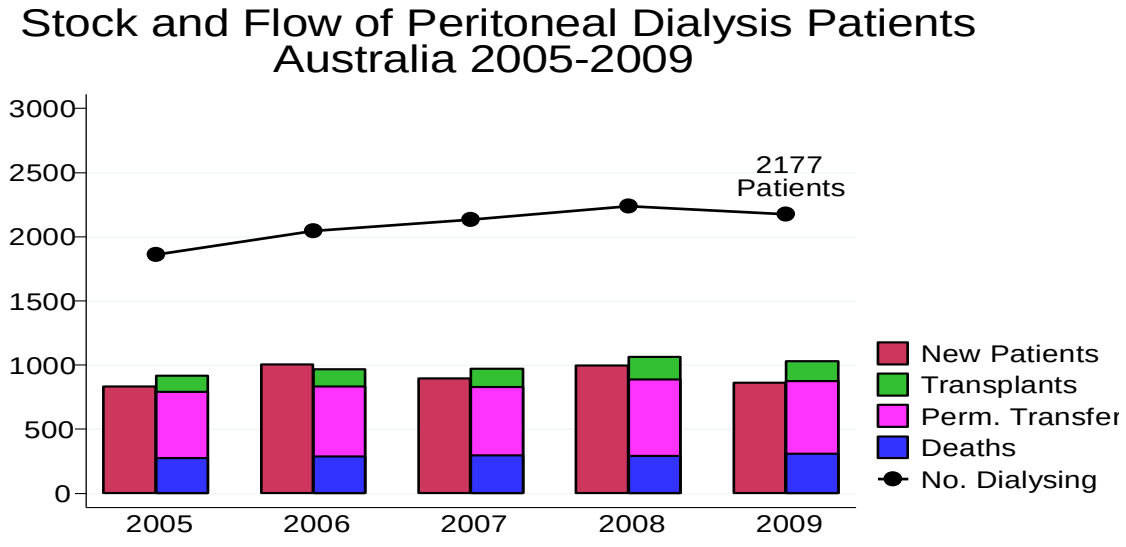
Diagram 8: Stock and Flow of Peritoneal Dialysis Patients



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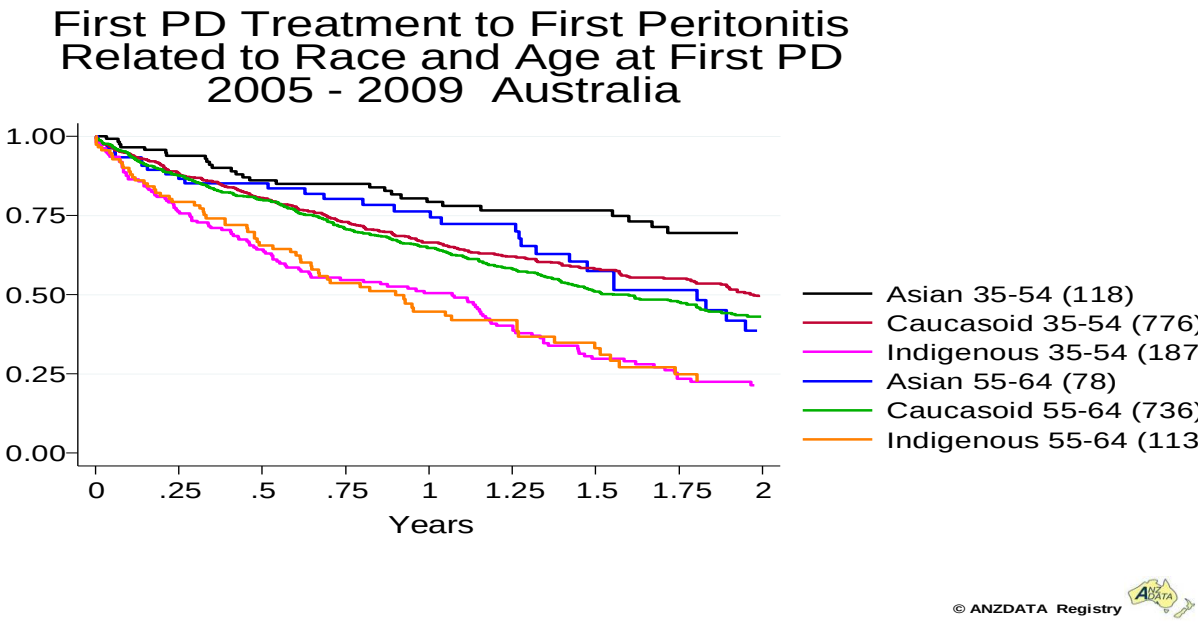
Technique failure including peritonitis and social reasons accounts for 55% of PD dropouts. Currently more patients leave each programme than are trained per year. This churn is approximately 40% of the numbers on the programme. The primary reason for leaving HD programmes is death at 50% and transplant at 25%.[3] HHD withdrawal has a weighting towards transplantation.

Monitoring of risk factors

In peritoneal dialysis programmes turnover is 40% per annum. Only 4% remain on PD after 5 years.[3] Withdrawal causes (excluding death) are infectious complications (27%) and social or technique failure with 5% unable to self-care and 37% by choice – reason unspecified. 14% fail to clear adequate amounts of fluid and/or electrolytes.[3] HHD dropout at 25% includes cardiac related death.[3]

Diagram 9: First PD treatment – Time to Peritonitis



At minimum a unit must monitor its dropout rates with reasons and benchmark to comparative populations. Indigenous and remote are risk factors for failure in PD. Peritonitis rates for example vary between 1:36 to 1:6 pt months and some of this is accounted for by race prevalence. [3] Quality projects should target areas where benchmarks are not met. All aspects of care and training should meet evidence based recommendations.[35]

Table 7:

Figure 6.39

Peritoneal Dialysis at 90 Days
Technique Survival - Diabetic / Non Diabetic
Censored for Transplant Commenced 1998 - 2009
% [95% Confidence Interval]

	No. of Patients	Survival			
		6 months	1 year	3 years	5 years
Australia					
Non Diabetic	5445	85 [83, 85]	71 [70, 73]	35 [33, 36]	16 [14, 17]
Diabetic	2283	81 [79, 83]	68 [66, 70]	25 [23, 27]	9 [7, 11]
New Zealand					
Non Diabetic	1449	88 [86, 89]	76 [74, 78]	42 [39, 45]	19 [16, 21]
Diabetic	1102	89 [87, 90]	76 [73, 78]	34 [31, 37]	11 [9, 13]

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Reduction of risk factors

Reductions in modifiable risk factors include preservation of residual renal function by ACE inhibitors, avoiding nephrotoxins and possibly by use of biocompatible dialysis solutions.[103] Residual renal function (RRF) is reported to be preserved on PD, however further research is needed in this area.[103] Reducing infections can be achieved by close follow-up, adhering to national guidelines, regular retraining on technique and a system to address social concerns and respite needs.[19] Models that support care in the home, respite care and good community support can reduce social failure.[39] To prevent technique failure a minimum annual check on technique and trouble shooting is recommended. Social isolation can be reduced by use of support groups, nursing or community visits and newsletters or websites.

Management of complications

Monitoring of complications with benchmarking is critical if effective policy and protocols are to be developed. For effective treatment of complications must be as per evidence based guidelines.[19,39,59,60,61] Peritonitis management and timely tube removal for recurrent peritonitis to preserve the peritoneum are important factors. For HHD managing access complications and early detection of fistula problems can be a challenge. The simple rule of reporting and investigating once needles require repeat insertion and observing venous/arterial pressures can be managed in home environments and in 19 out of 21 patients was indicative of stenosis in fistulae.[104] For both modalities adequate fluid control minimising the rate of left ventricular failure is recommended. Recent introduction of bio-impedance technology allows improved accuracy in fluid status and nutritional assessment which can be used at home.[105]

Symptom management

The renal patients' uncontrolled pain, itch, cramps and depression all contribute to burnout on a programme. Weight, haematological and biochemical factors are routinely and carefully monitored. The level of pain, presence of itch and other signs that make life less tolerable are often overlooked. A tool that measures these symptoms should be considered at every check-up. Additionally the use of palliative care services to assist in management of difficult symptoms can be very effective.

Adequacy of dialysis and Quality of life

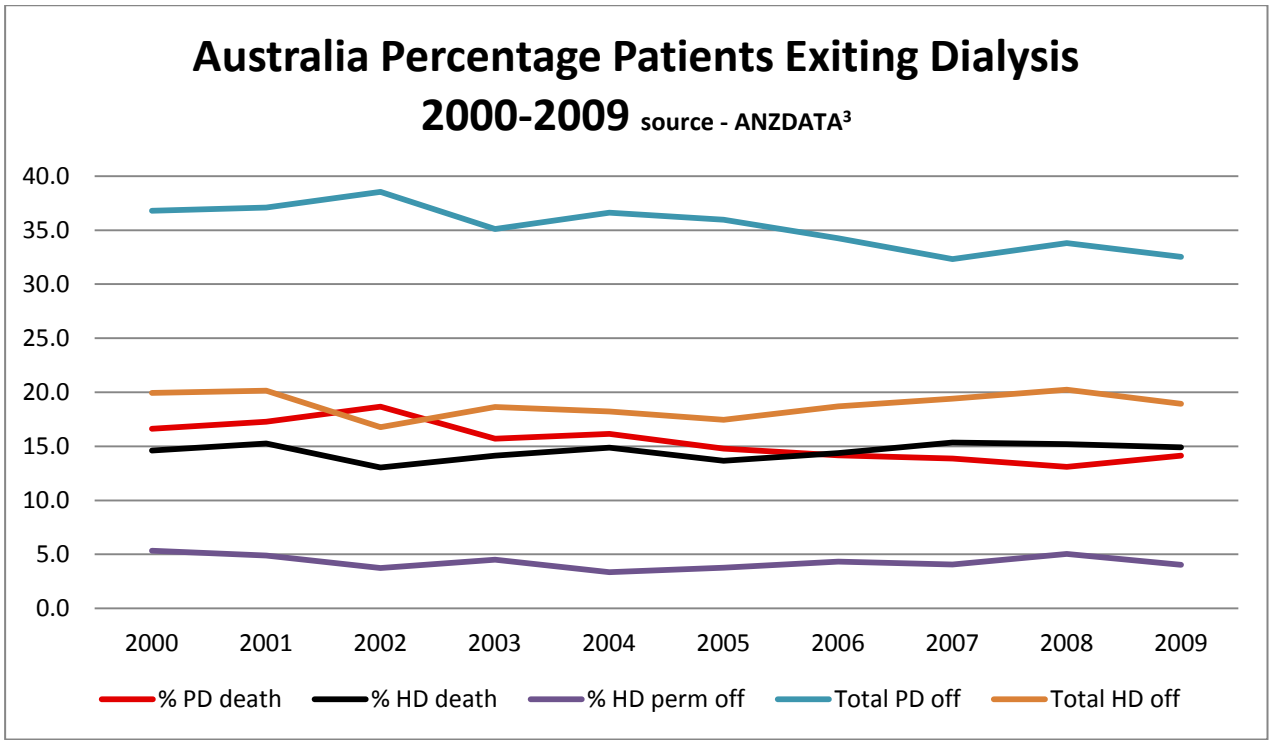
Quality of life (QOL) and measured blood targets determine adequacy. Under-dialysis and malnutrition are predictive of poor outcomes. HHD offers the option for longer HHD hours whether nocturnal, short daily or alternate day dialysis. This increases adequacy and a sense of well-being and literature is pointing to improved mortality and well-being outcomes [17,21,22, 26] For PD it is important the prescription is maximised in relation to the membrane type and that adjustments are made as RRF is lost. Ongoing monitoring of quality of life with the use of an endorsed tool such as KDQOL36 available on the KDQOL complete monitoring service will track individuals and groups electronically and provide an objective overview of QOL outcomes of the home programme.[106]

Retention Barrier 1:	Clinical policy and procedure does not adhere to best practice guidelines
Retention Barrier 2:	Lack of monitoring and QI programmes
Retention Barrier 3:	Limited symptom control programmes
Retention Barrier 4:	Individuals are not meeting minimum targets and have poor QOL
Retention Action 1:	Develop and implement clinical policy and procedure that does adhere to best practice guidelines
Retention Action 2:	Establish monitoring databases with benchmarks and realistic targets using the results to develop a minimum of one QI project each year to address deficiencies
Retention Action 3:	Establish a documented symptom assessment system and links with palliative care for difficult to manage symptoms
Retention Action 4:	Include monitoring of individuals in ongoing assessment and be pro-active in maximising dialysis prescription in balance with QOL

Withdrawal from Home

Whether death, transplant or transfer to another modality of dialysis is the reason for withdrawal there will be a sense of life-change, possibly loss and possibly failure. For the family it may be relief. Those leaving the programme frequently share their dialysis experience with others later. Many patients and care partners appreciate some contact with the home training unit for closure. PD overall withdrawals and death rates per annum have decreased over the last 10 years.[3]

Diagram 10: Australian Percentage Exiting Dialysis 2000-2009



Withdrawal from PD and transfer to haemodialysis

A structured pathway should be in place to ensure that those suitable for HHD are captured. For planned transfer coordination of access creation and appointments will ease the transition. It is important if the withdrawal is temporary from PD that the individual does not get lost in the HD systems and never return to home dialysis. If the reason for leaving PD is temporary referral back to surgeons or the HTU to restart PD once the causal issue is rectified should be booked.

Withdrawal leading to death

A palliative care pathway should be followed for all dialysis patients on the programme and the early part of the pathway can be used for symptom management. This same network can be used for timely withdrawal and end of life support. St George in NSW are developing a detailed plan in this area which includes a renal palliative care clinic.[95] The two main objectives for end of life are for everyone to feel that withdrawal is timely and that the death was as symptom free as practicable. Palliative support and discussions can be conducted by trained nurses, trained nephrologists and specialist palliative care teams. Nurse referrals are often accepted by palliative care teams but nephrologist approval is politically appropriate.

Collection of equipment and consumables

If death is the cause of withdrawal this must be completed with empathy and support. Large amounts of equipment and consumables remain in the community if systems for retrieval are not tight. Therapeutic goods administration (TGA) regulations and provider regulations will limit redistribution of product for other consumers.[81]

Withdrawal Barrier 1: Ineffective pathways or support regarding withdrawal, palliation and transfer to alternative home modality
Withdrawal Barrier 2: Inadequately trained nurse or nephrologists
Withdrawal Barrier 3: Ineffective stock management systems

Withdrawal Action 1: Develop a pathway re withdrawal, palliation and transfer to alternative home modality at unit or State level
Withdrawal Action 2: Develop and provide training programmes accessing local resources
Withdrawal Action 3: Ensure stock management systems detail locations of equipment and pick-up

Summary

A successful home dialysis programme has many facets and involves system factors as well as local factors. Many barriers exist that have reduced the uptake of home dialysis over the last decade. All barriers have a solution that will allow them to be tackled and removed or at minimum reduced. To overcome the barriers will require a comprehensive approach with commitment from the entire population who contribute both to policy and to the renal health workforce. When this is achieved the consumer will have equity in choice and the option to choose the dialysis modality that will best enhance their quality of life.

Recommendations Kidney Health Australia:

The recommendations below relate to Kidney Health Australia and an intention to pursue barriers in consultation with or on behalf of the renal community and consumers:

Recommendation 1
Specific consumer barriers are identified and where appropriate government or the health service is objectively briefed regarding these issues.

Recommendation 2
KHA publishes a position Statement and distributes the KHA model of home dialysis.

Recommendation 3
KHA participates in State renal networks and provides assistance with Federal or State funding barriers with appropriate patient advocacy at local and Federal government level.

Recommendation 4
KHA reduces the education barriers with establishment of a neutral, central home dialysis website that provides education, tools and support for both consumers and health professionals. The role of KHA related to provision of education continues and home dialysis is incorporated into programmes.

Recommendation 5
KHA facilitates and supports the establishment of networks of pre-dialysis educators, home dialysis units and allied health and supports these groups in tackling individual and system barriers.

Recommendation 6
KHA supports the streamlining of renal health care across jurisdictions, which may include supporting development of senior home dialysis health professional positions, supporting senior working groups and participation in committees.

Recommendation 7
KHA repeat the consumer survey at 5 year intervals to determine if strategies are effective.

Recommendation 8
KHA advocate for and support ANZDATA to include detailed reports regarding home haemodialysis utilisation and outcomes.

Barriers and Actions Grouped by Type and Including Responsibilities for Actions

Philosophy Barrier	**Action**	**Responsible**
Individuals or organisations may prevent a positive home dialysis philosophy	Determine who the barriers are. Consider and address these individually.	Head of Department. Senior renal nurse
Realistic targets have not been determined and written into the State philosophy.	Determine and agree upon the State/organisation home dialysis philosophy with benchmark targets. Incorporate the home dialysis philosophy with benchmark targets into all relevant written documentation.	State Government. Renal Working groups Head of Department.
Lack of flexibility in contract or model to meet the individual needs of the local population	Determine local barriers and develop a model to address these	State Government Head of Department Senior renal nurse Contract managers
Local lack of expertise in home dialysis	Education for nephrologist, registrars and nurses in home dialysis	Educators Senior renal nurse Head of Department KHA
No marketing strategy to promote home dialysis to consumer and health professionals	Develop a marketing strategy based on fact for home dialysis	State Government Renal working groups
Lack of research, evidence based guidelines to support home dialysis	Support and encourage research and articles re home Use ANZDATA information Support CARI guideline re home dialysis	Renal working groups Head of Department Senior renal nurse KHA
Leadership Barrier	**Action**	**Responsible**
Inadequate funding to appoint leadership roles	Determine a business case: use the cost analysis of saving based on targets expected to cover funding.	Head of Department Senior renal nurse Renal working groups
Lack of interest by individuals to hold senior leadership roles	Determine and recruit potential candidates for senior roles	Head of Department Renal working groups
Politics weaken the ability of the leadership team to improve home dialysis access and outcomes	Assign the appointed leader the power to determine the future of the programme based on objective policy development	Renal working groups Head of Department
No structure or IT and database system	Develop a business case for a database based on efficacy, effective clinical follow-up and capacity to produce KPIs leading to quality programmes	Head of Department Renal Working groups Senior renal nurse
The home dialysis model does not have an appropriate patient focus	Develop a patient centred focus and consult consumers for opinion	Renal working groups Head of Department Consumer groups, KHA
No clear policy, procedures and guidelines to ensure best practice	Access relevant information to ensure programme is based on best practice and monitored appropriately for best outcomes	Renal working groups Head of Department
Funding Barrier	**Action**	**Responsible**
Home dialysis has a cap or funding limitation preventing those who are choosing home dialysis from being placed onto the programme	Determine if there are any limitations and if so are those capital, recurrent or policy/contract based Determine current model and potential appropriate models for the health districts concerned	Renal Working groups State Government Head of Department
The funding stream and costings are not clearly identified	Develop a business case to lobby for change in funding arrangements	Renal working groups Head of Department State Government

Key: Funding Health worker barrier Process or IT Model/Policy Education Consumer

Education Barrier	Action	Responsible
No pre-educator or inadequate hours available	Lobby for appropriate FTE Educate appropriate community renal nurses at country sites. Partner with larger organisations for co-joined education	Head of Department Senior renal nurse Pre-educator KHA
Biased educator /nephrologist not supporting home dialysis or programme delivered has inappropriate content	Identify biased educators and nephrologists. Promote State philosophy and provide objective education Develop curriculum that enhances positive aspects of home dialysis	Head of Department Nephrologist Senior renal nurse Pre-educator
Late referrals	Education and provision of tools to GP network to support timely referrals	Renal working groups KHA
Inadequate pathway and follow through	Invest in a pathway either on paper or electronic	Head of Department Senior renal nurse
Lack of culturally specific education or educators	Identify the key cultures in the catchment and employ appropriate individuals or access appropriate tools	Senior renal nurse Pre-educator KHA
Limited take-home resources to consolidate teaching	Establish an easily accessible list of training resources via sources including KHA, dialysis providers, overseas renal sites, pharmaceutical companies	Pre-educator Home Dialysis team KHA Industry
Health care professionals inadequately informed re home dialysis	Educate all health care professionals with accurate and objective data	Home Dialysis team Educators KHA
Preparing barrier	**Action**	
Surgery has a waitlist and lack of access coordinator	Collect data and lobby for increased surgical time, access coordinator based on cost savings if patients transitioned earlier	Head of Department Senior renal nurse
Ineffective surgery	Collect and monitor data re access failure	Head of Department
Cost of preparing home or relocating	Collect data and participate in lobbying for out of pocket expenses	Senior renal nurse Allied health Consumer groups KHA
Inadequate social work support leading to unresolved social issues	Establish a local resource list and application forms for current financial, travel and accommodation support for training. Develop business case for social work FTE	Head of Department Senior renal nurse Social work Department KHA
Lack of accommodation or travel assistance with anticipated cost to patient/carer during training i.e. travel, lost earnings	Consider training models where pts commence training as per official curriculums at their current satellite, hospital dialysis unit with fine-tuning at HTU Collect data and lobby for out of pocket expenses Access PATS systems	Home Dialysis team Senior renal nurse Consumer groups KHA
Waitlist for larger or appropriate rental housing/community centre	Notify Government. Lobby local ministers.	Renal working groups Consumer groups KHA
Poor planning and communication for transition	Develop and implement a concise transition pathway	Head of Department. Senior renal nurse Home Dialysis team

Key: Funding Health worker barrier Process or IT Model/Policy Education Consumer

Home Training Unit Barriers	Action	Responsible
Lack of proximity and easy access for the patient	Review location of home training and considering required factors determine if a move is feasible and advantageous	Head of Department State Government Senior renal nurse KHA
Inadequate space and resources for effective and private training	Review location of home training and considering required factors determine if a move is feasible and advantageous	Head of Department State Government Senior renal nurse KHA
No direct access to nephrologists, allied health and specialist nurses	Establish referral pathways, outpatient systems and possible multidisciplinary clinics with at the hospital or onsite at training. Consider telemedicine, GP networks, nurse practitioners in home dialysis	Senior renal nurse Home Dialysis team
Limited access to training hours	Think outside the square with flexible rostering, staggered staff shifts, partnerships with satellite units.	Senior renal nurse Home Dialysis team
Lack of relevant policies and procedures to meet legislation and maximise patient safety	Develop policy and protocols that incorporate current legislation	Senior renal nurse
Training Barrier	**Action**	**Responsible**
Inadequately skilled staff	Upskill staff with formal orientation and ongoing training programmes	Senior renal nurse Home Dialysis team
Cultural language inappropriate staff	Recruit staff with appropriate skills or train those employed	Senior renal nurse
Ad hoc training curriculum	Establish a formal training curriculum and pathway	Senior renal nurse Home Dialysis team
Difficult to use equipment or consumables	Collect data and report equipment failures or difficult to use consumables. Lobby industry for simpler machinery	Contract manager Industry Senior renal nurse
Fears that block learning	Identify and training fears and determine individual solutions	Home Dialysis team
Inadequate documentation capacity or access to pre-training information	Determine and implement a suitable IT solution	Head of Department Senior renal nurse
No consent process	Establish a consent form and policy with a strategy for renewal as deemed appropriate	Head of Department Senior renal nurse
Transition Barrier	**Action**	**Responsible**
Poor planning and coordination	Develop a clearly defined discharge to home pathway	Senior renal nurse
Inability to provide installation support related to staffing	Determine the benchmark FTE Incorporate home install visits into nursing FTE and develop business case if needed to obtain funding	Renal working Group Head of Department Senior renal nurse

Key: Funding Health worker barrier Process or IT Model/Policy Education Consumer

Support (ongoing care) Barrier	Action	Responsible
Inadequate FTE for nursing or allied health	Develop business case and lobby for appropriate FTE	Renal working Group Head of Department Senior renal nurse
No structured follow-up programme or on-call service	Develop and implement a structured follow-up pathway with funding	Head of Department Senior renal nurse
No system to manage debilitating symptoms	Establish a model of care and referral pathway for symptom management	Head of Department Senior renal nurse
No respite or holiday plan or availability	Lobby for respite, consider nursing homes, assisted care in the home	Renal working group Consumer group Senior renal nurse
Actual or perceived financial disadvantages	Determine and document actual financial burden and lobby for reimbursement	Renal working party Consumer group
Isolation and lack of local support groups	Newsletters, phone calls, online groups and home visits. Liaise with KHA re setting up support groups or motivate a local individual	KHA/consumer group Home dialysis team
Training curriculum or policy does not cover/allow administration of IV medications	Change policy re IV meds and develop a training component for this	Senior renal nurse
Home Dialysis Model does not allow for supported care at home	Consider home dialysis models that allow supported care in the home	Renal working group Senior renal nurse
No plan for natural disasters	Develop a business continuity plan and brochures for individuals	Senior renal nurse
Retention Barrier	**Action**	**Responsible**
Clinical policy and procedure does not adhere to best practice guidelines ie peritonitis prevention	Develop and implement clinical policy and procedure that does adhere to best practice guidelines	Head of Department Senior renal nurse
Lack of monitoring and QI programmes	Establish monitoring databases with benchmarks and develop a minimum of one QI project each year to address deficiencies. Set realistic targets	Head of Department Senior renal nurse
Individuals are not meeting minimum targets and have poor QOL	Include monitoring of individuals in a regular assessment and be proactive in coordinating dialysis prescription in balance with QOL	Home Dialysis team
Withdrawal Barrier	**Action**	**Responsible**
Ineffective pathways or support re withdrawal, palliation and transfer to alternative home modality	Develop a pathway re withdrawal, palliation or transfer to alternative home modality at unit or State level	Renal working groups Head of Department Senior renal nurse
Inadequately trained nurse or nephrologist re palliative care	Develop and provide training programmes accessing local resources	Educators Head of Department Senior renal nurse KHA
Ineffective stock management systems	Ensure stock management systems detail locations of equipment and pick-up	Industry

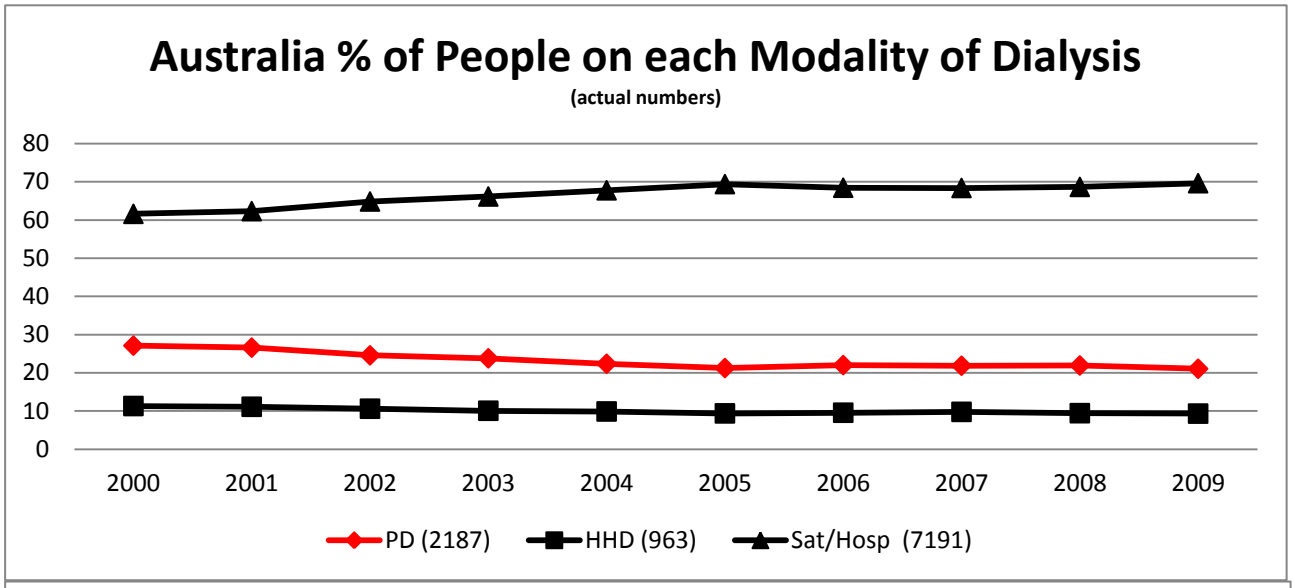
Key: Funding Health worker barrier Process or IT Model/Policy Education Consumer

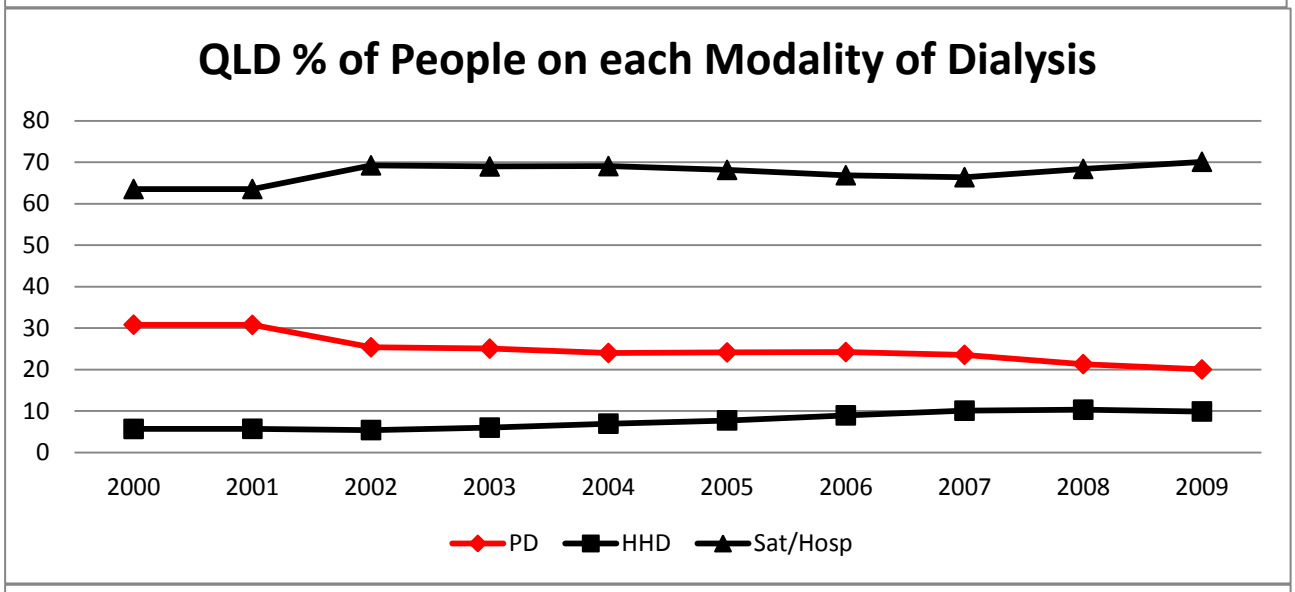
Glossary

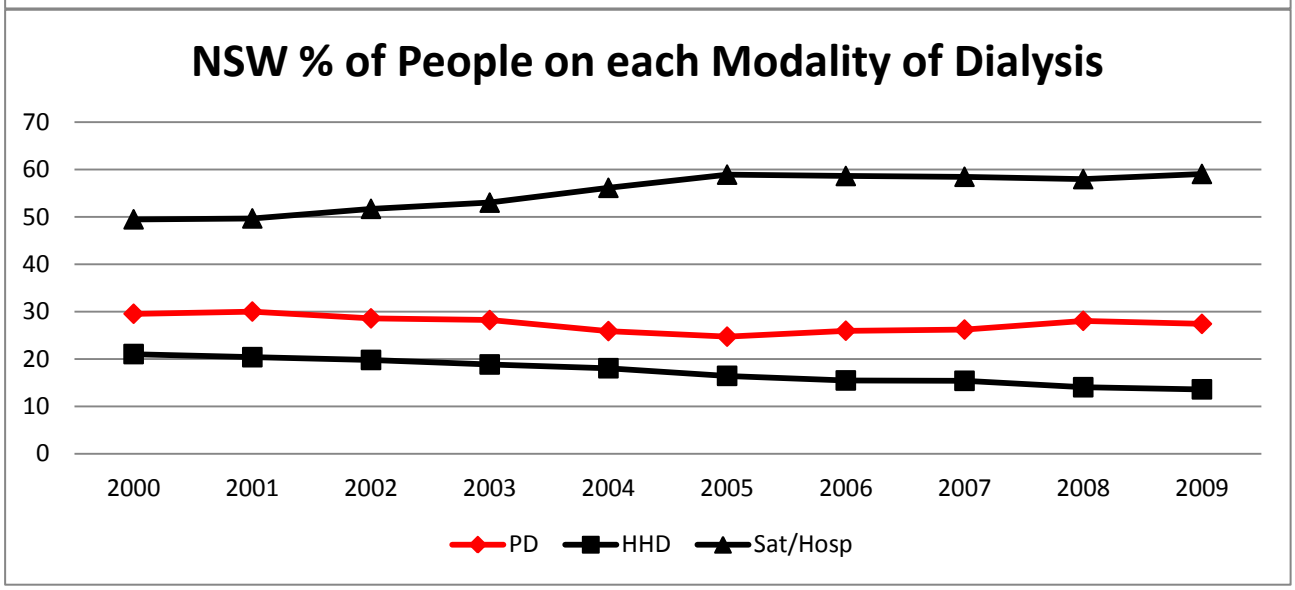
AHS	Area Health Service
ABF	Activity Based Funding
ACT	Australian Capital Territory
ANZDATA	Australian New Zealand Dialysis and Transplant Registry
APD	Automated peritoneal dialysis
CAPD	Continuous ambulatory peritoneal dialysis
CARI	Caring for Australians with Renal Impairment guidelines
CKD	Chronic kidney disease
DVA	Department of Veteran Affairs
FTE	Full time equivalents
GP	General Practitioner
HD	Haemodialysis
HDF	Haemodiafiltration
HHD	Home haemodialysis
HTU	Home training unit
ISPD	International Society of Peritoneal Dialysis
IT	Information technology
KCAT	Kidney Check Australian Taskforce
KDIGO	Kidney Disease Improving Global Outcomes
KHA	Kidney Health Australia
KPI	Key Performance Indicator
NKFKDOQI	National Kidney Foundation Kidney Disease Outcomes Quality Initiative
NSW	New South Wales
NT	Northern Territory
PD	Peritoneal dialysis
PPT	Price per treatment
QI	Quality Improvement
QLD	Queensland
SA	South Australia
SHD	Satellite Haemodialysis
SHDF	Satellite Haemodiafiltration
TGA	Therapeutic Goods Administration Authority
UK	United Kingdom
USA	United States of America
VIC	Victoria
WA	Western Australia

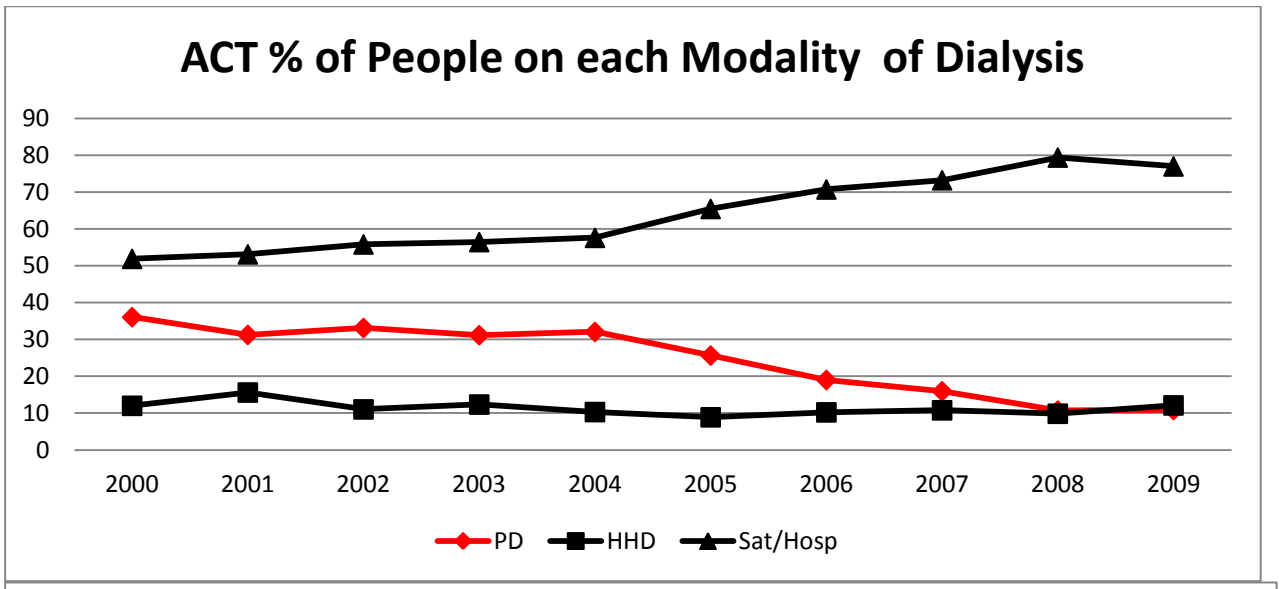
Appendices

Appendix 1 State Percentages of Dialysis modalities – Source – ANZDATA 2000-2010 Reports








ACT % of People on each Modality of Dialysis
90
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50
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30
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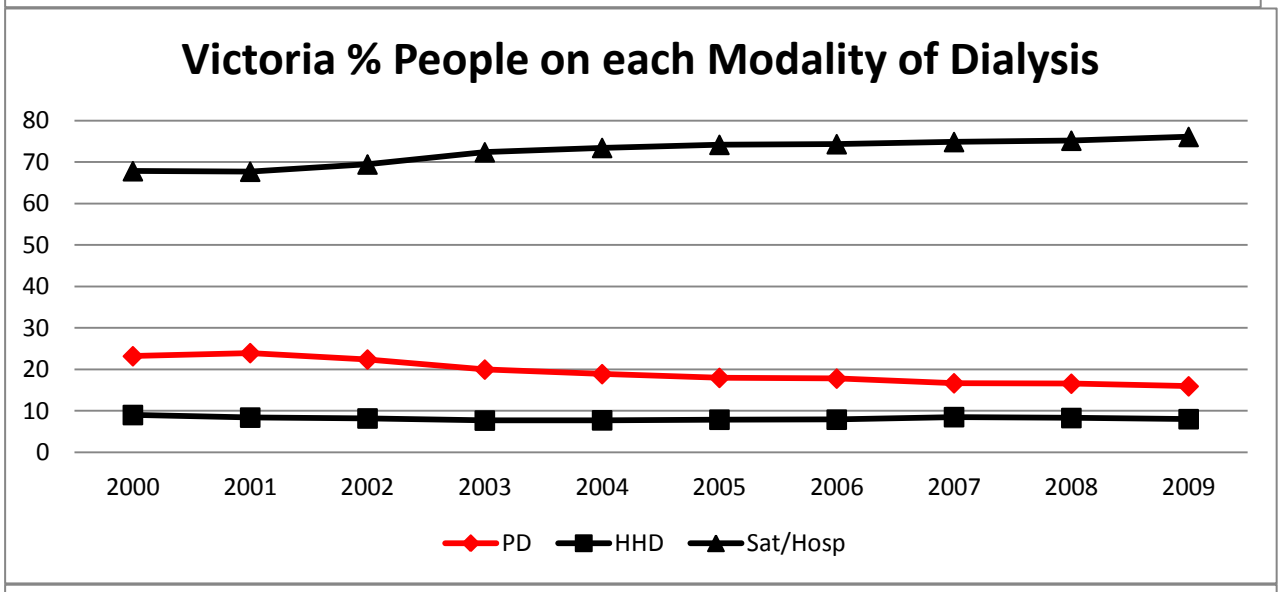
10
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
PD
HHD
Sat/Hosp


Victoria % People on each Modality of Dialysis
80
70
60
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2003
2004
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2006
2007
2008
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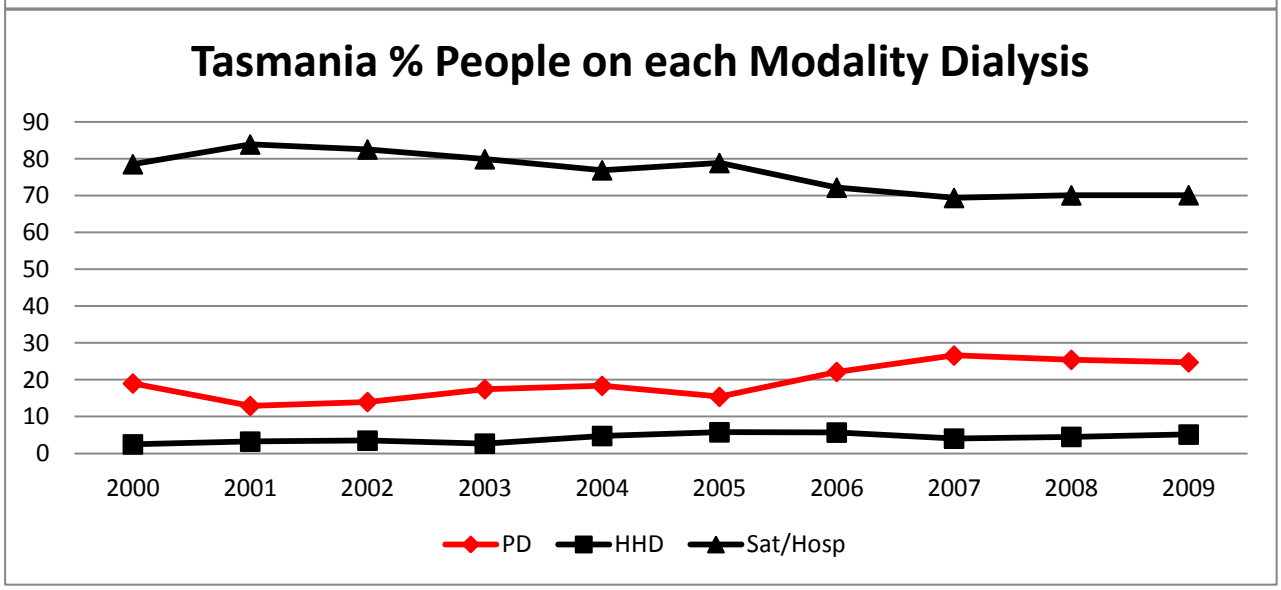
PD
HHD
Sat/Hosp


Tasmania % People on each Modality Dialysis
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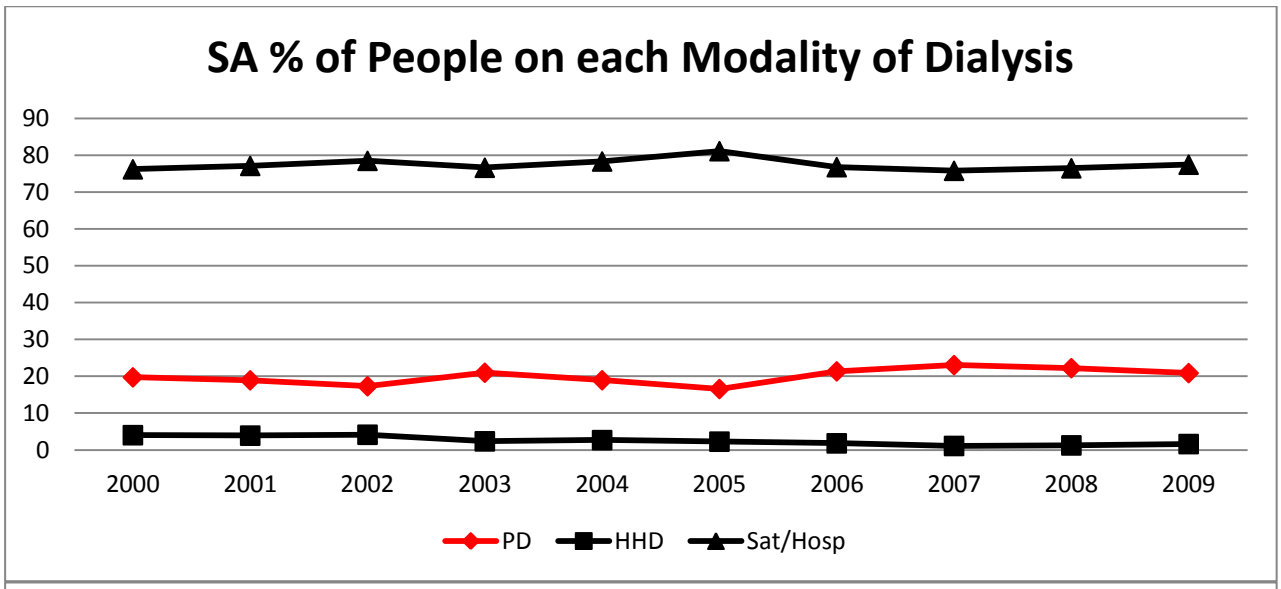
Sat/Hosp


SA % of People on each Modality of Dialysis
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2000
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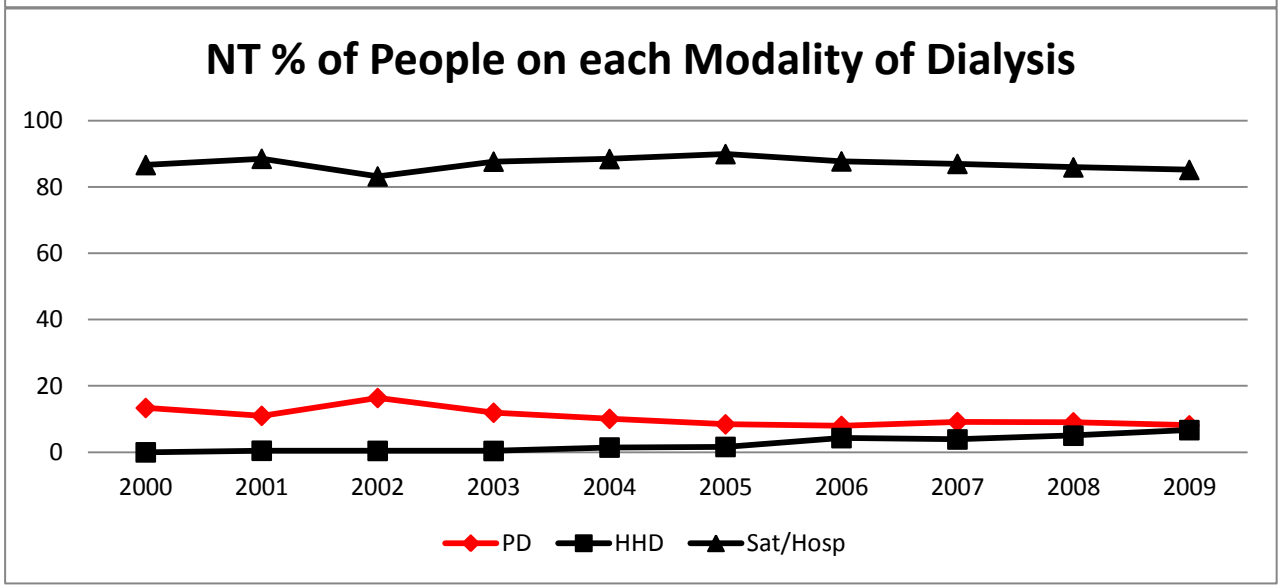
NT % of People on each Modality of Dialysis
100
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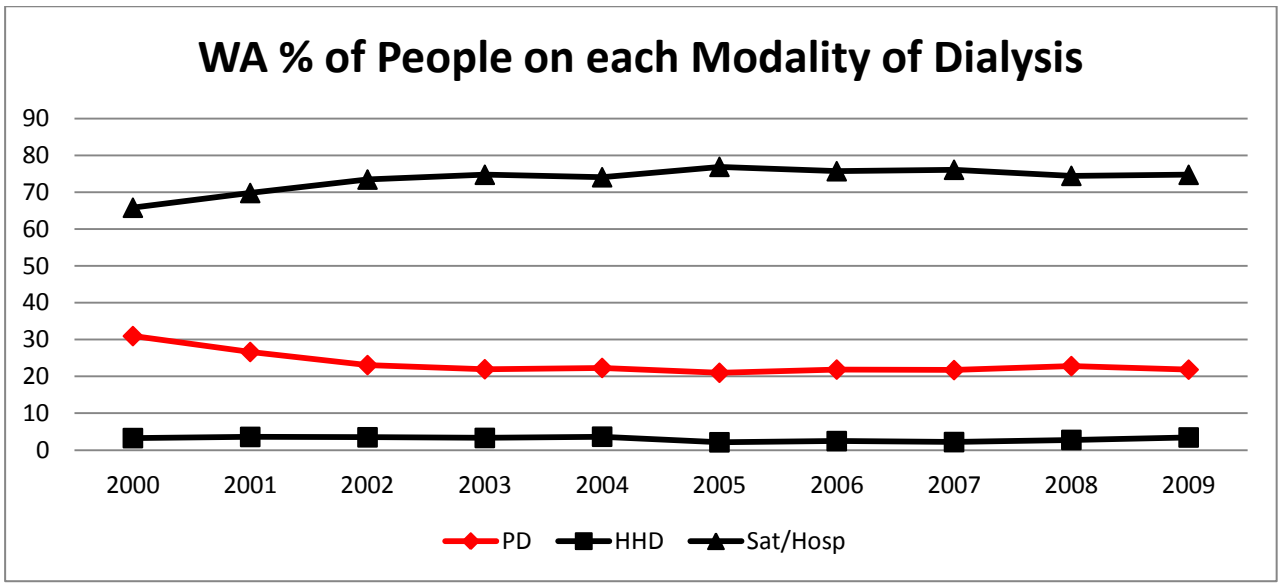
2009
PD
HHD
Sat/Hosp


WA % of People on each Modality of Dialysis
90
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2006
2007
2008
2009
PD
HHD
Sat/Hosp

Appendix 2 Distribution of Home Dialysis Units across Australia (Dec 2011)

Health service/Unit Name	Location	Postcode	Parent Hospital	HHD	PD	Satellite	Incentre	Self-care HHD
Sydney Local Health (Statewide renal service)	Camperdown	2050	Royal Prince Alfred, Wagga	X	X	X	X	
Nth Sydney Central Coast (Sydney Dialysis Centre - SDC)	St Leonards	2065	Royal North Shore	X	X	X	X	
Nth Sydney Central Coast	Gosford	2250	Gosford	X (+SDC)	X	X		
West Sydney AHS	Blacktown	2148	Westmead/Blacktown	X	X		X	
South West Sydney LH Service	Liverpool	2170	Liverpool/Bankstown	X	X	X	X	X
South East Sydney & Illawarra	Kogarah	2217	St George	X (+SDC)	X		X	
South East Sydney & Illawarra	Waverley	2024	Prince of Wales	X	X	X		
South East Sydney & Illawarra	Woolongong	2500	Woolongong	X	X		X	
Hunter New England	Charlestown	2290	Newcastle (John Hunter)	X	X			
North Coast Area Health Service	Ballina	2478	Ballina/Lismore	X		X		
North Coast Area Health Service	Lismore	2480	Ballina/Lismore		X		X	
Great South Area Health Service	Wagga Wagga	2650	Wagga Wagga	No service		X		
Rural Regional Western AHS	Dubbo	2830	Dubbo Base	X	X		X	
Canberra	Garran (2 sites)	2605	Canberra	X	X	X		
Western Health	St Albans	3021	Sunshine Hospital	X	X		X	
North West Dialysis service	Parkville	3052	Royal Melbourne	X	X			
St Vincents	Fitzroy	3065	St Vincents	X	X	X		
PANCH	Preston	3072	Austin Health	X		X		
Austin	Heidleburg	3084	Austin Health		X		X	
Eastern Health Int Renal Service	Box Hill	3128	Box Hill	X	X		X	
Alfred Health	Caulfield	3162	Alfred	X	X		X	
Southern Health	Clayton	3168	Monash		X		X	
Southern Health	Dandenong	3175	Monash	X		X		
South Geelong	Sth Geelong	3220	Geelong		X	X		
Geelong	Geelong	3220	Geelong	X				

Health service/Unit Name	Location	Postcode	Parent Hospital	HHD	PD	Satellite	Incentre	Self-care
Royal Brisbane	Bowen Hills	4006	Royal Brisbane	X	X			X
Royal Brisbane	Wooloongabba	4102	Princess Alexandra	X	X		X	
Logan Home Dialysis	Meadowbrook	4131	Logan	X	X			
Gold Coast Health Service	Southport	4214	Gold Coast Hospital		X		X	
Gold Coast Health Service	Robina	4226	Robina hosp	X			X	
Toowoomba	Toowoomba	4350	Toowoomba	X	X	X		X
Sunshine Coast	Nambour	4560	Nambour, Caloundra	X	X	X		X
Fraser Coast Renal Service	Maryborough	4650	MaryBorough/Hervey Bay	X	X	X		
Bundaberg	Bundaberg	4670	Bundaberg	X	X		X	X
Rockhampton	Rockhampton	4700	Rockhampton	X	X	X		X
Townsville	Townsville	4810	Townsville	X	X	X		
Cairns HHD	Nth Cairns	4870	Cairns Base	X				
Cairns PD	Cairns	4870	Cairns Base		X		X	
Central North Adelaide renal & Transplant service	Woodville Sth	5011	Queen Elizabeth, Royal Adelaide	X (all S/A)	X		X	
Flinders Medical Centre	Bedford Park	5042	Flinders Medical centre		X		X	
Royal Perth PD Unit	Perth	6001	Royal Perth		X		X	
Sir Charles Gairdner PD Unit	Nedlands	6009	Sir Charles Gairdner		X		X	
Warwick (Fresenius)	Warwick	6024	FH, RPH, SCGH	X	X			
Fremantle PD Unit	Fremantle	6160	Fremantle		X		X	
Coolbellup (Fresenius)	Coolbellup	6163	FH, RPH, SCGH	X	X			
Kimberley (KAMSC)	Broome	6725	Royal Perth		X	X		
Karingal renal education centre	Hobart	7000	Hobart	X	X			X
Launceston	Kings Meadow	7249	Launceston		X		X	
Launceston	Launceston	7250	Launceston	X			X	
Nightcliffe Renal Unit	Nightcliffe	O810	Darwin	X	X		X	
Katherine District Hospital	Katherine	O852	Darwin	X	X	X		
Flynn Drive Renal Unit	Alice Springs	O870	Alice Springs	X	X	X		

Appendix 3 Patient Testimonies

These are a small sample of the multitude of positive stories that are on the internet. Many are also available as videos.

Peritoneal Dialysis:

Last year we went away for a fortnight in Cornwall and of course I took my dialysis equipment with me. With home dialysis I am completely unrestricted, and can even travel abroad with a bit of forward planning. I'm lucky because I am in complete control of my treatment and I feel like there is nothing I can't do.

http://www.idratherbeathome.org/pamela_l_story.html

I can now continue with my hobbies and spend my time at home, instead of having to do a 220-mile round trip three times a week to receive my treatment, which would have tired me out.

http://www.idratherbeathome.org/hugh_story.html

After being diagnosed I felt very isolated. Now I realise that with my home treatment I do not have to alter my plans too much – I can still work, visit my grandchildren and daughters, and travel. I'm a regular extra on Eastenders and sometimes have to work 10 hour days. I was in the latest Harry Potter film, and my scene took two whole days of filming. APD at home is really flexible and allows me to do this – after all I can always take my machine with me.

http://www.idratherbeathome.org/gwyneth_story.html

Nocturnal Haemodialysis

"The nocturnal dialysis program allows me work and go to my practices and games. On nights that I do dialysis, I go in around 11:00 p.m., leave the centre around 6:00 a.m., go to work and then coach. Thanks to DaVita's nocturnal dialysis program, I have the extra energy to keep up with a hectic schedule and extremely active athletes," shares Donavon.

http://www.davita.com/treatment-options/in-center-nocturnal-dialysis/nocturnal-testimonials/

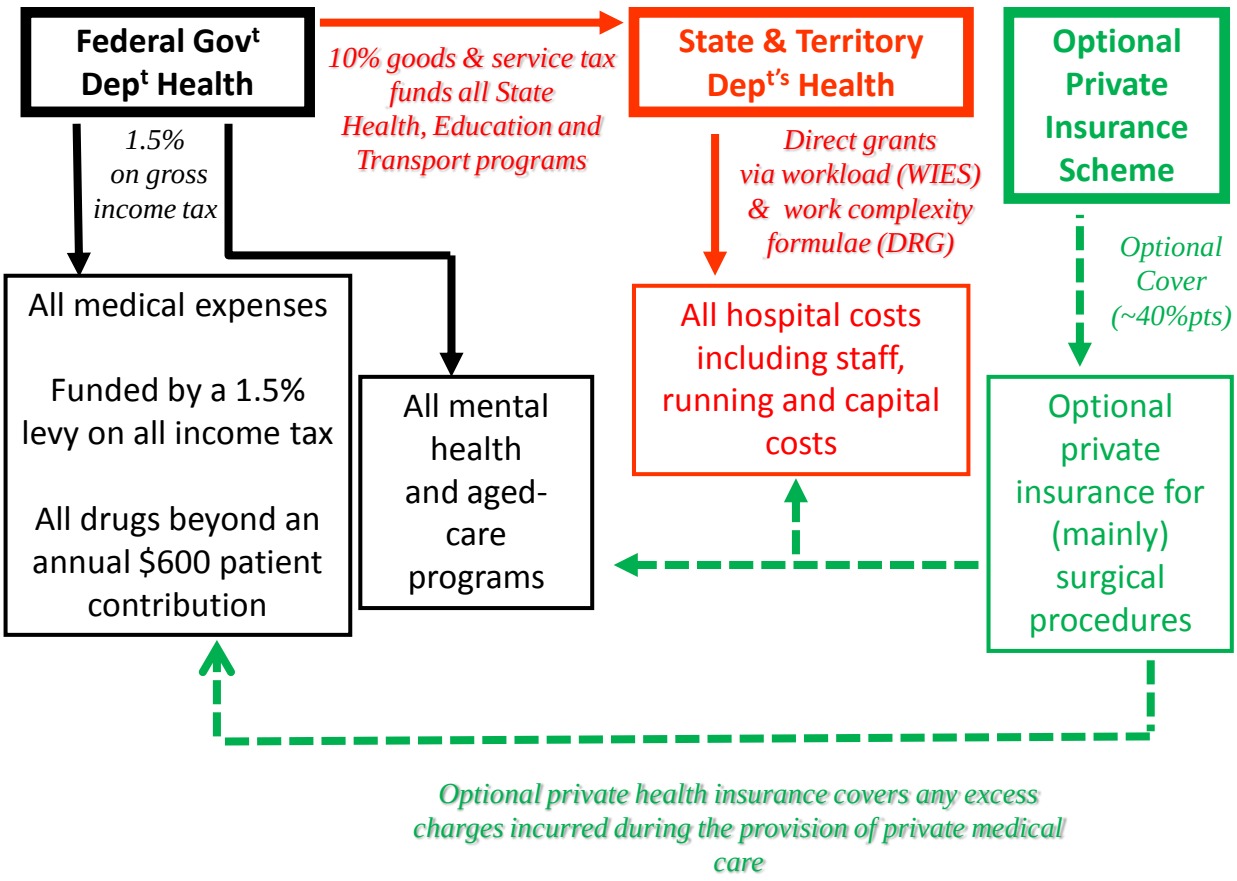
Daily Haemodialysis

Everette had been undergoing in-centre dialysis treatments when he learned about daily home hemodialysis with **. "For the past seven years, the ** has given me the freedom to live my life closer to the way I want to live it and allowed me to dedicate more time to my hobbies and business dreams," he said. Thanks in part to ** and dialyzing more frequently, I feel more healthy and active. I've come off several blood pressure medications and play basketball twice a week while spearheading my online clothing store.

" http://www.prnewswire.com/news-releases/first-nxstage-home-hemodialysis-patients-celebrate-seven-year-anniversary-111990404.html

Appendix 4 Summary of Australian Funding Mechanism for Renal Replacement Therapy

John Agar – Beijing presentation 2009



Appendix 5 Victoria Funding Model - General Information

Victorian funding model accessed in August 2011 at http://www.health.vic.gov.au/renaldialysis/funding.htm

The Government will spend $150 million dollars in 2010-11 to provide maintenance dialysis (MD) services across Victoria. The annual recurrent budget for MD is paid through a two-tier funding model that includes a capitation grant that is paid to the hub hospitals and a variable (WIES) payment that is paid directly to the in-centre and satellite providers. Under the current policy, renal dialysis payments are paid to actual so that all patients requiring renal dialysis receive it.
While renal targets (capitation and WIES) are set for health services, their renal budget will be updated as a prior year adjustment to reflect actual activity (either positively or negatively). Health services are encouraged to quarantine their renal budgets until this final wrap up has occurred. Any funding that is recalled will be re-distributed within the MD service system.
For the 2010-11 financial year the case payment is calculated on the number of annual attendances, the weight associated with the Diagnosis Related Group (DRG) of 'Renal Dialysis' and the payment per Weighted Inlier Equivalent Separation (WIES). This payment is made directly to providers of in-centre and satellite services. The Case Payment covers the costs of:

- Nurse care
- Waste management
- Power, water, domestic/cleaning services
- Supply of some linen
- Limited catering
- Receiving goods
- Provision of some equipment, eg. chairs, dressing trolleys
- Telecommunications
- Medical records
- Patient transport (inter hospital)

Capitation Grants are payable to the hub providers to cover a set of costs that are not covered by the Case Payment and are associated with treatment provided to the patients treated and managed within their service network. The Capitation Payment covers the costs of:

- Haemodialysis consumables
- Medical care, review and 24 hour call service, including emergency
- Acute dialysis treatments
- Nurse training
- Provision of 24 hour support to nurses
- Provision of allied health services – dietetics and social work
- In-patient pharmacy
- Pathology
- Provision and maintenance of dialysers, lines, and associated ancillary fittings, including all plumbing fittings
- On-call service of equipment
- Water quality testing
- Recovery of machine usage fee from other hub units that use the satellite service

Funding Model 2009-10

Following a Renal Dialysis Costing and Funding Review in 2006-07, a new funding model for maintenance dialysis services was implemented on 1 January 2008. This model included the use of three capitation grants and a single WIES payment rate.

In 2010-11, the funding model will continue to use three capitation grants and a single WIES payment rate. The capitation grant includes, in 2010-11:

- a $10,383 incentive payment to hub services for each home haemodialysis patient;
- an additional $2,686 payment to hub services for each peritoneal dialysis patient;
- patient payment, as below, to hub services which will be administered by hub services:
    - for home peritoneal dialysis - $489 per patient per annum; and
    - for home haemodialysis - $1,289 per patient per annum

The total capitation grant rates for 2010-11, which includes the components listed above, are in the table below.

Table 1. Victorian Maintenance Dialysis Program, Capitation Grant Payments in 2010-11

	Facility dialysis	Home Haemodialysis	Home peritoneal dialysis
Capitation grant	$29,608	$52,092	$46,968

WIES rates are available from the Policy and Funding Guidelines, 2010-11.

Reporting will continue to occur through the Victorian Admitted Episodes Dataset (VAED) and the Agency Information Management System (AIMS).

Reports

Renal Dialysis Costing and Funding Review Report (draft) - December 2006 (pdf, 1.69mb) (consultants report)

Report on Outcomes of the Renal Dialysis Costing and Funding Review (pdf, 90k) (department's response to consultant's report)

Appendix 6 CARI Guidelines

http://www.cari.org.au/DIALYSIS

Peritoneal dialysis *versus* haemodialysis (adult)

Final submission: March 2009
Author: Melissa Stanley

GUIDELINES
No recommendations possible based on Level I or II evidence

SUGGESTIONS FOR CLINICAL CARE
(Suggestions are based on Level III and IV evidence)

-
- Treatment starting with peritoneal dialysis (PD) may lead to more favourable survival in the first 1–2 years compared to starting treatment with haemodialysis (HD)(Level II evidence, small RCT).
    - Peritoneal dialysis compared with conventional HD is associated with equivalent or better survival in the first few years, especially with respect to residual renal function (RRF) (Level III evidence)
    - With loss of RRF, PD may lead to worse outcomes than HD (Level III evidence)
    - Haemodialysis is associated with improved long-term survival (Level III evidence)
    - A timely transfer from PD to HD may improve patient survival (Level IV evidence)
    - Renal programs should include an integrated PD/HD program where therapies are not competitive but rather complementary (Opinion)
    - Survival according to modality should be considered in the context of life quality as perceived by the patient when they are choosing HD or PD as initial therapy (Opinion

Predialysis education

Date written: December 2004
Final submission: June 2005

GUIDELINES

No recommendations possible based on Level I or II evidence

SUGGESTIONS FOR CLINICAL CARE

(Suggestions are based on Level III and IV evidence)

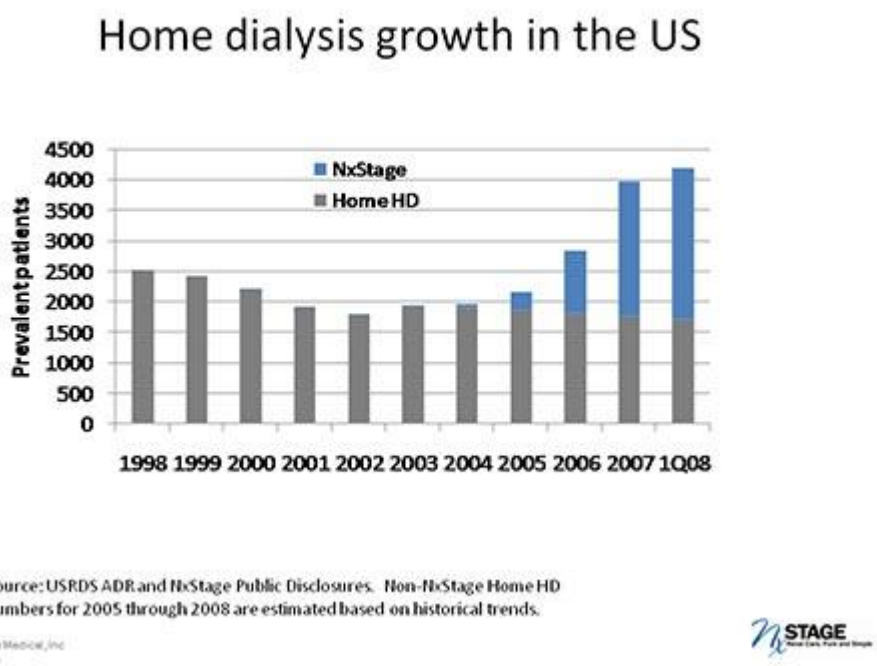
Patients and their families or carers should receive sufficient information and education regarding the nature of end stage kidney disease (ESKD), and the options for the treatment to allow them to make an informed decision about the management of their ESKD (Level III evidence). The use of multidisciplinary clinics with input from medical, nursing and allied health personnel using standardised protocols for the preparation of patients for dialysis is one way of achieving this outcome. Pre-dialysis education programmes providing information about kidney disease, options for the management of chronic kidney disease (CKD) prior to dialysis (including pharamacological and dietary management) and the options for renal replacement therapy may also be beneficial. These clinics or education programmes should incorporate a mechanism for the timely referral of patients for the creation of an access for dialysis. Existing data suggest that these clinics and education programmes may facilitate the improved medical care of patients (for example, better control of anaemia and hypertension), greater patient involvement in the selection of the mode of dialysis, a reduction in the need for 'urgent start' dialysis, and improved short-term survival and quality of life after the initiation of dialysis.

Appendix 7 NxStage and Impact on Home Dialysis in the US

http://www.nxstage.com/chronic_renal_care/registry/overview.cfm

Why At Home Today?

During the 30 years between 1975 and 2005, home hemodialysis nearly disappeared as an option for patients. The NxStage System One's FDA home clearance in 2005 has led to a new wave of clinical adoption of home hemodialysis. NxStage is leading a movement to improve patient care, and has been told that the community could benefit from timely insight into this progress.



Traditional data registries on dialysis care such as the USRDS and the ESRD Networks cannot structurally provide timely reports on this movement. This is due to data lags (2 years) as well as coding inconsistencies that make capture of information on home hemodialysis and the frequency in which it is delivered challenging. And, home hemodialysis still comprises less than a one percent of the patient population. Particularly during these early years of this rebirth of home dialysis and its enabling technologies, more timely and focused information can be insightful.

From the beginning, NxStage implemented and has maintained a thorough internal database capturing its therapy experience.[1] Thousands of patients and over one million home treatments have added to this insight. The company reviews this information regularly with its Scientific Advisory Board to allow for continuous improvement and education on the therapy. In keeping with NxStage's commitment to innovate, educate, and advocate, our Scientific Advisory Board recommended that NxStage should make summaries of this information available in a readily accessible, updated format so that folks may be better informed as home daily dialysis clinical adoption spreads through the community.

It is our commitment to the kidney care community to update this information on a regular basis, and to make the data available for public use to those who desire for as long as it is valuable.

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THE ECONOMIC IMPACT OF END-STAGE KIDNEY DISEASE IN AUSTRALIA

PROJECTIONS TO 2020

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This report was commissioned by Kidney Health Australia with the objective of conducting a review and update of the first comprehensive research into the economic burden of kidney disease in Australia, published in 2006. The George Institute for Global Health assures the integrity of the data and appropriateness of the analyses. The research was undertaken and the report written by academics from the George Institute for Global Health, the Sydney Medical School and Centre for Obesity, Diabetes and Cardiovascular Disease at the University of Sydney, Royal Prince Alfred Hospital, Concord Repatriation General Hospital and the Central Northern Adelaide Renal and Transplantation Service.

The data presented in this report is drawn from the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA). The analysis and conclusions presented are the responsibility of the authors, not the ANZDATA Registry.

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Executive Summary

Key messages

- In 2008, 2,476 Australians of all ages commenced renal replacement therapy (RRT). At 31 December 2008, there were 17,578 Australians receiving RRT, of whom 7,516 had a functioning transplant and 10,062 were receiving dialysis.
- By 2020 it is projected that between 3,335 and 4,472 Australians of all ages will commence RRT, an increase of 35% to 81% over 2008 numbers.
- The total number of patients receiving treatment for end-stage kidney disease (ESKD) in Australia in 2020 is projected to lie between 27,013 and 30,293 based on the same models, an increase of 54% to 72% above 2008 numbers.
- The cumulative cost, in today's dollars, of treating all current and new cases of ESKD from 2009 to 2020 is estimated to be between approximately $11.3 billion and $12.3 billion.
- Increasing the utilisation of home-based dialysis (home haemodialysis and peritoneal dialysis) over this period would lead to estimated net savings of between $378 and $430 million.
- After factoring additional costs associated with increasing organ donation, increasing the rate of kidney transplantation by 50%, to match rates currently achieved in the United States and numerous European countries, would be associated with cost savings and with greater health benefits. Performing more kidney transplants would be both less expensive and more effective than current practice.
- The projected growth in the burden of ESKD necessitates a 'whole of government' approach to chronic disease prevention, early identification and intervention. Social, behavioural and biological determinants of health should be addressed within the framework of an overarching national chronic disease strategy.
- Priorities in renal service planning include developing strategies to overcome the financial and structural barriers affecting the ability to shift dialysis treatment from the hospital sector to home-based care and to increase the availability of organs for transplantation.

Background and Objectives

In 2005, Kidney Health Australia commissioned a comprehensive report on the economic burden of kidney disease in Australia. The research and writing was undertaken by a collaborative team from The George Institute, The University of Sydney, Royal Prince Alfred Hospital, The Queen Elizabeth Hospital and The Australian and New Zealand Dialysis and Transplant Registry (ANZDATA). The resulting report was in two parts: Part I — The Economic Impact of End-Stage Kidney Disease in Australia; and Part II — The Cost-Effectiveness of Early Detection and Intervention to Prevent the Progression of Chronic Kidney Disease in Australia.

In our previous report, 'The Economic Impact of End-Stage Kidney Disease in Australia', we estimated that, by 2010, between 2,185 and 2,698 Australians would commence renal replacement therapy (RRT) each year. Based on conservative estimates, we suggested that the cost of providing RRT to new and existing patients from 2004 to 2010 would exceed $4 billion. We reported that switching patients from hospital-based haemodialysis to home-based dialysis options would result in net health sector cost savings, and that increasing the kidney transplantation rate would result in both considerable health sector savings and significantly improved health outcomes.

Since our original analyses were performed, the number of patients requiring RRT has continued to grow, with the largest increase in the over-65 age category. Diabetes has consolidated its position as the most common cause of kidney disease amongst Australians commencing RRT. Although several state jurisdictions have established targets for home-based dialysis, there has been minimal increase in the proportion of dialysis patients receiving home-based therapies. The establishment of the Australian Organ and Tissue Authority (AOTA) in 2009 has signalled a more concerted national effort to increase organ donation rates, which, if successful, would consequently increase the rate of kidney transplantation. In the context of a national health reform agenda, which includes a focus on the prevention and management of complex chronic diseases, we present an updated report on the economic impact of end-stage kidney disease (ESKD) in Australia projecting disease burden to 2020.

The objectives of these new analyses are:

1. **To estimate the health sector costs (and benefits) projected to 2020 of providing RRT, in accordance with current clinical practice, to current and future ESKD patients; and**
2. **To assess the relative costs and benefits of (i) an increase in the proportion of ESKD patients receiving home-based dialysis; and (ii) an increase in rates of kidney transplantation.**

Methods

This Report establishes the baseline estimate of the national costs of renal service provision for current and new (to 2020) patients, and of the benefits (survival and quality of life) of treating all patients to 2020. We used similar methods in this report as in Part I of our previous report to Kidney Health Australia. To estimate the current and future health sector costs (and benefits) of RRT, and the impact of changing the clinical management of ESKD patients, we first defined baseline practices as the existing patterns of RRT in Australia. Costs and benefits of RRT in Australia from 2009 - 2020 were estimated based on a Markov model, informed by an updated dataset of national patient outcomes from incident patients commencing RRT during the period 2004 - 2008, as recorded by ANZDATA. Cost data were based on the best available published data for this purpose. As indicated in Department of Health and Ageing guidelines for preparing submissions to the Pharmaceutical Benefits Advisory Committee, a discount rate of 5% per annum was applied to all modelling of future cumulative costs, benefits and cost-effectiveness analyses.

Historic age-specific trends in the incidence of treated ESKD in the non-Indigenous and Indigenous population were examined to determine likely future trends for the years 2009-2020. We report both steady-state models (assuming that current observed age-specific rates were maintained to 2020) and growth models (assuming that the linear trend of increasing age-specific rates evident over the period 2000-2009 is maintained to 2020).

Compared to our previous analysis, we have made the following significant changes in this updated report:

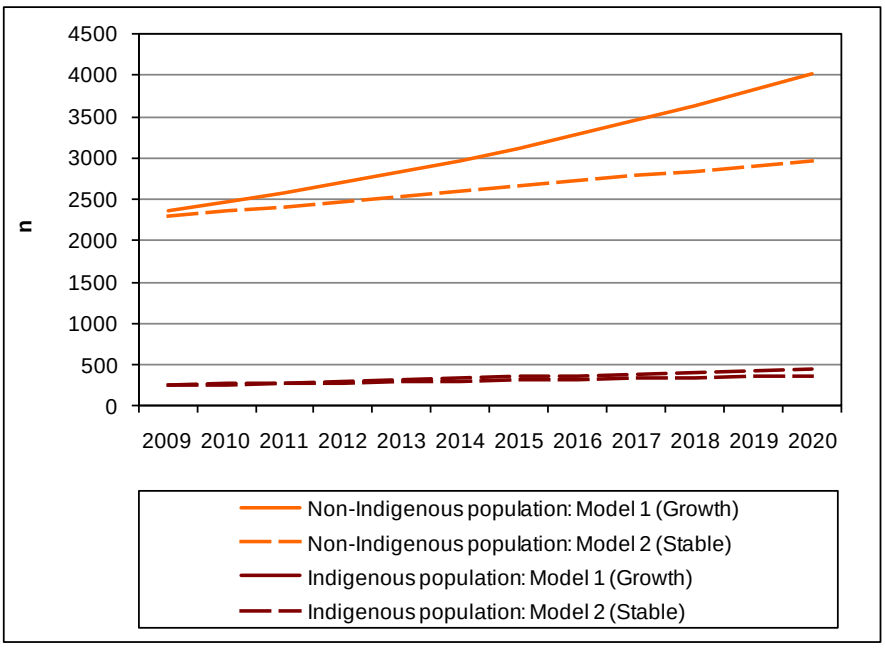
1. The cost of each dialysis modality was based upon the NSW Dialysis Costing Study, 2008, with prices indexed to 2009 dollars.
2. When estimating the impact of shifting dialysis management from the hospital to the home, we combined the increased uptake of both peritoneal and home-haemodialysis in the same model, aiming to reflect a realistic and potentially achievable mix of dialysis therapies flexible to the requirements of individual States and Territories.
3. When estimating the cost-effectiveness of increasing kidney transplant rates, we included a nominal 5% increase in the cost of transplants to account for likely increased resources required to achieve increases in transplant numbers.

Results

Projected incidence of treated ESKD to 2020

These projections indicate that, in 2020, the number of Australians of all ages commencing RRT will lie between 3,335 (2,971 non-Indigenous and 364 Indigenous, steady-state model) and 4,472 individuals (4,019 non-Indigenous and 453 Indigenous, growth model). On the basis of these models, an increase of between 35% and 81% in the number of new patients commencing RRT above 2008 figures is projected. The majority of this increase is driven by new ESKD cases in the non-Indigenous population aged 75 years and over.

Figure ES-I: Projected incident RRT patients, 2009-2020

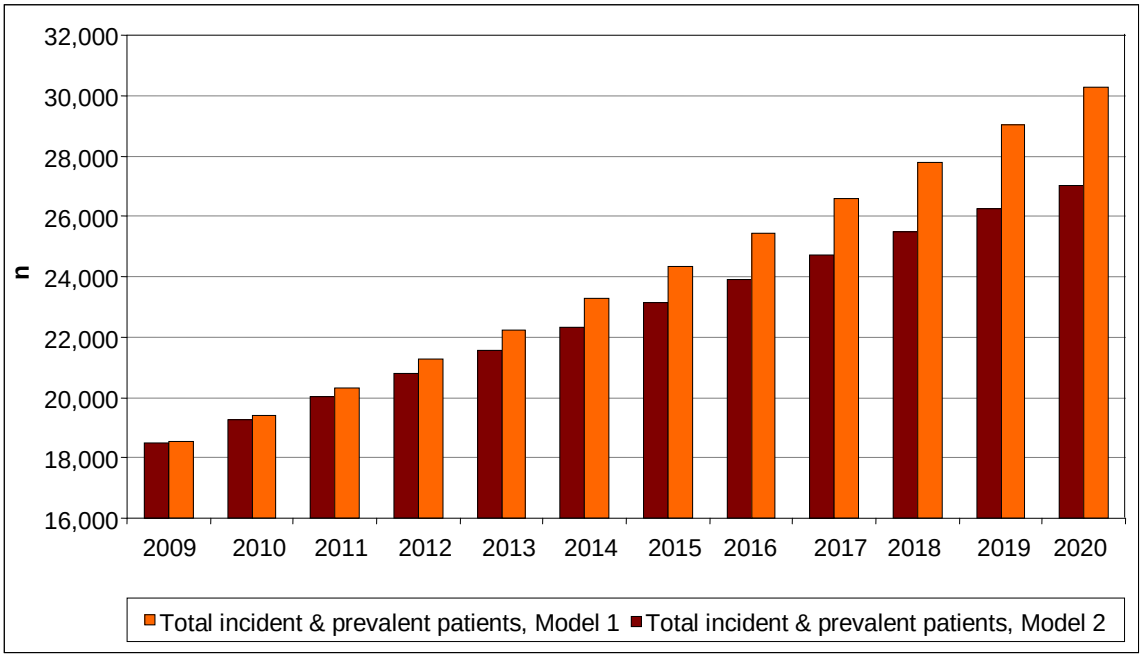


These projections are based upon observed, age-specific incidence rates for treated ESKD. An increasing demand for RRT can be driven both by trends in the incidence and prevalence of underlying risk factors for chronic kidney disease (CKD), including diabetes, obesity and hypertension, as well as changing professional practice and community expectations of access to health care, irrespective of age, and the ability of the health system to meet these expectations. As noted above, new cases of ESKD in Australians aged 75 and over contribute significantly to the projected demand for renal services. However, even when making projections based upon the "Growth" model, the age-specific incidence of RRT in 2020 amongst Australians 75 and over is lower than the incidence in this age group in comparable countries including the United States.

Projected prevalence of treated ESKD to 2020

These projections indicate that, on 31 December 2020, the number of Australians receiving RRT will lie between 27,013 (steady-state model) and 30,293 individuals (growth model). On the basis of these models, an increase of between 54% and 72% in the number of patients receiving RRT above 2008 figures is projected.

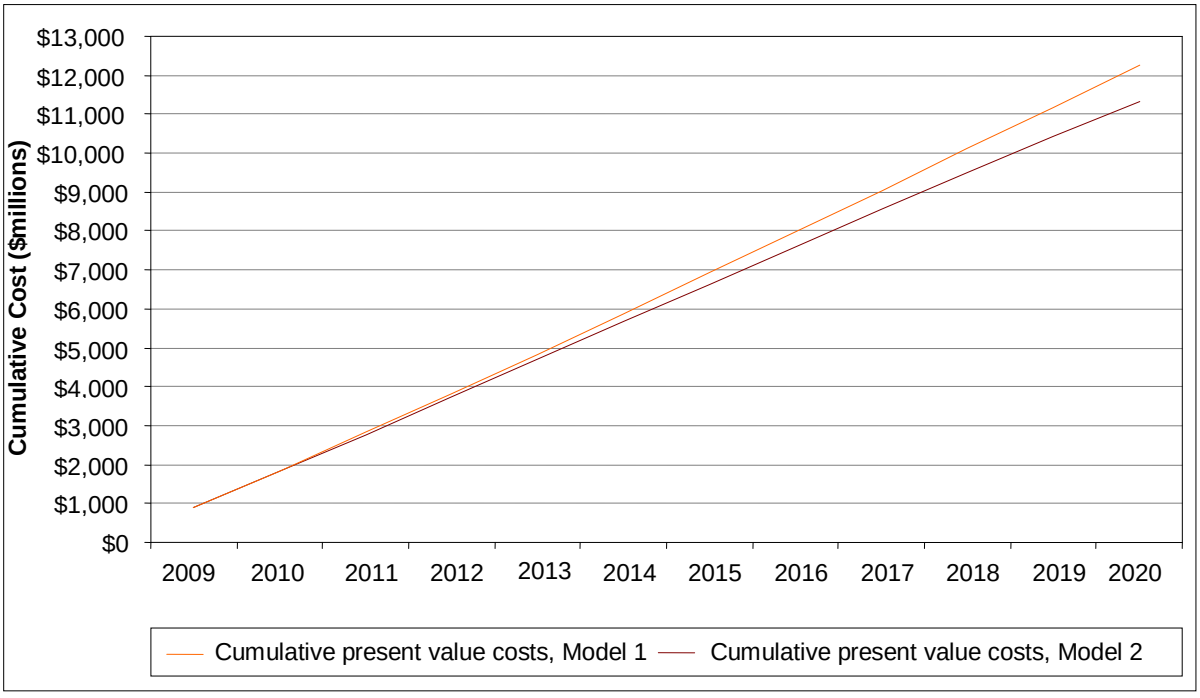
Figure ES-II: Projected prevalent RRT population, 2009-2020 (alive and on RRT at 31 December)



Cost of treating current and new RRT patients out to 2020

As at 31 December 2020, these projections with respect to the future RRT population equate to an annual cost of RRT service provision of between $1.58 billion and $1.86 billion in 2020 dollars ($922 million to $1.09 billion in 2009 dollars). In 2009 dollars the cumulative cost of RRT for all current and new cases of ESKD is estimated to be between approximately $11.3 billion and $12.3 billion by the end of 2020 (Figure ES-III). These total cost estimates *exclude* the following expenditures: i) the cost of providing RRT services to Australians under 25 (less than 3% of new cases); ii) the cost of providing services for co-morbid conditions such as cardiovascular disease and diabetes; and iii) the indirect or non-health sector costs associated with ESKD.

Figure ES-III: The cumulative present value treatment cost for all new and existing RRT patients treated out to 2020



Costs and health outcomes of alternate service provision models

Increasing the utilisation of home-based dialysis therapies

Increasing the utilisation of home-based therapies (home haemodialysis (HD) and peritoneal dialysis (PD)) will lead to net savings of between $378 million and $430 million (Tables ES-I and ES-II). In general, the alternate service provision models aim to reflect a realistic and potentially achievable mix of dialysis therapies, consistent with recently developed state-wide renal service strategies. Specifically the alternate service provision scenarios reflect greater uptake of home HD within the first year of treatment and commencement of a significant proportion of patients on PD, with subsequent change to other treatments over the course of RRT (Table 8). According to these modelled scenarios, in the first year of RRT, approximately 40% to 60% of dialysis patients, by age group, would be established on home-based dialysis. Without robust Australian data on utility-based quality of life on each dialysis modality, it is not possible to estimate the incremental benefits of the 'switch modality' scenarios. It is, however, reasonable to assume that there would also be improvements in quality of life resulting from these changes.

Table ES-I: The present value costs and health benefits (out to 2020) of increasing the utilisation of both Home HD and PD services in Australia (Incidence Model 1)

Costs and benefits to 2020	Total cost ($million)	Incremental cost ($million)	Total LYS	Total QALYs
Base Case	$8,304.27	-$430.25	125,104.93	71,528.19
Increased Home HD & PD utilisation	$7,874.03		125,104.93	71,528.19

Table ES-II: The present value costs and health benefits (out to 2020) of increasing the utilisation of both Home HD and PD services in Australia (Incidence Model 2)

Costs and benefits to 2020	Total cost ($million)	Incremental cost ($million)	Total LYS	Total QALYs
Base Case	$7,371.44	-$378.24	112,452.50	64,543.34
Increased Home HD & PD utilisation	$6,993.19		112,452.50	64,543.34

Increasing the rate of kidney transplantation

A number of sensitivity analyses were conducted assessing the impact of varying increases in transplant rates (10% or 50%) under different assumptions concerning the cost of achieving these increases (no additional costs, or a 5% increase in costs per transplant). Under both models of projected ESKD incidence, the incremental cost effectiveness of increasing kidney transplants ranges from being dominant over current practice (i.e. less expensive and more effective than current practice) to a maximum cost of approximately $26,000 per Quality-Adjusted Life Year gained. Even when accounting for estimated additional costs associated with achieving increased donor numbers, increasing the availability of donor organs is well within the range of currently funded treatment and prevention programs. If a 50% increase in the transplant rate is achieved, the additional costs are more than offset by the reduction in costs associated with moving patients from dialysis (Tables ES-III and ES-IV).

Table ES-III: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 50% over current levels (Incidence Model 1)

Costs and Benefits to 2020	Total cost ($million)	Incremental cost ($million)	Total life years	Incremental life years	Total QALYs	Incremental QALYs
Base case	$8,304.27		125104.93		71528.19	
Increased transplant rate (no additional resources)	$8,248.22	-$56.06	128215.43	3,110.50	74570.06	3,041.87
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$8,290.52	**-$13.75**	128215.43	**3,110.50**	74570.06	**3,041.87**

Table ES-IV: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 50% over current levels (Incidence Model 2)

Costs and Benefits to 2020	Total cost ($million)	Incremental cost ($million)	Total Life Years	Incremental life years	Total QALYs	Incremental QALYs
Base case	$7,371.44		112452.50		64543.34	
Increased transplant rate (no additional resources)	$7,314.79	-$56.64	115538.63	3,086.14	67561.34	3,018.00
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$7,356.57	**-$14.87**	115538.63	**3,086.14**	67561.34	**3,018.00**

Chapter 1 Introduction

1.1 Background to the burden of ESKD in Australia

Chronic diseases represent a significant long-term challenge for the Australian health care system, in terms of the number of people affected, and the associated morbidity, mortality and health-system expenditure. Chronic diseases are estimated to be responsible for more than 80% of the burden of disease and injury,[1] and more than two thirds of all health expenditure in Australia.[2] Furthermore, chronic diseases disproportionately affect Aboriginal and Torres Strait Islander people, contributing significantly to the gap in life-expectancy between Indigenous and non-Indigenous Australians.

Chronic kidney disease (CKD) is the progressive deterioration of the filtration ability of the kidneys. A prime example of the challenges of chronic disease, CKD is characterised by a gradual and typically asymptomatic onset, a complex aetiology, increasing prevalence with older age, the co-existence of multiple conditions and potential complications affecting quality of life, leading to high rates of premature mortality. Affecting approximately 13% of Australian adults according to recent estimates,[3] the health burden associated with CKD is twofold: first, even moderate reductions in kidney function are associated with significantly increased risks of cardiovascular events and mortality; second, for those persons who progress to End-Stage Kidney Disease (ESKD), at which point the options are dialysis, kidney transplantation or palliation, the provision of renal replacement therapies (RRT) is highly costly and consumes a sizeable portion of the health budget.

Nevertheless, opportunities exist to reduce the impact of the health burden associated with CKD and ESKD via disease prevention and informed planning of health service delivery. CKD usually develops over a number of years and, with early identification and management, the disease can be slowed and progression to ESKD significantly delayed or prevented. Primary prevention through intervention targeted to the principal modifiable risk factors for CKD, diabetes and hypertension, is also critical. At the same time, the different RRT modalities – which include hospital, satellite and home haemodialysis (HD), peritoneal dialysis (PD) and kidney transplantation – are each associated with different patterns of resource utilisation, infrastructure and staffing requirements, and therefore with different per patient costs. Existing international evidence and local costings indicate that home-based dialysis is less expensive than hospital or satellite HD, while for those patients who are suitable candidates, kidney transplantation is more cost-effective than any form of dialysis. Significantly, kidney

[1] National Priority Action Council, 2006. National Chronic Disease Strategy, Australian Government Department of Health and Ageing, Canberra, p. 1

[2] Australian Institute of Health and Welfare (AIHW) 2006. Chronic diseases and associated risk factors in Australia, 2006. Canberra: AIHW.

[3] White SL, Polkinghorne KR, Atkins RC, Chadban SJ. Comparison of the prevalence and mortality risk of CKD in Australia using the CKD Epidemiology Collaboration (CKD-EPI) and Modification of Diet in Renal Disease (MDRD) Study GFR estimating equations: the AusDiab (Australian Diabetes, Obesity and Lifestyle) Study. Am J Kidney Dis. 2010 Apr;55(4):622-7

transplantation is also associated with improvements in survival and quality of life when compared to dialysis, making it a compelling treatment option for those who are suitable.

Service planning which actively pursues the optimal mix of modality utilisation for a given population has the potential to contain the significant costs associated with the treatment of ESKD. Cost-effective algorithms of RRT service provision are likely to be those that maximise transplantation for all suitable candidates and support home-based dialysis for patients who would prefer this option. Health service planning that takes this into account is essential to maximise health gains for the available resources, especially in the context of an ageing population and the epidemic of type 2 diabetes, factors which already exert noticeable pressure on demand for RRT services in Australia. Informing the planning of renal services in Australia is the ANZDATA registry, a comprehensive database monitoring ESKD patient trends, service utilisation and patient outcomes. ANZDATA is an essential resource enabling comprehension of the nature of the burden of ESKD in Australia and informing best practice in the provision of RRT services.

1.2 CKD and ESKD in Australia 2005 to 2010

This report reprises an analysis of the economic impact of ESKD in Australia originally conducted in 2005, which projected the burden of disease out to 2010.[4] The modelling performed is based on long-term trends in RRT service provision as recorded by ANZDATA. In our previous report we determined, on the basis of conservative estimates, that the cost to the health sector of providing RRT to new and existing patients in Australia for the period from 2004 - 2010 would exceed $4 billion. We also reported that switching patients from hospital-based haemodialysis to home-based dialysis options would result in net health sector cost savings, and that increasing the kidney transplantation rate would result in both considerable health sector savings and significantly improved health outcomes.

Since the original analysis was reported, there have been a number of developments in the fields of public health, clinical medicine and health policy that have influenced awareness of CKD, the clinical management of ESKD, priority setting in the planning of RRT services, and the national policy framework within which the continuum of CKD/ESKD care is delivered. In this context therefore, we present an updated report on the economic impact of ESKD in Australia, projecting disease burden to 2020.

Increasing recognition of the burden of disease

A recent step towards greater recognition of CKD in its earlier stages among Australian clinicians has been the implementation of routine reporting of estimated glomerular filtration rate (eGFR), a measure of kidney function, from serum creatinine measurements performed in pathology laboratories. While eGFR is the best readily measurable index of disease severity in CKD, most clinicians do not routinely calculate eGFR from serum creatinine results. The automatic reporting strategy was intended to opportunistically

[4] Cass, A, Chadban, S, Craig, J, Howard, J, McDonald, S, Salkeld, G, White, S. *The Economic Impact of End-Stage Kidney Disease in Australia*, Kidney Health Australia, Melbourne, 2006.

identify people with CKD, who might not previously have been identified as having reduced kidney function, with a view to facilitating appropriate management. Anecdotal reports indicate that automated reporting has aided the detection of asymptomatic CKD at an earlier stage, better decision making, and appropriate referral for those affected.[5]

Opportunities exist for intervention to reduce avoidable morbidity and mortality at each stage across the renal health continuum. The advantage of early identification is that greater opportunities are available for management to delay or prevent progression to ESKD and the subsequent requirement for dialysis. Effective disease recognition in primary care is also a critical factor in timely referral to a nephrologist where specialist management is appropriate. Timely referral, in turn, is critical to maximising the treatment options available to the person with ESKD and, in particular, making home-based dialysis more feasible as the individual is in a better position to make considered treatment choices and to prepare for dialysis.

Recognition of the potential benefits of early detection and intervention in CKD is also reflected in the incorporation of guidelines for the early identification and management of CKD into the Royal Australian College of General Practitioners (RACGP) Red Book. Current guidelines recommend the opportunistic screening by general practitioners for CKD in people with diabetes, hypertension, a family history of CKD, and for Indigenous Australians.[6] Screening for early signs of kidney damage is relatively inexpensive and simple, involving a urine dipstick test for albuminuria or proteinuria, measurement of blood pressure, and a blood sample to measure serum creatinine, tests which lend themselves well to opportunistic screening.

In addition to opportunistic screening within the primary care setting, community-based or workplace-based kidney health screening programs have been suggested as potentially effective and affordable means of CKD detection. Since 2000, the National Kidney Foundation in the United States has been running the Kidney Early Evaluation Program (KEEP), a nation-wide community-based kidney health screening program targeting adults with diabetes, hypertension or a family history that places them at risk.[7] In 2010, the Kidney Evaluation for You (KEY) pilot program was conducted in Australia, based on the KEEP model. Targeting high-risk groups within the community, the KEY pilot project recruited participants in the communities of Townsville, Roxby Downs and Perth, and offered a free and comprehensive on-the-spot evaluation of kidney function, cardiovascular health and diabetes risk, with subsequent referral to GPs of test abnormalities. Of 402 high-risk individuals recruited, findings were suggestive of CKD in 20.4%, with 58% referred to their primary care providers for further action. High rates of disease detection and follow-up

[5] Mathew TH. Chronic kidney disease and automatic reporting of estimated glomerular filtration rate: revised recommendations. Med J Aust, 2007; 187:459-463

[6] Guidelines for preventive activities in general practice, 6th edition. Eds. Harris M, Bailey L, Bridges-Webb C et al. Royal Australian College of General Practitioners, Melbourne, 2005.

[7] http://www.kidney.org/news/keep/KEEPhealthcare.cfm

suggest that the KEY approach to early detection of CKD may be suitable for broader evaluation.[8]

Policy developments

In addition to programs seeking to address the early stages of CKD, a number of Australian States and Territories have recently developed plans for the delivery of renal services, emphasising the provision of better coordinated care, promotion of self-management and investments in home-based therapies and transplantation in the provision of RRT.[9] NSW and Queensland have set benchmarks for home-based dialysis, with a target of 50% of all dialysis to be delivered as home-based self-care dialysis. The Tasmanian State Plan for Renal Services outlines a reorientation of renal service delivery to a single state-wide Renal Service, reallocation of resources to support the achievement of targets for home-based dialysis, and the integration of renal services across the continuum of care including the development of partnerships with the primary health sector.

Uptake of kidney transplantation is limited by the availability of donor organs. Deceased donation remains low by international standards, yet substantial regional variation in donor rates, for example a rate of 20.3 deceased donors per million population (pmp) achieved in South Australia in 2009 compared to a national average of 11.3 donors pmp, is a clear indication that improvement is possible.[10] It is evident that opportunities for deceased donation are frequently missed through refusal of consent to donation and other critical factors preventing the conversion of potential donors to actual donors. In response to the need for a nationally coordinated approach to maximise organ and tissue donation for transplantation, the Australian Government established The Organ and Tissue Authority on 1 January 2009.[11] The Authority is an independent statutory authority within the Australian Government Health and Ageing portfolio.

The responsibilities of the Authority include coordination of a national network of clinicians and other hospital staff involved in organ donation and transplantation; ongoing professional education; oversight and regulation of a new national network of State and Territory organ and tissue donation agencies; introduction of a national data and reporting system; community awareness and education programs; formulation of national policies and clinical practice protocols and standards; and monitoring and evaluation of practice. The potential impact of national coordination of organ donation and transplantation activities has been demonstrated in countries such as Spain where, 20 years after implementing a

[8] Mathew T, Corso O, Ludlow M et al. Screening for chronic kidney disease in Australia: a pilot study in the community and workplace. Kidney Int, 2010;77 (Suppl 116):S9–S16.

[9] Statewide Services Development Branch. Service Planning Series: NSW Renal Dialysis Service Plan to 2011. NSW Department of Health, Sydney, 2007.

Queensland Government. Queensland Statewide Renal Health Services Plan, 2008-17. Part One: The Way Forward, Queensland Government, Brisbane 2007

Tasmanian Government (2009), *Tasmanian State Plan for Renal Services 2010-2020, Part One: Overview and Action Plan.* Tasmanian Government, Hobart.

[10] http://www.anzdata.org.au/

[11] http://www.donatelife.gov.au/

similar nationally coordinated organisational model, deceased donation rates have reached 35 donors pmp and continue to increase.[12]

Changes in clinical management of ESKD

Pharmaceutical costs represent a significant proportion of the total cost associated with treating ESKD. The introduction of newer, more expensive agents has the potential to increase costs. Recent years have seen the introduction and widespread use of new pharmaceuticals — sevalamer, cinacalcet and lanthanum — for treatment of mineral and bone disorders associated with CKD, all of which are substantially more expensive than existing agents (including calcium carbonate and activated vitamin D). Conversely, recent evidence showing adverse patient outcomes with high or inappropriate dosing of erythropoietic agents used to treat anaemia has led to a reduction in their use. Changes in the use of these medications and newer regimens for post-transplant immunosuppression have been taken into account in the updated modelling for this report.

1.3 The current health care and reform context

In 2005, The Australian Health Ministers' Conference (AHMC) endorsed the National Chronic Disease Strategy (NCDS), seeking to provide an overarching policy framework and national direction for managing and improving chronic disease prevention and care. Within the Strategy, the national service frameworks identify opportunities to reduce the impact of specific chronic diseases, including diabetes. Critical intervention points and areas for facilitating improvements are identified, and have been drawn upon by individual states and territories in developing their own plans. Common themes across jurisdictions include strategies for greater coordination and integration across the care continuum, and a growing focus on self-management of chronic diseases. For ESKD in particular, policy developments in all jurisdictions have been broadly consistent with these priority areas for intervention outlined in the NCDS.

In 2010, the Federal Government announced significant changes to Australia's health, hospital and aged care systems via a National Health and Hospitals Network. The reform agenda includes a number of themes relevant to the management of chronic diseases. These include enhanced connection and integration of health and aged care; better utilisation of specialist services; continued strengthening and reliance on primary health care services; and implementation of evidence-based improvements to delivery and organisation of health services. Targeted measures seek to strengthen these outcomes in groups facing particular health inequities including Aboriginal and Torres Strait Islander populations, and those in rural and remote communities.

Lastly, while a 'fee for service' model remains the cornerstone of outpatient healthcare funding in Australia, there has been increasing recognition that such a funding model poses significant challenges to the effective management of chronic diseases. Policies in recent years such as providing access to Medicare funding for allied health groups, reimbursing

[12] Matesanz R, Dominguez-Gil B. Strategies to optimize deceased organ donation. Transplant Rev, 2007;21:177-188

renal physicians for supervision of home-based dialysis, and plans to explore limited capitation payments in primary care for management of diabetic patients, all signal a shift toward mixed funding models for the future. This trend is likely to continue and it is probable that this will impact upon current models of management of CKD and ESKD.

1.4 The ongoing need for more cost-effective models of service provision

Planning for the future burden of kidney disease continues to be vital to containing costs of ESKD while maximising the benefits of treatment. The development of renal services plans by individual States has been an important step forward. Nevertheless, there is an ongoing need to provide high level evidence regarding the cost-effectiveness of the various RRT modalities to inform policy-making, and to enable these economic realities to be reflected in service delivery.

A number of key recent trends in delivery of RRT must be noted. Firstly, there has been limited expansion of home-based dialysis services since 2005 and current patterns of usage emphasise the long periods required to establish people on home HD. Limited resources and facilities for home HD training remain a persistent barrier to achieving targets for home-based treatment. Secondly, the proportion of patients receiving dialysis in satellite centres has increased steadily over the past decade, and this trend has mirrored the decline in home HD over the same period. Although satellite dialysis originally emphasised self-care, the distinction from hospital HD with respect to dependency on nursing care and other health workers is less and less apparent, despite the cost implications.[13] Thirdly, despite an increasing awareness of CKD and the importance of early detection, this is yet to translate into measurable improvements in late referrals which remain above 20%. Late referral to a nephrology service, within three months of commencing RRT, directly impacts on preparation for RRT. Patients who are referred late are less likely to utilise home-based dialysis and kidney transplantation. Finally, regional variation in rates of transplantation and comparisons with international benchmarks continue to underscore the extent of improvement that is possible with respect to organ donation and transplantation in Australia.

The ageing of the Australian population and increasing prevalence of diabetic nephropathy will continue to be major drivers of the demand for RRT services into the future. In this report we project the future burden of ESKD in Australia, based on considered methodologies that use recent age-specific trends for the actual national patient cohort. We estimate the health sector costs (and benefits) projected to 2020 of providing RRT, in accordance with current clinical practice, to the population of current and future ESKD patients. We assess the relative costs and benefits of increases in the proportion of dialysis delivery at home and in rates of kidney transplantation. In the context of the NCDS, Health and Hospital Reform and the Organ and Tissue Authority, a framework is now in place by which the needs of the population with respect to ESKD, from prevention to the optimal treatment of end-stage disease, might be systematically addressed at a national level.

[13] Agar J, Hawley C, George C, Mathew T, McDonald S, Kerr P. Home haemodialysis in Australia – is the wheel turning full circle? MJA, 2010; 192(7):403-406

Therefore, this is an opportune time for a concerted effort to move towards more cost-efficient models of RRT service provision that, crucially, will also deliver better outcomes in terms of survival and quality of life to those Australians affected by ESKD.

Chapter 2 Projections of the burden of disease

2.1 Projected burden of disease to 2020

The annual incidence of treated ESKD was projected to 2020. Separate estimates were generated for the Indigenous and non-Indigenous populations, and the age-specific trends within each of these groups examined. Estimates of future incidence of RRT patients are based on Australian Bureau of Statistics population projections. Mid-range (series B) population projections were used for the non-Indigenous population,[14] whereas upper-range projections were applied for the Indigenous population.[15] For both groups, the numerical impact of this choice is small relative to other sources of variation affecting growth of RRT populations.

Separate prediction models for the Indigenous and non-Indigenous populations were necessary due to the heavy burden of ESKD among Indigenous Australians, the different demographic characteristics of the Indigenous and non-Indigenous RRT populations, and the volatility in census counts and demographic data for the Indigenous population, which introduces uncertainties in projections of future population growth.

Two models projecting incidence were created for both the Indigenous and non-Indigenous populations. The two models account for changing trends in the incidence of treated ESKD over recent years; whereas the trend over the past 10 years has been towards growth in new RRT patients, the trend over the past 3 years alone suggests that incidence has reached a plateau. A key unknown factor is whether this is a 'true' stabilisation of rates, or an artefact reflecting random fluctuations in observed numbers. Hence separate models generated from each scenario produce upper (growth) and lower range (steady-state) projections of ESKD incidence to 2020.

Model 1:

Model 1 uses a Poisson model based on RRT trends observed over the last 10 years (2000-2009), for all age groups, with the exception of the non-Indigenous, 45-64 year old age group, where the last 20 years of data was used due to a high degree of unexplained variability in recorded rates for this group. The basic assumption underlying this model is that the observed trend in rates towards growth over the previous 10-year period will continue in a similar manner into the future. These age-specific trends have been largely stable over the past 10 years.

Model 2:

Model 2 assumes that recently observed age-specific rates will remain constant over the period to 2020 (i.e. a steady-state model). This model is based on the arithmetic mean of

[14] 3222.0 – Australian Bureau of Statistics. Population Projections, Australia, 2006 to 2101 (www.abs.gov.au)

[15] 3238.0 – Australian Bureau of Statistics. Experimental Estimates and Projections, Aboriginal and Torres Strait Islander Australians, 1991 to 2021 (www.abs.gov.au)

age-specific incidence rates recorded over the last 3 (non-Indigenous) or last 4 (Indigenous) years. The historical and projected age-specific rates are summarised in Figure 1 and Figure 2.

Figure 1: Observed and projected rates, incidence of non-Indigenous RRT patients to 2020 (per million population per year)

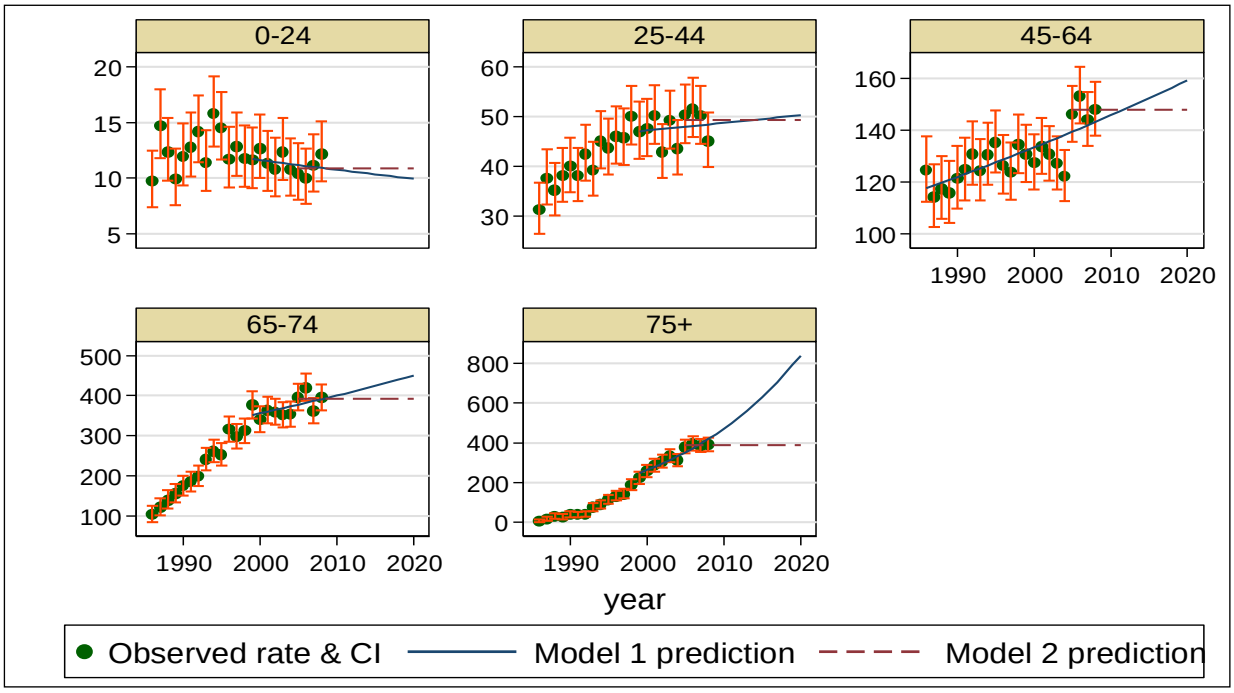
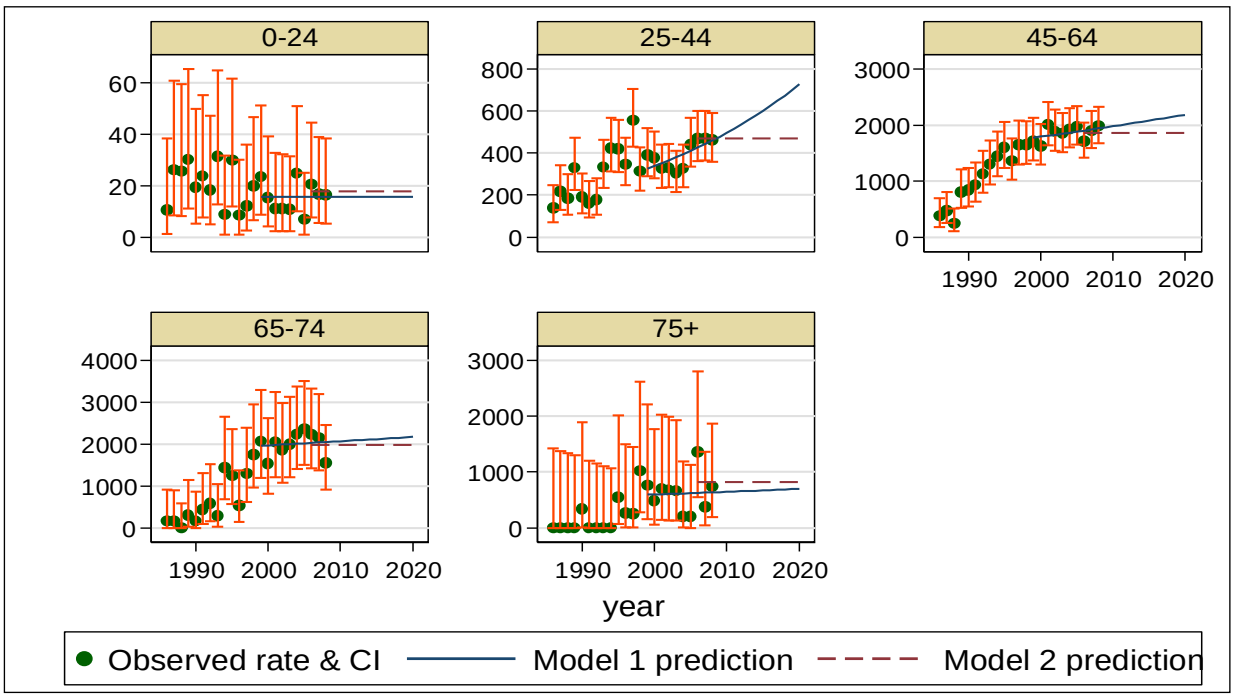


Figure 2: Observed and projected numbers of incident Indigenous RRT patients to 2020



There is little variation between the two models when applied to most age groups in either the Indigenous or non-Indigenous populations. The exception is the non-Indigenous 75+ year age group, for which Model 1 predicts a rate of 840 per million per year (pmpy) by 2020. Although this represents a doubling of current rates, it is still significantly lower than the current rate of ESKD reported for US Whites aged 75+ (1441 pmpy).[16] The prediction for the 75+ category is a key driver of the longer term numbers.

Table 1: Predicted incident counts of non-Indigenous patients 2009-2020 (Model 1)

Age group	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0-24	74	74	74	74	74	74	74	74	74	74	74	74
25-44	290	295	300	305	310	314	319	323	327	332	337	342
45-64	780	800	818	831	847	864	883	904	924	942	960	976
65-74	611	644	678	727	771	813	857	900	942	986	1025	1063
75+	604	653	709	771	838	912	994	1083	1184	1292	1421	1564
Total new patients	***2359***	***2466***	***2579***	***2708***	***2840***	***2977***	***3127***	***3284***	***3451***	***3626***	***3817***	***4019***

Table 2: Predicted incident counts of non-Indigenous patients 2009-2020 (Model 2)

Age group	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0-24	74	75	76	76	77	78	78	79	79	80	80	81
25-44	295	299	303	306	310	314	318	321	324	327	331	335
45-64	798	811	823	828	836	846	856	869	881	890	899	905
65-74	606	632	658	697	731	761	793	823	851	881	905	928
75+	528	539	552	566	581	596	613	631	650	670	695	722
Total new patients	***2301***	***2356***	***2412***	***2473***	***2535***	***2595***	***2658***	***2723***	***2785***	***2848***	***2910***	***2971***

Table 3: Predicted incident counts of Indigenous patients 2009-2020 (Model 1)

Age group	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0-24	5	5	5	5	5	5	5	5	5	6	6	6
25-44	70	74	78	83	88	94	99	106	113	121	130	139
45-64	155	163	171	180	188	197	206	215	222	230	238	246
65-74	26	28	29	32	34	37	39	42	45	48	51	55
75+	4	4	4	4	4	5	5	5	6	6	7	7
Total new patients	***260***	***274***	***287***	***304***	***319***	***338***	***354***	***373***	***391***	***411***	***432***	***453***

Table 4: Predicted incident counts of Indigenous patients 2009-2020 (Model 2)

Age group	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0-24	6	6	6	6	6	6	6	6	6	6	6	7
25-44	68	69	71	72	74	76	78	79	82	84	87	89
45-64	147	154	160	166	172	178	184	190	195	200	205	210
65-74	25	27	28	30	32	34	36	39	41	44	47	50
75+	5	5	5	5	5	6	6	6	7	7	8	8
Total new patients	***251***	***261***	***270***	***279***	***289***	***300***	***310***	***320***	***331***	***341***	***353***	***364***

[16] USRDS 2009 Annual Data Report: Atlas of Chronic Kidney Disease and End-Stage Renal Disease in the United States, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2009.

2.2 Trends and implications

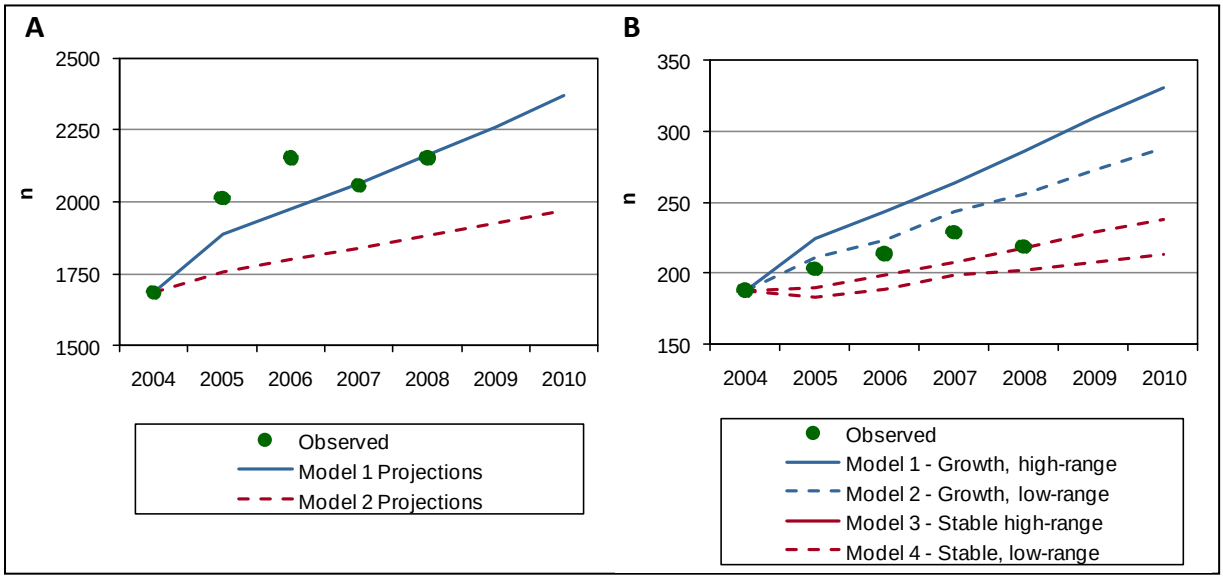
These projections indicate that, in 2020, the number of Australians of all ages commencing RRT will lie between 3,335 individuals (2,971 non-Indigenous and 364 Indigenous, steady-state model) and 4,472 (4,019 non-Indigenous and 453 Indigenous, growth model). Therefore, on the basis of these models, an increase of between 35% and 81% in the number of new patients commencing RRT above 2008 figures is projected.

These projections are based upon observed, age-specific incidence rates for treated ESKD. An increasing demand for RRT can be driven both by trends in the incidence and prevalence of underlying risk factors for CKD, including diabetes, obesity and hypertension, as well as changing community expectations of access to health care, irrespective of age, and the ability of the health system to meet these expectations. As noted above, new cases of ESKD in Australians aged 75 and over contribute significantly to the projected demand for renal services. However, even when making projections based upon the "Growth" model, the age-specific incidence of RRT in 2020 amongst Australians 75 and over is lower than the incidence in this age group in comparable countries including the United States.

In our previous report, the annual number of patients commencing RRT in Australia was projected to the year 2010. Similarly, Indigenous and non-Indigenous patients were modeled separately, and two prediction models were created to account for the alternative scenarios of the continuation of growth trends, or the maintenance of current rates of incidence. Model 1 (growth model) assumed that the linear trend in age-specific incidence rates over the period from 1991 - 2004 would be maintained to 2010. Model 2 (steady-state model) assumed that age-specific incidence rates averaged over the 2002-2004 period would be maintained to 2010, based on an observed 'leveling-off' in incident patient numbers during these years.

Figure 3 shows that, for the non-Indigenous population over 25 years of age, the observed number of new patients commencing RRT in each of the years 2005-2009 most closely approximates the growth model for this period. This observation lends credibility to the upper-range projections reported here for the period 2009-2020.

Figure 3: Observed and projected RRT counts 2004-2010, (A) non-Indigenous population aged 25 years and older, (B) Indigenous population aged 25 years and older

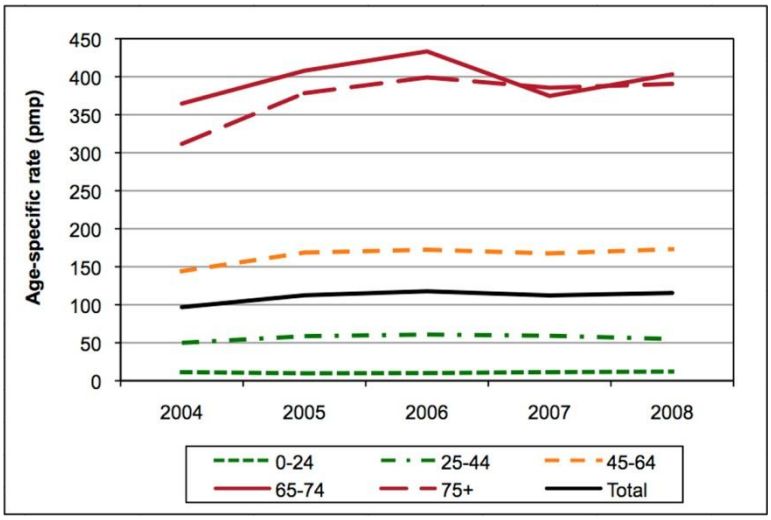


Chapter 3 ESKD overview – current data and trends

3.1 Changes in demographics of the population on RRT 2004-2008

In our original report we noted the approximately linear growth of the RRT population in Australia over the period from 1991-2004. In the five years since the original report, the number of Australians receiving RRT has continued to increase, from 14,291 individuals (711 pmp) at 31 December 2004, to a figure of 17,578 (822 pmp) reported as of 31 December 2008.[17] The annual intake of new patients commencing RRT has increased over this interval, from 1,949 individuals (97 pmp) in 2004, to 2476 (116 pmp) individuals in 2008, an increase of nearly 20%. Population-adjusted incidence rates are highly variable across the States and Territories, ranging from a high of 405 pmpy in the Northern Territory to 99 pmpy in Victoria. For Australia as a whole, increases in the incidence of treated ESKD have been observed in all age groups, with the exception of 0-24 year-olds. The largest population-adjusted increases have been in the 65+ age group (Figure 3). Correspondingly, the median age at start of dialysis rose slightly from 62.5 years in 2004 to 63.1 years in 2008. The RRT population therefore continues to grow with a demographic shift towards older age groups.

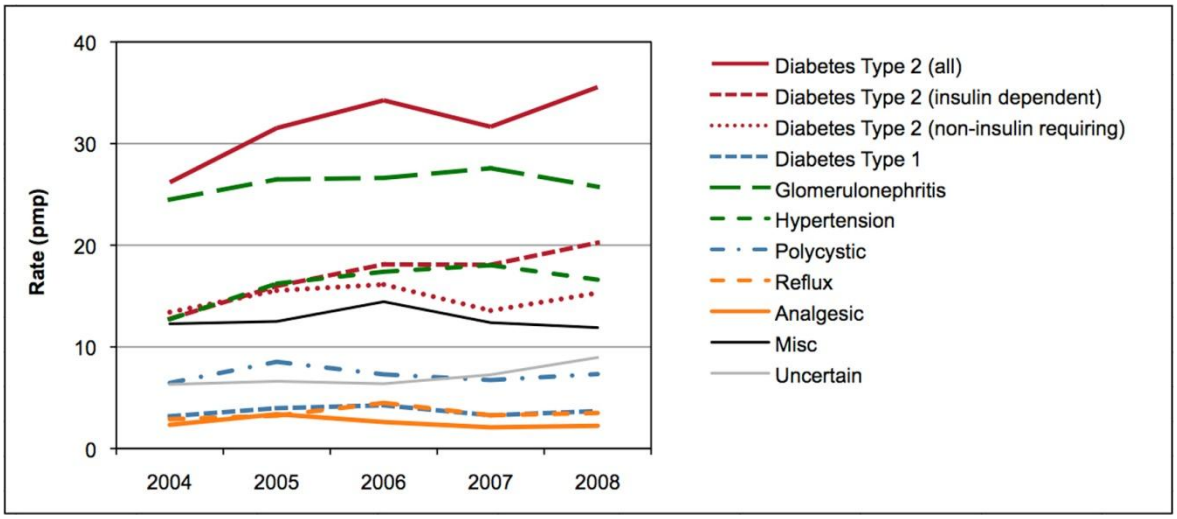
Figure 4: Acceptance of new RRT patients 2004-2008, age specific rates (per million population)[17]



At the time of our original report, diabetic nephropathy had emerged for the first year as the single most common cause of ESKD in the Australian population. Consistent with international trends, diabetes has continued for the past five years as the most common cause of primary renal disease in Australians receiving RRT (Figure 5).

[17] http://www.anzdata.org.au/v1/annual_reports_download.html

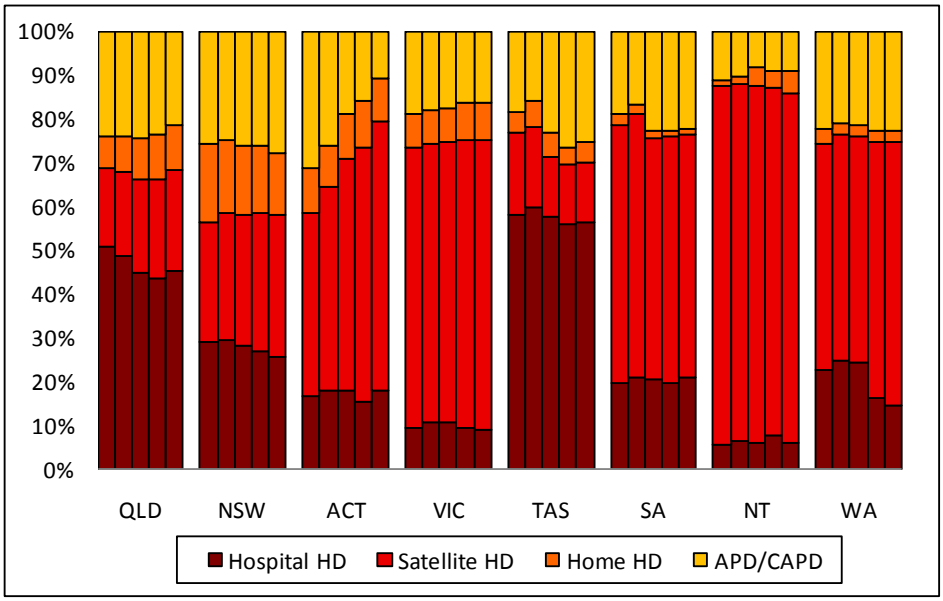
Figure 5: Acceptance of new RRT patients 2004-2008, rates by primary renal disease (per million population)[17]



3.2 Changes in modality utilisation patterns 2005-2009

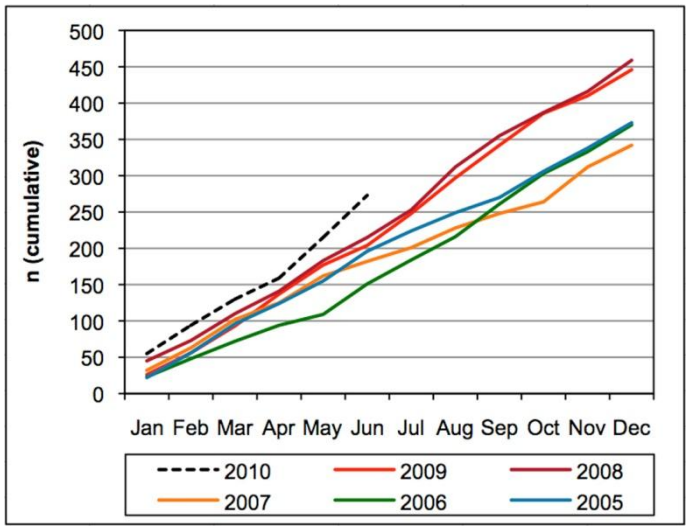
National variability in dialysis utilisation patterns reflects differences between the States and Territories with respect to the scale of the burden of ESKD in the resident population, the characteristics of ESKD patients and their treatment needs, and the local health services delivery context. In most State/Territory jurisdictions the majority of patients receive satellite or hospital haemodialysis rather than the less expensive home-based treatment options of home haemodialysis or peritoneal dialysis. Although several State jurisdictions have established targets for home-based dialysis,[9] there has been minimal increase in the proportion of dialysis patients receiving home-based therapies.

Figure 6: Proportions on each dialysis modality within each State and Territory, 2004-2008[17]



Data from the ANZDATA registry show that, from 2004 - 2008, there has been a trend towards expansion of satellite dialysis services (Figure 6). Home-based dialysis therapies are accessed by a variable proportion of dialysis patients; from 41.8% in New South Wales in 2008 to 13.1% in the Northern Territory. This proportion has fallen in the ACT, increased in Tasmania and appears relatively stable in other states.

Figure 7: Annual cumulative number of kidneys transplanted from deceased donors, 2005-2010[18]



Of the Australians receiving RRT on 31 December 2004, 44% had a functioning transplant. As of 31 December 2008, this proportion was essentially unchanged with 43% having a functioning kidney transplant. Nevertheless, there have been recent increases in organ donation and transplantation in Australia. In particular, 2008 saw a substantial increase in transplant numbers. With 813 kidney transplant operations performed, this represented the highest annual number of transplants performed in Australia and is attributable to increases in both living and deceased donor transplants. As shown in Figure 7, the increased number of kidneys retrieved and transplanted from deceased donors was sustained in 2009, and initial data for 2010 indicate that there might be further increases in deceased donation.

In response to survey data indicating that 40% of Australians do not know the donation wishes of family members, the Organ and Tissue Authority launched its DonateLife campaign[19] on 22 May 2010. The mass-media campaign ran nationally until 30 June 2010 and included television, radio, outdoor, online, cinema and print advertising, as well as outdoor activities for the public. Actual deceased donors in June 2010 totalled 31, compared with 17 in June 2009 and 18 in June 2008. Ongoing monitoring and evaluation will substantiate whether short-term trends in increased deceased kidney donation will be sustained.

[18] http://www.anzdata.org.au/anzod/v1/summary-org-donation.html

[19] http://www.donatelife.gov.au/News-and-Events/News/Media-Releases/Prime-Minister-Launches-Donatelife-Discuss-It-Today-OK.html

Chapter 4 Current and future costs of ESKD

4.1 Research Questions

- What is the total cost of treating new and existing ESKD?
- What are the costs and benefits of increasing the proportion of patients on home-based dialysis?
- What are the costs and benefits of increasing the proportion of patients treated with transplantation?

4.2 Overview of Methods

The approach used in this analysis follows a previously developed and reported methodology for the analysis of costs and benefits of RRT in Australia.[4] Many of the data limitations identified in this earlier work are also applicable in the current setting. These estimates of costs and benefits *exclude* the following: i) the costs and benefits of providing RRT services to Australians under 25 (less than 3% of new cases); ii) the costs of providing services for co-morbid conditions such as cardiovascular disease and diabetes; and iii) the indirect or non-health sector costs associated with ESKD. Additional detail of the model, data sources and assumptions are reported in Appendix B – Model Methods.

4.2.1 The Economic Model

A Markov model was constructed as the basis for estimating the costs and benefits of RRT in Australia over 2009-2020. This model is based upon the general structure (including assumptions) of the earlier model, with cohort transition probabilities based upon an updated ANZDATA data set of patient outcomes and transitions estimated from incident patients commencing RRT over the timeframe 2004 - 2008.

The model follows multiple cohorts of patients newly treated for ESKD (i.e. commencing RRT), along with existing RRT patients. The length of each 'treatment' cycle in the model is one year. The structure of the model is shown in detail in Appendix B. The model is stratified by age.

In the absence of good-quality individual randomised control trials or large prospective observational studies conducted in Australia, this study uses the best available Australian data to derive estimates for the model parameters. This required a substantial secondary analysis of ANZDATA in order to derive transition probabilities between health states and RRT modalities. Details of the sources of cost and quality of life data are outlined in the following section. If no published evidence or registry data could be found, the opinion of clinical experts was sought.

Rates of treated ESKD for years 2009 - 2020 were projected based on two models of incidence in the non-Indigenous and Indigenous populations: a growth model assuming that linear increases observed over the period 2000-2009 are maintained to 2020; and a steady-

state model assuming that current rates are maintained to 2020. Details of the modelling of future ESKD incidence are given in Section 2.1.

4.2.2 Health State Utilities (Quality of life weights)

There are no Australian data on utility (QoL) scores for patients in pre- (i.e. dialysis) and post-transplant health states. The health utility scores for dialysis and post-transplant states, derived from published international sources, are summarised in Table 5.

Table 5: Health utility scores for dialysis and post-transplant states

Assumptions	Value	Source	Justification for source
Renal transplant Time after transplant 1 month 3 months 6 months 12 months *Time weighted average 0-12 months* 18 months 24 months *Time weighted average 12-24 months*	 0.68 0.71 0.75 0.74 *0.7325* 0.7 0.7 *0.7*	Laupacis et al (1996)	Pre-and post-transplant time trade-off (TTO) utility valuation study conducted on transplant patients and on dialysis patients (pre-transplant)
Dialysis (pre-transplant)	0.55	Laupacis et al (1996)	
Death	0	Convention	

4.2.3 Resource use and costs

Cost data were based on the best available published data that conform to Australian government guidelines for the application of economic evaluation to funding submissions to the Pharmaceutical Benefits Advisory Committee (PBAC) and the Medical Services Advisory Committee (MSAC). The most recent National Hospital Cost Data Collection Round 13: 2008-9 Australian Refined Diagnosis Related Groups cost -weights have been used for relevant DRG-based costs. Additional detail is available in Appendix B.

A primary costing study of dialysis modalities or transplantation was not undertaken. The cost of each dialysis modality was based upon the NSW Dialysis Costing Study, 2008, with prices indexed to 2009 dollars. These costs included:

- Staff costs (including nursing and allied health staff)
- Price per treatment (PPT) payments
- Direct costs associated with dialysis (including pharmacy, fluids and consumables, depreciation and overheads)
- Other costs associated with dialysis included medical services, access surgery, some pharmacy costs and pathology.

The NSW Dialysis Costing Study also measured ongoing out-of-pocket costs to patients and families, and estimated costs associated with Home HD and PD training and costs for patients for modality initiation. As newer pharmacological agents, now Pharmaceutical Benefits Scheme (PBS) subsidised exclusively for use in dialysis patients (cinacalcet, sevelamer and lanthanum), were not widely available at the time of the NSW Dialysis Costing study, costs associated with the use of these agents have been included separately. Average cost per patient was calculated based upon the total cost of these agents for January to December 2009, apportioned over all patients receiving dialysis in that year.

Other inpatient resource use has not been included as it was not measured and costed as part of the NSW Dialysis Costing Study. The unit costs of dialysis per patient per annum, by treatment modality, are summarised in Table 6 (with further details of the costs of RRT provided in Appendix B).

Table 6: Annual cost of each dialysis modality per patient (NSW Dialysis Costing Study, indexed to 2008 - 2009 dollars)

	In centre		Satellite		Home HD		PD	
Estimated health system expenditure/pt/yr AUD 2007-2008		**$76,881**		**$63,505**		**$47,775**		**$51,640**
Indexed to AUD 2008-2009*		**$79,072**		**$65,315**		**$49,137**		**$53,112**
Components of costs	**%**	**AUD 2009**	**%**	**AUD 2009**	**%**	**AUD 2009**	**%**	**AUD 2009**
Direct dialysis service provision								
Nursing	33%	$26,094	24%	$15,349	5%	$2,457	5%	$2,656
Allied health	2%	$1,581	3%	$1,959	5%	$2,457	4%	$2,124
Other employee related	3%	$2,372	2%	$1,306	3%	$1,474	0%	$0.00
Pharmacy	3%	$2,372	6%	$3,919	5%	$2,457	2%	$1,062
Other direct provision costs†	27%	$21,350	30%	19,594	32%	$15,723	36%	$19,252
Other costs								
Medical	3%	$2,372	3%	$1,959	4%	$1,965	3%	$1,593
Access surgery	6%	$4,744	7%	$4,572	9%	$4,668	19%	$10,224
Pharmacy								
Section 100	13%	$10,279	15%	$9,471	21%	$10,073	21%	$11,286
Other prescribed medicines	8%	$6,326	9%	$5,878	13%	$6,388	7%	$3,851
Pathology	2%	$1,581	2%	$1,306	3%	$1,474	2%	$1,062
Total	**100%**	**$79,072**	**100%**	**$65,315**	**100%**	**$49,137**	**100%**	**$53,112**
Ongoing out-of-pocket costs to patients		$4,172		$3,209		$2,246		$1,913
Other drugs (cinacalcet, sevelamer, lanthanum)‡		$1,511		$1,511		$1,511		$1,511
Transplant work-up costs for those on waiting list¶		$375		$375		$375		$375
Total (all ongoing costs)		**$85,128**		**$70,409**		**$53,268**		**$56,910**
Once-off costs (Training and once-off patient costs)						$15,093		$3,823

*AIHW Total Health price Index for 2007-8 (1.0285) applied to 2008-9: http://www.aihw.gov.au/publications/hwe/hwe-46-10954/hea07-08

†Other direct provision costs include PPT payments, dialysis fluids/consumables, depreciation, other goods and services and overheads.

‡Average cost per patient was based on PBS cost data for cinacalcet, sevelamer and lanthanum item numbers from Jan to Dec 2009, apportioned over all dialysis patients.

¶Based upon work-up regimen costs from 2006 Kidney Health Australia Report 'The Economic Impact of End-Stage Kidney Disease in Australia', with costs indexed to 2009 values.

The annual cost of transplant includes surgery and hospitalisation, immunosuppressive therapy, specialist review and consultations and other drugs, as well as donor costs for a transplant. Data sources are discussed in more detail in Appendix B.

Table 7: Unit cost of kidney transplant per patient per year (AUD 2008 - 2009)

Resource items	Live donor *Recipient unit cost*	Live donor *Donor unit cost*	Deceased donor *Recipient unit cost*	Deceased donor *Donor unit cost*
Year 1				
Surgery and hospitalisation	$37,362	$15,832	$37,362	$3,000
Regular Immunosuppressive therapy (PBS)	$21,694		$21,694	
Additional Immunosuppression (induction and acute rejection)	$7,648		$7,648	
Other drugs	$8,619		$8,619	
Non drug follow-up costs	$6,227		$6,227	
TOTAL YEAR 1 COST	**$81,549**	**$15,832**	**$81,549**	**$3,000**
Year 2 onwards				
Regular Immunosuppressive therapy	$10,227		$10,227	
Other drugs	$724		$724	
Non drug follow-up costs	$819		$819	
TOTAL YEAR 2 ONWARDS COST	**$11,770**		**$11,770**	

4.2.4 Transition probabilities

The full set of transition probabilities has been reported previously.[4] These transition probabilities have been updated to reflect a more recent cohort of prevalent patients (See Appendix B).

4.2.5 Calculation methods including sensitivity analyses

Methods of calculating costs and benefits from 2009-2020 are explained in detail in Appendix B. This Appendix also provides details of the methods used for calculating the incremental costs and benefits, and the incremental cost-effectiveness ratios (ICER) associated with changing patterns of RRT modality utilisation for non-Indigenous patients. The specific calculations are:

- The present value of costs and benefits of treating all existing and new cases of ESKD (from 2009 - 2020).
- The additional health care costs (savings) that accrue by changing the proportion of patients that undergo different types of dialysis (hospital HD, home HD, PD, and satellite HD), predominantly focusing on a shift towards home-based therapies (see Table 8, below).
- The additional health care costs (savings) and benefits of increasing the proportion of new ESKD patients who receive a kidney transplant. In addition, we have included a

nominal 5% increase[20] in the cost of transplants as part of this sensitivity analysis, to factor in a likely estimate of increased resource requirements to achieve the modelled increases in transplant numbers.

Table 8: Proportion of patients receiving each dialysis modality in each year

Age	Modality	Current patients		Proportion of new dialysis patients for sensitivity analyses				
		Year 0	Year 4+	Y0	Y1	Y2	Y3	Y4+
25-44	APD/CAPD	0.393	0.122	0.35	0.30	0.25	0.20	0.15
	Home HD	0.075	0.294	0.30	0.325	0.35	0.375	0.40
	Satellite HD	0.259	0.422	0.25	0.275	0.30	0.325	0.35
	Hospital HD	0.274	0.163	0.10	0.10	0.10	0.10	0.10
45-64	APD/CAPD	0.361	0.117	0.40	0.35	0.30	0.225	0.15
	Home HD	0.062	0.220	0.20	0.225	0.25	0.275	0.30
	Satellite HD	0.323	0.459	0.30	0.325	0.35	0.40	0.40
	Hospital HD	0.253	0.203	0.10	0.10	0.10	0.10	0.15
65-74	APD/CAPD	0.313	0.129	0.40	0.35	0.30	0.225	0.15
	Home HD	0.008	0.119	0.10	0.125	0.125	0.15	0.15
	Satellite HD	0.348	0.534	0.30	0.325	0.375	0.425	0.50
	Hospital HD	0.331	0.217	0.20	0.20	0.20	0.20	0.20
75 +	APD/CAPD	0.277	0.093	0.40	0.35	0.30	0.20	0.10
	Home HD	0.004	0.022	0.025	0.025	0.05	0.05	0.05
	Satellite HD	0.340	0.582	0.325	0.375	0.40	0.50	0.60
	Hospital HD	0.386	0.304	0.25	0.25	0.25	0.25	0.25

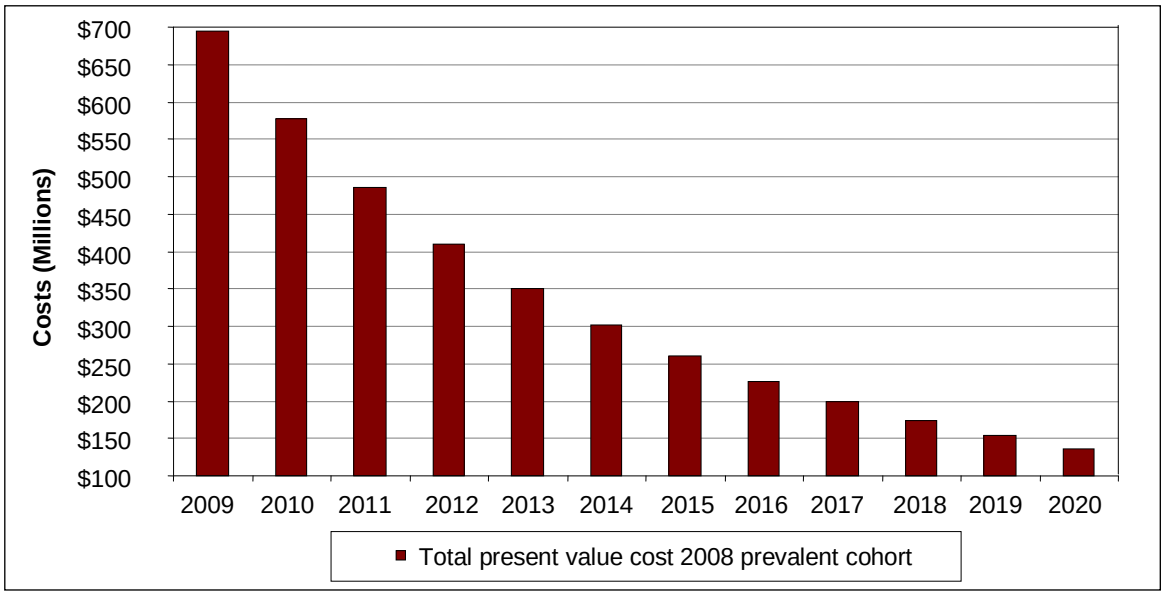
[20] This is consistent with the extent of expenditure on organ procurement and allocation reported by the Spanish National Transplant Organization (ONT), who operate their national organ donation and transplantation coordination structure at an annual cost of 9.2 million euros, representing 5.3% of the 170 million euros spent in total on all transplantation activities (figures from 2005, personal communication, B Domínguez-Gil)

4.3 Cost and health outcomes of treatment to 2020

4.3.1 Cost of treating current cases of ESKD

The present value total annual costs of RRT for current ESKD patients (receiving treatment as at 2009), based on the treatment of this cohort of patients up to and including the year 2020, is summarised in Figure 8. The declining annual cost reflects the diminishing patient cohort due to death. Costs of treatment of new cases of ESKD are not included.

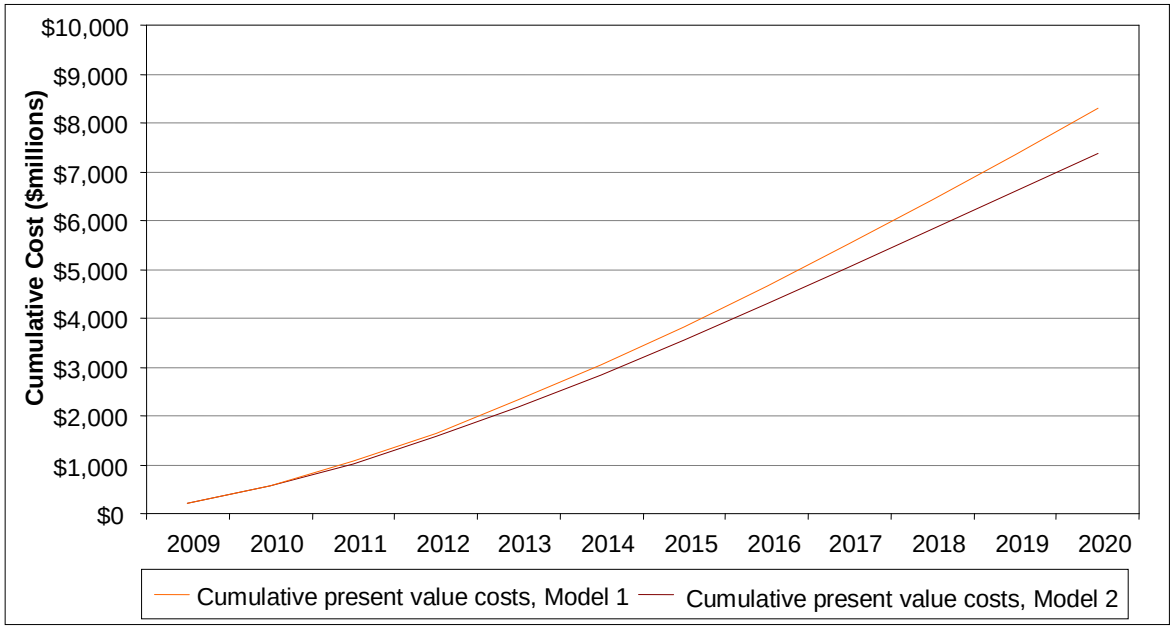
Figure 8: The total discounted annual cost of RRT for current ESKD patients



4.3.2 Cost of treating new cases of ESKD out to 2020

The present value cumulative cost of RRT for all *new* cases of ESKD, treated out to 2020, is estimated to be between $7 and $8 billion by the end of this period (Figure 9).

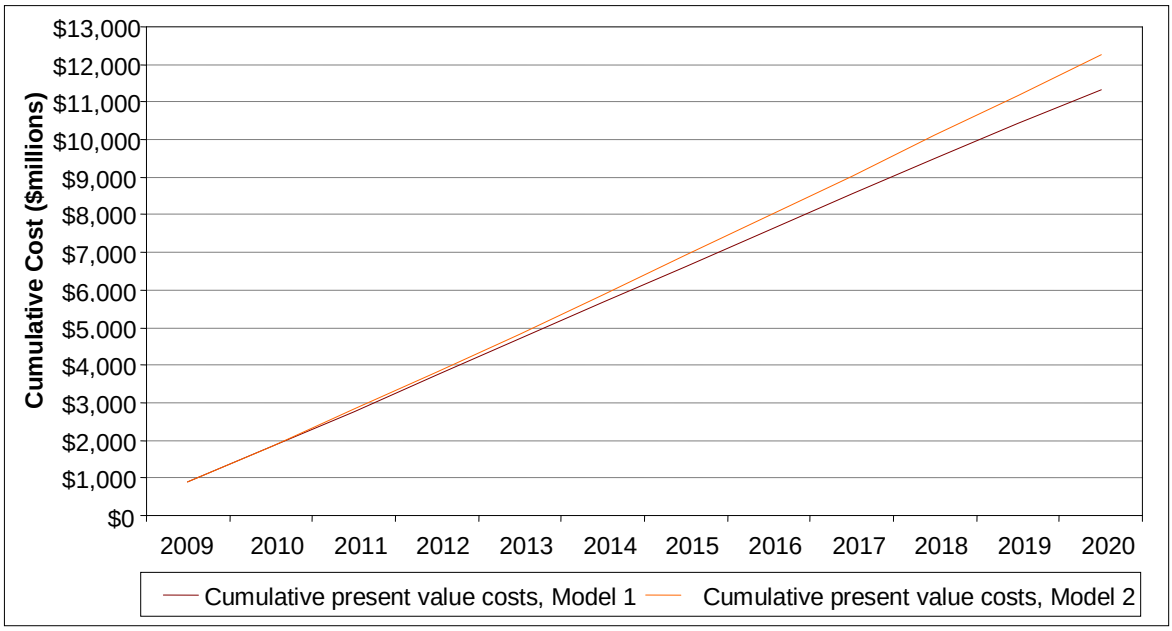
Figure 9: The cumulative present value costs for all new RRT patients treated out to 2020



4.3.3 Cost of treating current and new cases of ESKD out to 2020

The present value cumulative cost of RRT for all *current and new* cases of ESKD, treated out to 2020, is estimated to be between approximately $11.3 and $12.3 billion by the end of this period (Figure 10).

Figure 10: The cumulative present value treatment cost of all new and existing RRT patients treated out to 2020



4.3.4 Projected annual health sector costs of treating all cases of end-stage kidney disease (ESKD) to 2020

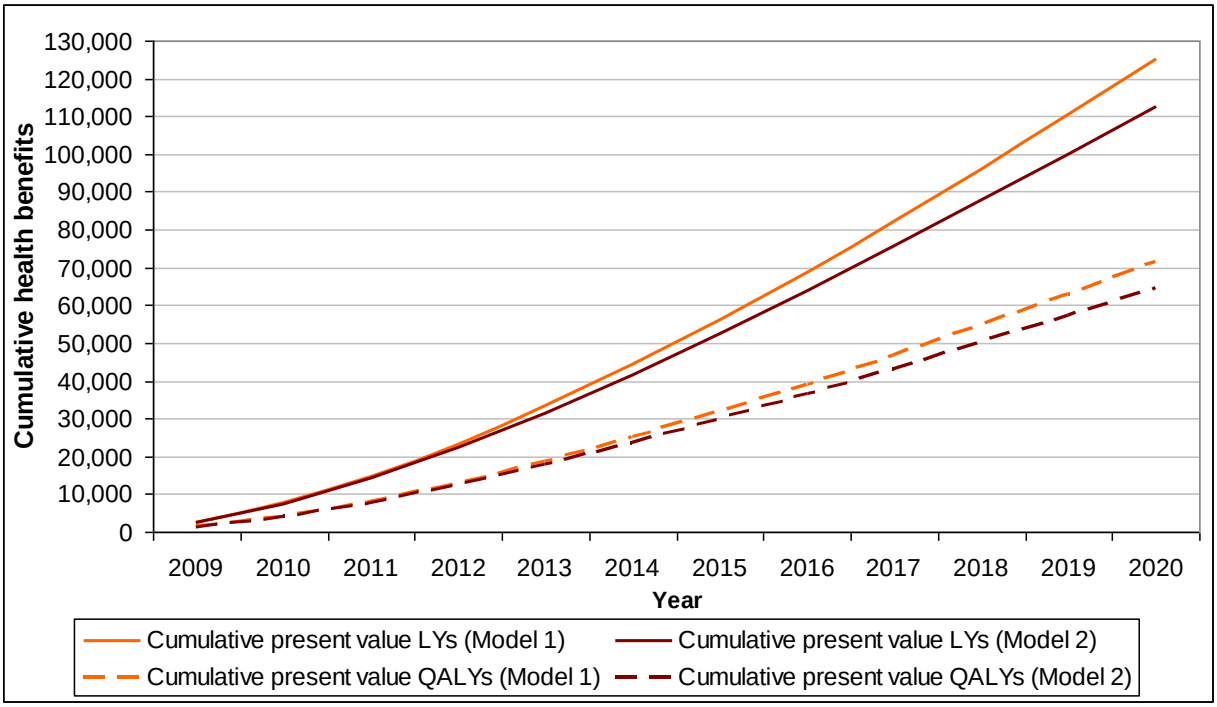
The present value annual cost of RRT is estimated to increase, from approximately $890 million in 2009, to between $920 million and almost $1.1 billion in 2020 (Table 9and Table 10). As at 31 December 2020, this would represent an annual cost of RRT service provision of between $1.58 billion and $1.86 billion in 2020 dollars (see Table 19 and Table 20 in Appendix A).

4.3.5 Health outcomes (in life years and quality-adjusted life years[21]) of treating new cases of ESKD (to 2020)

The present value of the cumulative benefits of RRT in life years saved (LYS), for all new cases of ESKD out to 2020, will be between 112,000 and 125,000 LYS by 2020. The present value of the benefits of RRT in quality-adjusted life years (QALYs), for all new cases of ESKD to 2020, will be between 64,500 and 71,500 QALYs.

The annual and cumulative total health benefits (present values) of providing RRT to all new cases of ESKD out to 2020 are summarised in Figure 11 and Table 12 and Table 11.

Figure 11: The present value cumulative health benefits (in life years and QALYs) for all new RRT patients treated (to 2020)



[21] Quality adjusted life years (QALYs) are a multidimensional outcome measure used in health economics. This economic index of health outcome combines patient survival in life years with an adjustment for the quality of life, where adjustment is based on interval scale from 0 (death) to 1 (full health).

Costs

Table 9: Total present value of projected annual costs of treating all RRT patients for 2009 – 2020 ($ millions; Incidence Model 1)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total annual costs (all patients)	$900.12	$947.40	$976.15	$998.32	$1,014.66	$1,029.67	$1,043.21	$1,055.23	$1,065.66	$1,074.57	$1,082.41	$1,089.21
Cumulative present value costs	$900.12	$1,847.52	$2,823.67	$3,821.99	$4,836.65	$5,866.32	$6,909.53	$7,964.76	$9,030.42	$10,104.99	$11,187.41	**$12,276.62**

Table 10: Total present value of projected annual costs of treating all RRT patients for 2009 – 2020 ($ millions; Incidence Model 2)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total annual costs (all patients)	$894.78	$933.50	$951.78	$961.36	$964.20	$964.64	$962.78	$958.68	$952.35	$943.96	$933.82	$921.92
Cumulative present value costs	$894.78	$1,828.29	$2,780.06	$3,741.43	$4,705.62	$5,670.26	$6,633.04	$7,591.72	$8,544.07	$9,488.03	$10,421.86	**$11,343.78**

Health Outcomes

Table 11: The present value of health benefits (life years and quality adjusted life years [QALYs]) for all new RRT patients out to 2020 (Incidence Model 1)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Total annual life years	2585.10	5021.62	6993.41	8620.44	9911.69	10998.06	11914.63	12689.10	13343.59	13896.01	14366.01	14765.29	**125104.93**
Total annual QALYs	1442.47	2820.98	3959.16	4906.15	5657.13	6289.37	6822.90	7273.65	7654.37	7975.38	8247.91	8478.73	**71528.19**

Table 12: The present value of health benefits (life years and quality adjusted life years [QALYs]) for all new RRT patients out to 2020 (Incidence Model 2)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Total annual life years	2517.91	4843.61	6677.38	8136.27	9243.31	10128.72	10831.04	11380.23	11799.49	12108.45	12325.16	12460.92	**112452.50**
Total annual QALYs	1405.89	2723.98	3786.79	4641.37	5290.50	5811.31	6225.81	6551.23	6800.97	6986.31	7117.63	7201.53	**64543.34**

4.4 Costs and health outcomes of alternative models of service provision

4.4.1 Increasing the utilisation of home-based dialysis therapies

The incremental costs and health outcomes indicated by sensitivity analysis examining the value of switching dialysis modality (from hospital- to home-based) are summarised in Table 14 below. For new patients commencing RRT from 2010, increasing the utilisation of home based therapies (home HD and PD), with change in the distribution of dialysis modalities introduced over 5 years in the manner detailed in Table 8 above, will lead to net savings of between $378 and $430 million. Without good Australian data on utility-based quality of life on each dialysis modality, it is not possible to estimate the incremental benefits of the 'switch modality' scenarios. However, it is reasonable to assume that there would also be improvements in quality of life resulting from these changes.

Table 13: The present value costs and health benefits (out to 2020) of increasing the utilisation of both Home HD and PD services in Australia* (Incidence Model 1)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Total QALYs
Base Case	$8,304,274,654	-$430,248,725	125104.93	71528.19
Increased Home HD & PD utilisation	$7,874,025,929		125104.93	71528.19

* The savings produced through increasing the utilisation of both home haemodialysis (HD) and peritoneal dialysis (PD) services in Table 10 are dependent on achieving the targeted levels of modality utilisation, as detailed in Table 8. The modality changes are applied to patients commencing RRT from 2010.

Table 14: The present value costs and health benefits (out to 2020) of increasing the utilisation of both Home HD and PD services in Australia* (Incidence Model 2)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Total QALYs
Base Case	$7,371,435,405	-$378,242,694	112452.50	64543.34
Increased Home HD & PD utilisation	$6,993,192,711		112452.50	64543.34

* The savings produced through increasing the utilisation of both home haemodialysis (HD) and peritoneal dialysis (PD) services are dependent on achieving the targeted levels of modality utilisation, as detailed in the Table 8. The modality changes are applied to patients commencing RRT from 2010.

4.4.2 Increasing the rate of kidney transplantation

A cost-effectiveness and cost-utility analysis was also conducted to examine the incremental cost effectiveness ratio (ICER) of increasing transplant rates. A number of analyses were conducted for each incidence model, varying the increase in transplant rates (10% increase and 50% increase) and the cost of achieving these increases (assuming no additional resources required, and assuming a 5% increase in the cost of each transplant, to account for the likely extra resources required to achieve increased donation rates).

Under both models of projected ESKD incidence and alternative increases in the rate of kidney transplantation, the incremental cost effectiveness of increasing kidney transplants ranges from being dominant over current practice (i.e. less expensive and more effective than current practice) to ICERs of $25,661 per life-year saved (LYS) and $26,081 per quality-adjusted life-year (QALY) gained. Results are shown in Tables 15 to 18 and demonstrate that, even when accounting for estimated additional costs associated with achieving increased donor numbers, increasing the availability of donor organs represents excellent value for money, well within the ICERs of currently funded treatment and prevention programs. If the higher transplant rate is achieved (50% increase), the additional costs are more than offset by the reduction in costs associated with moving patients from dialysis.

Table 15: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 10% over current levels (Incidence Model 1)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Incremental life years	ICER	Total QALYs	Incremental QALYs	ICER
Base case	$8,304,274,654		125,104.93			71,528.19		
Increased transplant rate (no additional resources)	$8,290,257,510	-$14,017,145	125,734.92	629.99	Dominant	72,148.05	619.86	Dominant
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$8,320,441,112	$16,166,458	125,734.92	629.99	$25,661.44/LYS	72,148.05	619.86	$26,081.00/QALY

Table 16: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 50% over current levels (Incidence Model 1)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Incremental life years	ICER	Total QALYs	Incremental QALYs	ICER
Base case	$8,304,274,654		125,104.93			71,528.19		
Increased transplant rate (no additional resources)	$8,248,216,165	-$56,058,489	128,215.43	3,110.50	Dominant	74,570.06	3,041.87	Dominant
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$8,290,520,577	-$13,754,077	128,215.43	3,110.50	Dominant	74,570.06	3,041.87	Dominant

Table 17: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 10% over current levels (Incidence Model 2)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Incremental life years	ICER	Total QALYs	Incremental QALYs	ICER
Base case	$7,371,435,405		112,452.50			64,543.34		
Increased transplant rate (no additional resources)	$7,357,311,555	-$14,123,850	113,078.06	625.57	Dominant	65,158.84	615.49	Dominant
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$7,387,105,361	$15,669,956	113,078.06	625.57	$25,049.23/LYS	65,158.84	615.49	$25,459.24/QALY

Table 18: The present value costs and health benefits (out to 2020) of increasing the current transplant rate by 50% over current levels (Incidence Model 2)

Costs and benefits to 2020	Total cost	Incremental cost	Total Life Years	Incremental life years	ICER	Total QALYs	Incremental QALYs	ICER
Base case	$7,371,435,405		112,452.50			64,543.34		
Increased transplant rate (no additional resources)	$7,314,793,160	-$56,642,245	115,538.63	3,086.14	Dominant	67,561.34	3,018.00	Dominant
Increased transplant rate (assuming 5% additional resources required to achieve increased donor rates)	$7,356,570,369	-$14,865,035	115,538.63	3,086.14	Dominant	67,561.34	3,018.00	Dominant

Chapter 5 Challenges and opportunities

5.1 Implications of the projected future burden of ESKD in Australia: from here to 2020

In our previous report we projected that the cumulative cost of providing RRT to new and existing patients over the seven-year period from 2004 - 2010 would exceed $4 billion (2004 dollars). In the present analysis, we project that the cumulative cost of providing treatment to new and existing patients over the period from 2009 - 2020 will reach over $6 billion by 2015, and between $11.3 and $12.3 billion by 2020 (in 2009 dollars). The growth in projected treatment costs reflects projected growth in the underlying ESKD population, coupled with persistent under-utilisation of RRT modalities that are associated with lower costs and improved patient outcomes. Costs associated with each modality have been updated in the present analysis as more up-to-date Australian costing data were available, which clearly affects projected treatment costs. The ongoing costs of dialysis in the current report are different, and often higher, than previous values (for example an ongoing annual cost of hospital HD of $85,128 versus $82,764). This is largely due to more recent cost estimates being available, the incorporation of out-of-pocket expenses to patients, and the costs associated with newer pharmacological agents. The cost of transplantation in the first year of treatment was also higher in the current analysis compared to previous analyses, predominantly reflecting the higher costs of immunosuppressive regimes (including those used for induction and acute rejection) and more recent estimates of regimen utilisation to more closely reflect current clinical practice.

We project that the rate of new patients commencing RRT will increase by 35% to 81% to 2020, with most of this projected increase being driven by patients aged 75 years and over. The number of patients aged 75 years and over entering onto RRT could realistically as much as double, and these patients will be characterised by high rates of chronic comorbid conditions and are likely to be more complex and more expensive to treat. In the context of the growth in the elderly population requiring treatment for ESKD, and the need for better evidence regarding the balance of benefit versus harm in providing RRT for the very old, discussion of the role of conservative care in the treatment of ESKD will need to be given serious consideration. A dialysis pathway is unlikely to be the preferred option for all older patients.

Overall, according to our projections, the number of Australians receiving RRT could be as high as 30,293 by 2020. However, the substantial difference between the steady-state and growth prediction models should be acknowledged and would have significant implications for health service planning. The report has explained the assumptions underlying these different prediction models and has also shown that the linear growth models used in the earlier Kidney Health Australia report, which projected ESKD burden to 2010, were highly consistent with actual numbers of Australians subsequently commencing RRT.

The projected growth in the burden of ESKD necessitates a ‘whole of government’ approach to chronic disease prevention, early identification and intervention. Critical interventions

across the course of kidney disease can alter patient outcomes, starting with preventive action targeting CKD within the framework of a broader strategy for chronic disease prevention. Such action should be complemented by planning of RRT services to achieve RRT dialysis modality utilisation that maximises health gains from limited resources. The key question is how public sector funders and clinicians can overcome some of the financial and structural barriers, especially those affecting the ability to shift to home-based dialysis treatment and to increase the availability of organs for transplantation, to bring such changes into effect.

5.2 Key challenges to expansion of home-based dialysis in Australia

Home-based dialysis requires lower infrastructure and staffing ratios than hospital or satellite dialysis and is therefore less expensive to deliver, as shown in the present analysis. Home-based dialysis also avoids some of the psychosocial, financial and vocational pressures for patients and their families that are associated with less flexible treatment schedules and repeated travel to and from satellite and hospital dialysis units. Although it was not possible to estimate the incremental benefits of the 'switch modality' scenarios (i.e. from hospital HD to home-based dialysis), by enabling patients to access services as close to home as possible, it is likely that quality of life would also be improved. Observational data also suggest that home HD might be associated with a survival advantage over in-centre HD.[13]

Building sustainable home-based dialysis programs will require the support of an adequately developed and maintained infrastructure and workforce supply, and the provision of support networks for home dialysis patients. In particular, adequate resourcing of training for home HD and PD is essential, as long waiting lists for training in some jurisdictions represent a significant barrier to home-based dialysis. The inadequacy of home HD training staffing and facilities has previously been articulated in the Western Australian context, where excessively long waiting times for home training meant that patients, who would otherwise be suitable for self-care, were being treated in-centre.[22] This report indicates ongoing variation in the utilisation of home HD and PD across jurisdictions, clearly suggesting the potential to improve the uptake of community-based dialysis across the country. Problems for patients from rural and remote areas who must relocate to receive treatment at the nearest satellite unit have been well documented, and further research is needed to focus on health system barriers which need to be addressed to provide better access to people from rural and remote areas.

PD training can be accomplished in the home and while it is possible to also do this for home HD, the infrastructure changes necessary in the patient's home require a level of certainty regarding the success of the training program and the commitment from the patient. Therefore purpose-built home HD training facilities are necessary.

Home training units, with their higher staff: patient ratios, can be threatened when resources run short. Dedicated and protected funding for home-based dialysis programs will be required if we wish to make real and sustainable shifts from hospital-based treatment. In

[22] Ward M, Bishop J, Theile D, Deane S, Chalmers J, Cass A. Options for Clinical Services: A paper prepared by the Role Differentiation Project Group Clinicians for the Health Reform Committee to facilitate public discussion. Government of Western Australia, October 2003, Perth.

addition, the establishment of partnerships with the primary health sector for the support of home-based dialysis, particularly in rural and remote areas, might have significant benefits for patient management and improve clinical outcomes. With appropriate support, patients would be able to access services as close to home as possible and potentially draw better on their own family and community support networks.

To encourage patients to shift to self-care, it will be important to ensure that financial barriers to home dialysis are minimised. Supporting patients on home-based dialysis, and their carers, through access to financial assistance may ameliorate such risk. For example, infrastructure changes to patients' homes (such as minor works for plumbing and electrical upgrades) should be borne by the health system. In addition various forms of reimbursement for essential services should be considered as HD machines utilise considerable amounts of water and electricity. In some states reimbursements and discounts on outlays in essential services are provided by the relevant authority, while in other jurisdictions, the renal service may offer reimbursement based on a calculation of usage. Although these possibilities were not factored into the present analysis, ensuring that the financial barriers to home-based dialysis are minimised is an important aspect of the feasibility of strategies which seek to expand uptake of home-based dialysis therapies.

5.3 The critical role of kidney transplantation in meeting the needs of Australians with ESKD

Today, approximately one in six dialysis patients in Australia are waitlisted for kidney transplantation and approximately 6% of the dialysis population is transplanted each year. The primary barrier to kidney transplantation is a lack of donor organs: compared to 1,298 patients on the waiting list for a kidney transplant at 1 January 2009, 446 deceased donor kidney transplants were performed in that year. The shortage of organs from deceased donors also means that waiting times on dialysis have reached 4-7 years. The second key factor restricting access to transplantation is recipient suitability; as the average age and comorbidity profile of dialysis patients continues to increase, a greater proportion of those on dialysis are deemed medically unsuitable for transplantation.

Transplantation is the optimal and most cost-effective treatment for ESKD. Unlike other therapies, transplantation activities rely on deceased or living donors, hence the key factor limiting access to transplantation is the availability of donor organs, especially organs from deceased donors. Only certain types of organs can be donated by living persons; furthermore, living donation entails a risk to the donor, even if this risk is small and considered acceptable in selected cases. Maximising deceased donation rates is therefore a priority to optimise the cost effectiveness of ESKD treatment and to ameliorate the demand for living donation.

The most compelling strategy to improve outcomes for Australians with ESKD is to increase deceased donation rates. Transplants from living donors should also be facilitated as complementary to deceased donation, by providing appropriate regulation, protocols and donor care standards, and by encouraging novel strategies to expand the donor pool such as paired kidney exchange and ABO-incompatible transplantation. It must also be recognised that any strategies directed at improving rates of organ donation and transplantation must

be conceived within a broader public health approach that equally emphasises preventive measures to decrease the burden of CKD and ESKD in the population.

5.4 Steps to improved rates of kidney transplantation in Australia

As of December 2008, the kidney transplant rate in Australia was 38 pmp (deceased donor transplants 21.4 pmp, living donor transplants 16.6 pmp). We assessed the cost effectiveness of increases of 10% and 50% in the number of transplants performed in our incident modelled cohort of Australian ESKD patients. Increasing the rate of kidney transplantation by 50% was both cost-saving and associated with better patient outcomes, even when factoring a cost for coordination of organ procurement and transplantation services. To express this in terms of hypothetical numerical benchmarks (figures are for illustrative purposes and do not reflect exact modelled numbers), a 50% increase on 2008 rates would equal a total kidney transplant rate of 57 pmp. If this increase were to be entirely achieved through expansion of deceased donation, the annual rate of deceased donor kidney transplantation would need to increase to 40 pmp. Belgium, France, Portugal and Spain already perform deceased kidney transplants at a rate in excess of 40 pmp.[23] Norway, which provides transplantation as the first line of treatment to 75% of ESKD patients, has an annual deceased donation rate of 37.5 pmp, complemented by a living donor transplant rate of 20.4 pmp. Therefore a 50% increase in the kidney transplant rate in Australia, to be achieved predominantly through increases in transplants from deceased donors, is entirely consistent with international benchmarks.

Consent

One of the key challenges for the Australian Organ and Tissue Authority is to promote a national culture of organ donation, ushering normative change in public attitudes towards, and participation in, deceased organ donation. Australia's current family consent rate for organ and tissue donation is 58%, and this is a contributing factor to low rates of transplantation. The mass media campaign launched by The Authority in May 2010 urges those who wish for their organs and tissues to be donated after death to make this known to their family. Ongoing evaluation of the impact of this and future media campaigns, and the other activities of the Authority, will be required.

Maximising deceased donor potential

System performance in organ donation and transplantation depends on successful coordination across systems, designated authorities, hospitals and individuals involved in donor detection and management, organ procurement, allocation, donor and recipient follow-up, monitoring and surveillance, and regulation. With the establishment of the Australian Organ and Tissue Authority, Australia for the first time has a nationally coordinated approach to deceased donation and a central authority to oversee reforms intended to maximise donor potential.[24]

[23] http://www.transplant-observatory.org/

[24] http://www.donatelife.gov.au/The-Authority/Worlds-Best-Practice-Reform-Package/Nine-measures.html

Under the Authority, provision has been made for selected public and private hospitals to employ specialist Medical Directors and organ donation nurses, and these new positions are currently being rolled out. Funding will also be provided for hospitals to address the additional staffing, bed and infrastructure costs associated with organ and tissue donation, made available on an activity basis to reimburse additional medical care in the Emergency Department once a patient is identified as a potential donor, and additional medical care in the Intensive Care Unit for patients identified as potential donors and theatre costs associated with organ retrieval. Professional development and training programs and an ongoing national community education and awareness campaign have already commenced.

An important future development will be the implementation of clinical triggers and standard hospital protocols for the identification and referral of potential donors. Without clear clinical practice algorithms for the identification and conversion of potential donors to actual donors, opportunities for organ and tissue donation are easily missed. Reasons may include: (i) failure to identify a potential donor; (ii) failure to complete brain death diagnosis or declare death in an appropriate timeframe; (iii) family not being approached to request consent; (iv) logistical problems or inability to identify a compatible recipient; and (v) inadequate donor management.

One of the challenges for The Authority will be to effectively implement these reforms across the country. The ability of The Authority to implement the new organisational systems, additional intensive care unit beds and specialized staff necessary to support substantial growth of deceased donation rates will be, to some extent, dependent on the commitment of individual health services and State governments to these reforms.

Since the passage of brain-death legislation in Australia, the removal of solid organs for transplantation has been undertaken almost exclusively from donors who were deemed to be brain-dead (DBD) with persisting blood circulation. Over the past 5 years, both internationally and within Australia, the practice of organ removal for transplantation following circulatory death of the donor has been progressively adopted. A potential donor after cardiac death (DCD) is a person for whom the withdrawal of life support is planned because further treatment would be futile, but brain death has not yet occurred. After the withdrawal of life-support, the cessation of circulatory and respiratory function must occur within 2 hours for a viable organ to be recovered. It is the consensus of professional bodies internationally that both DBD and DCD should be supported in order to maximise organ availability. In late 2008, the Commonwealth Department of Health and Ageing, on behalf of all States and Territories, commissioned the National Institute of Clinical Studies (NICS) to draft a national protocol for organ donation after cardiac death. This draft protocol was released for public consultation on 24 June 2009, and was approved by the National Health and Medical Research Council in March 2010.

Compatibility issues

The Australian paired Kidney eXchange (AKX) program is an initiative of the Organ and Tissue Authority to increase the options for living kidney donation. Living-related kidney donation cannot proceed in about 30% of potential donor-recipient pairs due to incompatible blood group or tissue type (HLA). The AKX program aims to help patients seeking a kidney transplant whose potential living donor is unsuitable for them due to blood

group and/or tissue incompatibility. The AKX User Manual was endorsed by stakeholders in June 2010 and enrolment of donor-recipient pairs into the program officially started in July 2010, with a first match expected in September 2010.

Another method of addressing compatibility issues between potential donor-recipient pairs is ABO-incompatible transplantation. Blood group incompatibility would ordinarily lead to rapid graft loss due to antibody-mediated rejection. However, desensitisation protocols in ABO-incompatible pairs have shown excellent results in Japan, USA, Sweden and recently in Australia. Desensitisation typically involves pre-transplant antibody removal and the commencement of immunosuppression prior to transplantation. First performed in Australia in 2007,[25] ABO-incompatible transplantation might become an increasingly common form of transplantation in the future, thus increasing the number of living donor transplants that can proceed. Similar techniques have also enabled transplantation of kidneys from donors with previously incompatible tissue types, by removal of HLA antibodies.

5.5 The future of RRT and how this will affect the cost-effectiveness of dialysis and transplantation

This analysis combined the increased uptake of both PD and home HD in the same model, aiming to reflect a realistic and potentially achievable mix of dialysis modalities in the assessment of relative costs of service delivery, without being overly prescriptive. We recognise that targets for the increased uptake of PD and home HD mix should be tailored to the requirements of individual States and Territories. Furthermore, pursuit of the optimal mix of dialysis therapies should maintain sufficient flexibility to adapt to technological innovations, clinical developments, and changes in key characteristics of the treated population. For example, simpler and more user-friendly dialysis equipment is emerging that will make home HD increasingly accessible and acceptable to patients.[13]

The mortality associated with different dialysis modalities is dependent on time spent on treatment, age and presence of comorbidities.[26] The continuing trend of the prevalent ESKD population in Australia towards older age and greater burden of comorbid illness is therefore likely to alter the optimal mix of RRT modalities over time. Targets for PD, home HD and in-centre HD should be subject to periodic re-evaluation to take account of the changing needs of the patient population. Clinicians might also be increasingly called on to provide conservative care to older patients for whom dialysis would be unlikely to provide benefit in terms of survival and particularly quality of life, although where this threshold of benefit lies is not clear on the basis of existing evidence. There is an urgent need for evidence concerning treatment preferences and outcomes of ESKD under different treatment pathways in elderly patients.

Numerous clinical and technological advances will also affect the cost-effectiveness of transplantation in coming years. First, as the science and practice of transplantation and the management of donors and recipients improves, the effectiveness of transplantation

[25] Cohney S, Walker R, Haeusler M, Francis D, Hogan C. Blood group incompatibility in kidney transplantation: definitely time to re-examine! MJA, 2007;187(5):306-308

[26] McDonald S, Marshall M, Johnson D, Polkinghorne K. Relationship between dialysis modality and mortality. J Am Soc Nephrol, 2009;20:155-163

therapy should continue to increase. For example, a sustained reduction in rates of cardiovascular death in the first 10 years after kidney transplantation has been observed over the last two decades among recipients in Australia and New Zealand, despite increasing rates of comorbidity over this period, pointing to improved cardiovascular risk management.[27] Second, changes in clinical practice such as the ABO-incompatible program and next generation drugs will have cost implications as well as potentially improving patient outcomes. Several new agents that are postulated to address novel targets or have reduced toxicity are currently in the preclinical pipeline. Three of these — AEB071 (a protein kinase C inhibitor), JAK3 and belatacept — are now in phase 3 trials and are likely to come to market within the time frame of these projections. The cost consequences of these developments for transplantation are not known, but will be fairly immediate.[28]

5.6 Limitations of this analysis and future challenges

As previously, we did not undertake primary research to determine the costs and benefits of RRT; instead the best-available published evidence was used to model the costs and benefits of providing RRT to current and future ESKD patients. The present analysis uses published utilities based on a patient sample experiencing both dialysis and transplantation in the mid-1990s. It is possible that our analysis therefore underestimates the true extent of improvements in quality of life associated with the current practice of transplantation, and there remains a need for updated quality of life data concerning movement between RRT modalities. We did, however, have access to more current and comprehensive data on costs than were available at the time of our previous report. The NSW Dialysis Costing Study additionally accounts for ongoing out of pocket costs to patients and families and estimated costs associated with Home HD and PD training, which we were unable to include in our previous analysis. No accurate data are available on the costs of providing services in more remote areas, but it is likely these will be more expensive that the overall estimates in the NSW costing study. Similarly, with the ageing population, it is possible that the per-capita costs of providing each modality will increase with increasing age and comorbidity of the dialysis population.

Not included in the present analysis were costs related to other in-patient resource use, for example as a result of comorbidities such as diabetes, ischaemic heart disease or cancer, as this was not measured and costed as part of the NSW Dialysis Costing Study. International experience clearly demonstrates higher rates of hospital admission (and therefore costs) for a variety of infective and cardiovascular causes in dialysis patients.[29,30,31,32] Nor were productivity changes included in this analysis as no reliable Australian data are available to estimate the opportunity cost of lost productivity due to ESKD. It is likely that the

[27] Pilmore H, Dent H, Chang S, McDonald S, Chadban S. Reduction in Cardiovascular Death After Kidney Transplantation. Transplantation, 2010;89(7):851-857

[28] Vincenti F, Kirk A. What's next in the pipeline. Am J Transplant, 2008;8:1972-1981

[29] Collins AJ, Foley RN, Gilbertson DT, Chen SC. The state of chronic kidney disease, ESRD, and morbidity and mortality in the first year of dialysis. Clin J Am Soc Nephrol. 2009 Dec ;4 Suppl 1:S5-11.

[30] Mau L, Liu J, Qiu Y, Guo H, Ishani A, Arneson T, Gilbertson D, Dunning S, Collins A. Trends in Patient characteristics and first-year medical costs of older incident hemodialysis patients, 1995-2005. Am J Kidney Dis, 2010;55:549-557

[31] Bruns F, Seddon P, Saul M, Zeidel M. The cost of caring for end-stage kidney disease patients: an analysis based on hospital financial transaction records. J Am Soc Nephol, 1998:9:884-890.

[32] Lorenzo V, Perestelo I, Barroso M, Torres A, Nazco J. Economic evaluation of haemodialysis. Analysis of cost components based on patient-specific data. Nefrologia, 2010;30(4):403-412

incorporation of lost earnings and productivity would further substantiate the economic benefit of increasing the transplant rate and moving dialysis patients away from hospital HD to home-based modalities.

Our modelling of the cost-effectiveness of switching the proportion of current ESKD patients receiving different types of dialysis, the 'switch-modality' scenario, does not take account of any additional resources required to support the expansion of home-based dialysis. Such additional resource requirements may include support for infrastructure changes to patients' homes or reimbursement of water and electricity bills, or costs associated with establishing integrated multi-disciplinary networks to improve access to home training and provide ongoing support to patients in the community. The cost of these initiatives to support the future expansion of home HD should be the subject of specific feasibility and costing studies.

In the assessment of the incremental cost effectiveness ratios associated with increasing transplant rates, we factored in a 5% increase in the cost of each transplant to account for the likely extra resources required to achieve increased donation rates. These resource requirements relate to the maintenance of the transplantation coordination network currently being established by the Australian Organ and Tissue Authority, and could nominally finance ongoing positions for specialist Medical Directors, organ donation nurses, additional staffing, bed and infrastructure costs, reimbursements to emergency departments and intensive care units and professional development and training. The 5% figure is adapted from reported annual expenditure supporting the Spanish Transplant Coordination Network, which consists of a central national organization, regional offices and hospital transplant coordinators responsible for donor detection, evaluation and maintenance, liaising with families and coordination of procurement.[12]

In planning for the future of RRT service provision in Australia, the most significant knowledge gap relates to the current and future *total* burden of ESKD in Australia. Our understanding of the natural history and incidence of CKD remains limited, and while excellent registry data is available, the *total* burden of disease is not equivalent to *treated* disease. Planning of future service provision would be enhanced if comprehensive information were available on the progression of CKD in the population, the true incidence of ESKD in all age groups, the complexity of comorbidities, and the key drivers of the disease burden in the population. We also need better evidence regarding the benefits and harms of RRT provision in the elderly. These are vital areas for ongoing research. Finally, the planning of RRT services must confront issues of equity in access to home-based dialysis and transplantation. One key example is the persistent inequitable access to different forms of RRT by Indigenous Australians. We know what the challenges are, and it is now time to respond with service models that better address the needs of ESKD patients.

Chapter 6 Appendices

Appendix A – Undiscounted Costs

Costs

Table 19: Total undiscounted projected annual costs of treating all RRT patients for 2009 – 2020 ($ millions) (Incidence Model 1)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total annual costs (all patients)	$900.12	$994.77	$1,076.20	$1,155.69	$1,233.33	$1,314.14	$1,398.01	$1,484.81	$1,574.47	$1,667.02	$1,763.14	$1,862.92
Cumulative undiscounted costs	$900.12	$1,894.89	$2,971.09	$4,126.78	$5,360.10	$6,674.25	$8,072.25	$9,557.06	$11,131.53	$12,798.55	$14,561.69	$16,424.60

Table 20: Total undiscounted projected annual costs of treating all RRT patients for 2009 – 2020 ($ millions) (Incidence Model 2)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total annual costs (all patients)	$894.78	$980.18	$1,049.33	$1,112.90	$1,171.99	$1,231.15	$1,290.22	$1,348.95	$1,407.06	$1,464.40	$1,521.10	$1,576.79
Cumulative undiscounted costs	$894.78	$1,874.96	$2,924.30	$4,037.19	$5,209.18	$6,440.33	$7,730.55	$9,079.50	$10,486.56	$11,950.96	$13,472.06	$15,048.85

Appendix B – Model Methods

Details of rationale, methods and results

In order to determine the impact on costs and health outcomes of changes in the clinical management of ESKD, the current costs and benefits of treatment have been defined and estimated. A Markov model for treated ESKD patients was constructed, to which the existing patterns of RRT utilisation in Australia were applied in order to predict the future health care costs and health outcomes associated with treating new and existing ESKD patients for each year up to and including 2020.

6.1 Methods for the analysis of costs and benefits

The approach used in this analysis follows a previously developed and reported methodology for the analysis of costs and benefits of RRT in Australia.[4] Many of the data limitations identified in this earlier work are also applicable in the current analyses.

6.1.1 Costs

Dialysis costs

In the current analyses we have used the unit costs for each dialysis modality as estimated in the NSW Dialysis Costing Study, 2008.[33] Annual costs associated with each dialysis modality, as estimated in the NSW Dialysis Costing Study, are given in Table 6.

Transplant costs

The costs associated with transplantation include surgery and hospitalisation, immunosuppressive therapy, specialist review and consultations and other drugs. The recipient-associated cost of a kidney transplant (for a kidney obtained from either a living or a deceased donor) was based on Australian National Hospital Cost Data Collection Round 13: 2008-9 cost weights for Australian Refined Diagnosis Related Groups (AR-DRG) A09A (Renal Transplant + Pancreas or + complications and/or combmorbidities) /A09B (Renal Transplant without pancreas transplant or without comorbidities of complications) for a public hospital admission. As there is no specific AR-DRG code for donor-associated costs of kidney transplantation, an assumption was made based upon expert opinion to base the cost incurred for a living kidney donor on Australian NHCDC Round 13 public sector cost weights for AR-DRG codes L04A and L04C for kidney procedures. No ongoing costs have been included for living donors. The cost of organ procurement from a deceased donor was unavailable from published sources, and has been estimated at $3,000 based on expert opinion, although this is likely to be an underestimate and does not include costs associated with the coordination of organ procurement and allocation (such organisational costs were accounted for in separate sensitivity analyses). As with dialysis, there is little available data on renal and non-renal inpatient resource use in patients with a functioning transplant. As such these costs have not been estimated. The unit costs of RRT per patient per annum, by treatment modality, are summarised in Table 7.

[33] NSW Government (2009) *NSW Dialysis Costing Study, 2008: Volume 1: Main Report* NSW Department of Health: Sydney

Table 21: Regular immunosuppressive therapy in year 1 of transplant (AUD$2008 - 2009)

Drug	Average annual per patient cost	Proportion of patients taking each drug at each time point (ANZDATA)					Source
		Initial	1 month	3 months	6 months	12 months	
Aza	$1,167.17	0.00511	0.00296	0.01760	0.01851	0.04924	ANZDATA proportion on each individual drug 2008 Figure 8.54 p8-21 + special data request for 1,3, 6mo
CSA	$8,497.76	0.34782	0.35311	0.29929	0.35185	0.32575	
Tacrolimus	$20,260.70	0.61381	0.62611	0.65845	0.57407	0.54545	
MMF	$6,110.68	0.93094	0.89317	0.82746	0.7555	0.71212	
Sirolimus	$14,717.09	0	0.00593	0.01056	0.02222	0.04166	
everolimus	$9,948.09	0	0.00890	0.01408	0.03333	0.05303	
prednisolone	$204.48	0.99488	0.99703	0.99647	0.97777	0.943181	
MPA	$6,272.38	0.05626	0.08605	0.16197	0.17037	0.17803	
Proportion and time weighted cost	**$21,694**						

Table 22: Regular immunosuppressive therapy in subsequent years (AUD$2008 - 2009)

Drug	Average annual per patient cost	Proportion of patients taking each drug at each time point (ANZDATA)	Source
		24 months	
Aza	$1,160.81	0.055350554	ANZDATA proportion on each individual drug 2008 Figure 8.54 p8-21, 24 months
CSA	$3,891.92	0.298892989	
Tacrolimus	$8,539.14	0.531365314	
MMF	$3,055.34	0.763837638	
Sirolimus	$8,801.34	0.084870849	
everolimus	$6,632.06	0.092250923	
prednisolone	$81.79	0.915129151	
MPA	$6,272.38	0.110701107	
Total (all subsequent years)	**$10,226.71**		

Table 23: Additional immunosuppression in year 1 of transplant (AUD$2008 - 2009; induction and acute rejection)

Drug	Average cost per patient	Proportion of patients	Source
OKT3 (Muromonab CD3)	$9,240.00	0.012300123	ANZDATA 2009 report figure 8.56&8.57, p8-23/4
ATG Fresenius	$10,540.00	0.049200492	
Basiliximab	$6,300.00	0.926199262	
daclizumab (discontinued 2008)	$0.00	0	
intravenous Immunoglobulin	$5,508.00	0.167281673	
rituximab	$4,679.98	0.055350554	Butterly et al Int Med J 2010 40:443-452
Additional immunosuppression (Induction + acute rejection)	**$7,647.71**		

Other costs

Productivity changes have not been included in this analysis. There are no reliable Australian data that can be used to estimate the opportunity cost of lost productivity due to ESKD, therefore the present analysis has not included productivity changes.

6.1.2 Utility based quality of life (QoL)

Quality of life (QoL) is a significant factor when assessing the outcome of RRT from a patient's perspective. The extent to which one treatment modality provides patients with good physical, social and emotional well-being, and allows them independence, can be measured and valued using a preference-based measure of QoL such as the QALY (quality adjusted life year). This economic index of outcome combines patient survival with an adjustment for QoL, where the adjustment is based on an interval scale from 0 (worst health) to 1 (full health). Changes in QoL that may result from switching RRT modalities, for example from hospital to home HD or from dialysis to transplant, can be measured on the 0-1 scale and the impact of the change captured in the number of QALYs derived from each treatment modality.

Dialysis QoL

A number of QoL studies have been undertaken and reported among dialysis and transplant patients. The present economic model uses the utility-based QoL reported in a well designed pre- and post-transplant study by Laupacis et al in 1996.[34] Laupacis et al conducted an earlier study on 188 HD patients enrolled in a RCT of the effect of erythropoietin (EPO). The authors used one disease specific measure of QoL, the Kidney Disease Questionnaire, and two generic instruments, the Sickness Impact Profile (SIP) and the utility-based Time Trade-off (TTO) method. The results of the Laupacis study were: for HD and no EPO (at 6 months) the mean utility score was 0.42; with EPO and maintaining Hb 95-110g/L utility equals 0.51; with EPO and maintaining Hb 110-130g/L utility equals 0.58.[35] There is limited and somewhat inconsistent utility-based QoL information available on alternative dialysis modalities, and there is no published information available on QoL in Australian patients.

Russell et. al. (1992) used the TTO method to measure QoL for a group of 27 patients on dialysis who subsequently received a successful kidney transplant.[36] The mean utility score whilst on dialysis was 0.41. De Wit et al (1998) administered a series of QoL questionnaires alongside a clinical study of dialysis treatments in thirteen Dutch dialysis centres.[37] Three instruments were used: the EQ-5D Visual Analogue Scale, the TTO and the standard gamble (SG) technique. The mean utility scores (SG, TTO and EQ-5D) for each type of dialysis were: 0.84, 0.87 and 0.58 respectively for hospital HD; 0.91, 0.93 and 0.65 for satellite centre HD; 0.81, 0.86 and 0.61 for CAPD; and, for continuous cycling peritoneal dialysis (CCPD), were 0.74, 0.93 and 0.61. In a subsequent study, de Wit et al used two health profile (generic) instruments, the EQ-5D and the SF-36, and two utility-based instruments, the SG and TTO,

[34] Laupacis, A, Keown, P, Pus, N, et al, 1996, 'A study of the quality of life and cost-utility of renal transplantation', *Kidney International*, vol. 50, no. 1, pp. 235-42.

[35] Laupacis, A, Wong, C, Churchill, D. 1991, 'The use of generic and specific quality-of-life measures in hemodialysis patients treated with erythropoietin', *Control Clinical Trials*, vol. 12, no. 4 Suppl, pp. 168s-79s.

[36] Russell, J, Beecroft, ML, Ludwin, D, Churchill, DN. 1992, 'The quality of life in renal transplantation - a prospective study', *Transplantation*, vol. 54, no. 4, pp. 656-60.

[37] de Wit, G, Ramsteijn, PG, de Charro, FT. 1998, 'Economic evaluation of end stage renal disease treatment', *Health Policy*, vol. 44, no. 3, pp. 215-32.

to compare health-related QoL for HD and PD health states. A total of 135 dialysis patients participated in the study (69 on HD and 66 on PD). The mean utility scores for HD were 0.86 (SG) and 0.89 (TTO) and for PD 0.82 (SG) and 0.87 (TTO).[38] The SG and TTO scores were higher than previously published data, which lead the authors to speculate that their results reflect adaptation by patients to their current state of health on dialysis. Wasserfallen used the EQ-5D multi-attribute utility instrument to measure quality of life in Swiss dialysis patients.[39] The EQ-5D measures five dimensions of QoL, including mobility, self care, usual activity, pain/discomfort and anxiety/depression. At the time of the survey 419 respondents were receiving HD and 49 PD. The mean utility score for HD was 0.62 and the mean score for PD was 0.58. Churchill (1987, 1991) has published two studies in which the TTO method was used to derive utility scores for hospital HD (0.43), home HD (0.49) and peritoneal dialysis (0.56).[40,41] McFarlane et al (2003) used the SG technique in a survey of 24 patients to value patients' quality of life for home nocturnal haemodialysis (0.77) and in-centre haemodialysis (0.53).[42]

Transplant QoL

The most extensive QoL study done on transplant patients was that conducted by Laupacis et al (1996).[34] The TTO method was used to measure pre- and post-transplant QoL for 136 patients who were on dialysis when they entered the study. In addition to rating their own health status at baseline (on dialysis and pre transplant), then at 1 month and subsequently at 3, 6, 12, 18 and 24 months post transplant, patients were also asked at the same points in time to rate four hypothetical scenarios representing patients who were doing well and poorly on both dialysis and transplantation. The mean utility score pre-transplant was 0.57 (for the whole group) and 0.55 (for those patients on dialysis prior to transplant), and 0.68 (1 month), 0.71 (3 months), 0.75 (6 months), 0.74 (12 months), 0.70 (18 months) and 0.70 at 24 months. Moons et al (2003) used the EQ-5D to derive utility scores for 350 renal transplant recipients on a tacrolimus-based immunosuppressive regimen. The mean utility score for transplant patients on tacrolimus +/- steroids was 0.80 and 0.73 for those on tacrolimus + steroids + azathioprine.[43] Girardi et al (2004) used the TTO and SG to estimate the utility associated with return to dialysis after a graft failure. Based on the responses of 166 patients, the mean utility score was 0.59 for the SG and 0.57 for the TTO.[44] Most recently, Smith et al (2010) used the SF-36 instrument to measure QoL in 37 simultaneous pancreas and kidney transplant recipients pre-transplant and at 4 months, 1 year, 2 years and 3 years post transplant.[45]

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[38] de Wit, G, Merkus, MP, Krediet, RT, de Charro, FT. 2002, 'Health profiles and health preferences of dialysis patients', *Nephrology, Dialysis and Transplant*, vol. 17, no. 1, pp. 86-92.

[39] Wasserfallen, J, Halabi, G, Saudan, P, et al. 2004, 'Quality of life on chronic dialysis: Comparison between haemodialysis and peritoneal dialysis.' *Nephrology, Dialysis and Transplant*, vol. 19, no. 6, pp. 1594-9.

[40] Churchill, D, Torrance, GW, Taylor, DS, et al. 1987, 'Measurement of quality of life in end-stage renal disease: the time-trade-off approach.' *Clin Invest Med*, vol. 10, no. 1, pp. 14-20.

[41] Churchill, D, Wallace, JE, Ludwin, D, Beecroft, ML, Taylor, DW 1991, 'A comparison of evaluative indices of quality of life and cognitive function in hemodialysis patients', *Control Clinical Trials*, vol. 12, no. 4 Suppl, pp. 159s-67s.

[42] McFarlane, P, Pierratos, A, Redelmeier, DA. 2002, 'Cost savings of home nocturnal versus conventional in-centre hemodialysis', *Kidney International*, vol. 62, no. 6, pp. 2216-22.

[43] Moons, P, Vanrenterghem, Y, Van Hooff, JP, et al 2003, 'Health-related quality of life and symptom experience in tacrolimus-based regimens after renal transplantation: A multicentre study.' *Transpl Int*, vol. 16, no. 9, pp. 653-64.

[44] Girardi, V, Schaedeli, F, Marti, HP, Frey, FJ, Uehlinger, DE. 2004, 'The willingness of patients to accept an additional mortality risk in order to improve renal graft survival', *Kidney International*, vol. 66, no. 1, pp. 375-82.

[45] Smith G, Trauer T, Kerr P, Chadban S. Prospective quality of life monitoring of simultaneous pancreas and kidney transplant recipients using the 36-item short form health survey. Am J Kidney Dis. 2010 Apr;55(4):698-707.

We were specifically interested in the change in QoL from dialysis to kidney transplant, however, as with previous analyses, there is limited published Australian data of pre- and post-kidney transplant QoL using appropriate instruments. The TTO derived utility scores from Laupacis et al for the pre-transplant dialysis state and the post-transplant state (using a weighted average of QoL score over 0-12 and 12-24 months post transplant) have been used to value outcomes in this study. Other studies have measured dialysis-specific quality of life, but the methods and values vary to such an extent that the measures of utility-based QoL are not comparable between modes of dialysis treatment. The health utility scores for dialysis, post- transplant states are summarised in Table 5.

6.2 The model structure and assumptions

A Markov model was constructed as the basis for estimating the costs and benefits of RRT in Australia. This model is based upon the general structure (including some assumptions) of an earlier model used to estimate costs and health outcomes of RRT, with transition probabilities based upon an updated patient cohort from 2004 - 2008.

The model follows a cohort of men and women newly treated for ESKD, along with existing RRT patients. The length of each 'treatment' cycle in the model is one year. The structure of the model is shown in detail in Figure 12 and Figure 13. The first diagram represents the pathway for patients undergoing their first year of any type of RRT. The second diagram represents the pathway for patients undergoing any type of RRT in the second and subsequent years. Treatment and outcomes are shown in the elliptical shapes, and arrows show the transitions that can occur. The model is stratified by the following age groups:

- 25-44 years
- 45-64 years
- 65-74 years
- 75 years and older

6.2.1 Main assumptions

The health states and pathways are the same for all types of ESKD. The treatment and outcome states in the ESKD model are as follows:

- Dialysis: includes hospital HD, home HD, satellite HD and PD.
- Functioning kidney transplant: patients may undergo a pre-emptive transplant from a live donor after diagnosis of ESKD or receive a first transplant following dialysis.
- Transplant outcomes: graft success or failure. A graft failure may result in a re-graft, a return to dialysis or death.
- Death: may occur whilst on dialysis or after transplant.
- Transition probabilities for year 0 to year 4 are based on the actual treatment and outcome probabilities derived from a cohort of incident RRT patients (2004-2008) from ANZDATA (for the entire Australian Indigenous and non-Indigenous cohort over this period).
- Transition probabilities from year 4 onwards are based on the application of constant year 4 transition probabilities.
- Total resource utilisation and benefits are calculated based on probability transitions at 6 months in each treatment cycle.

- Future projected incidence of treated ESKD in Indigenous and non-Indigenous patients is based on data from ANZDATA and ABS (see Chapter 2).

Other parameters included in the model are:

- Costs of each treatment modality.
- Utility weights (QoL assessments) associated with the outcomes of each treatment modality (based on Laupacis et. al. 1996[34]).
- The present value of all future costs and benefits was used (discounted at 5% per annum).

Figure 12: Markov model for ESKD patients in the first year of treatment (yr 0)

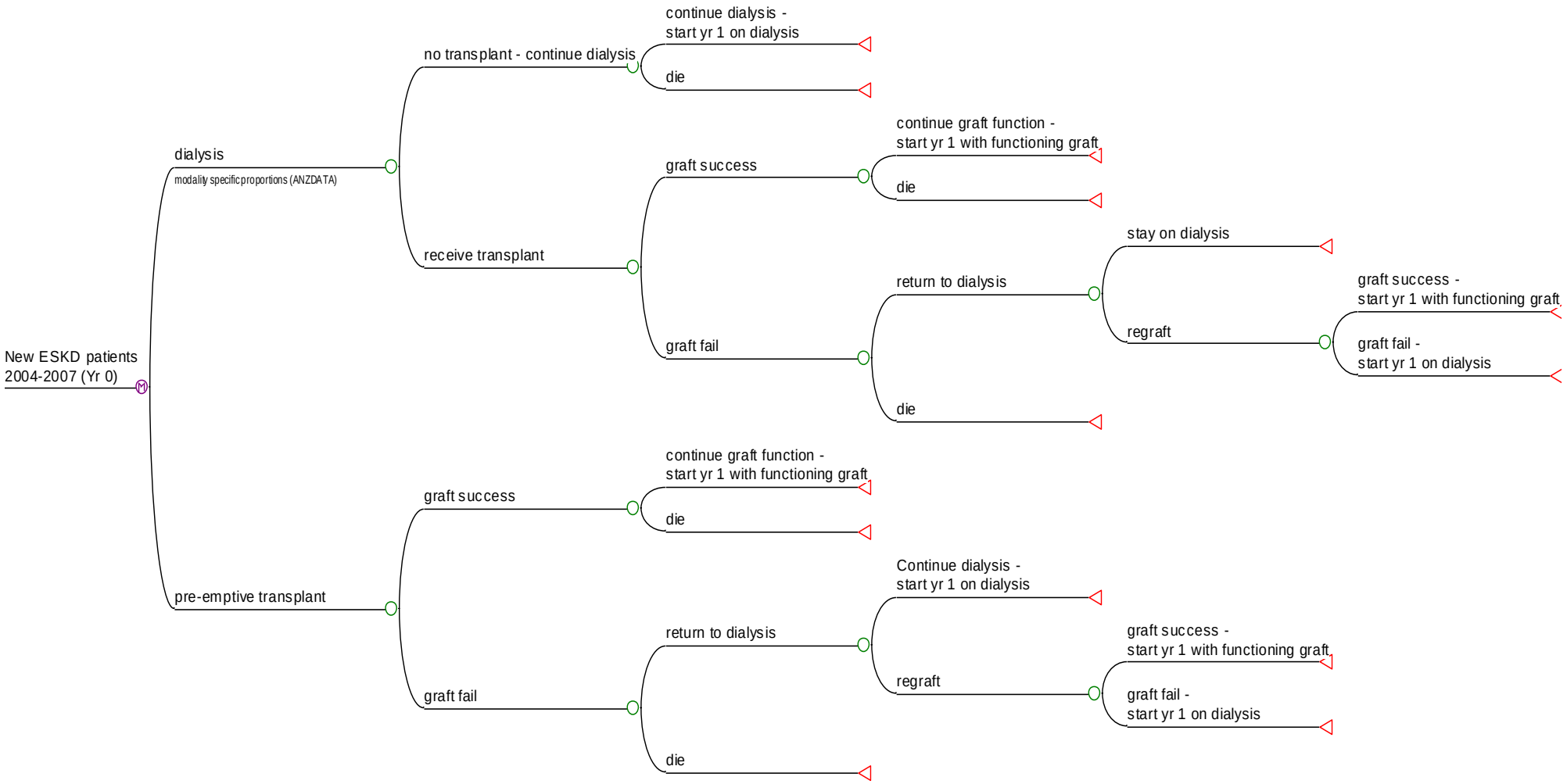
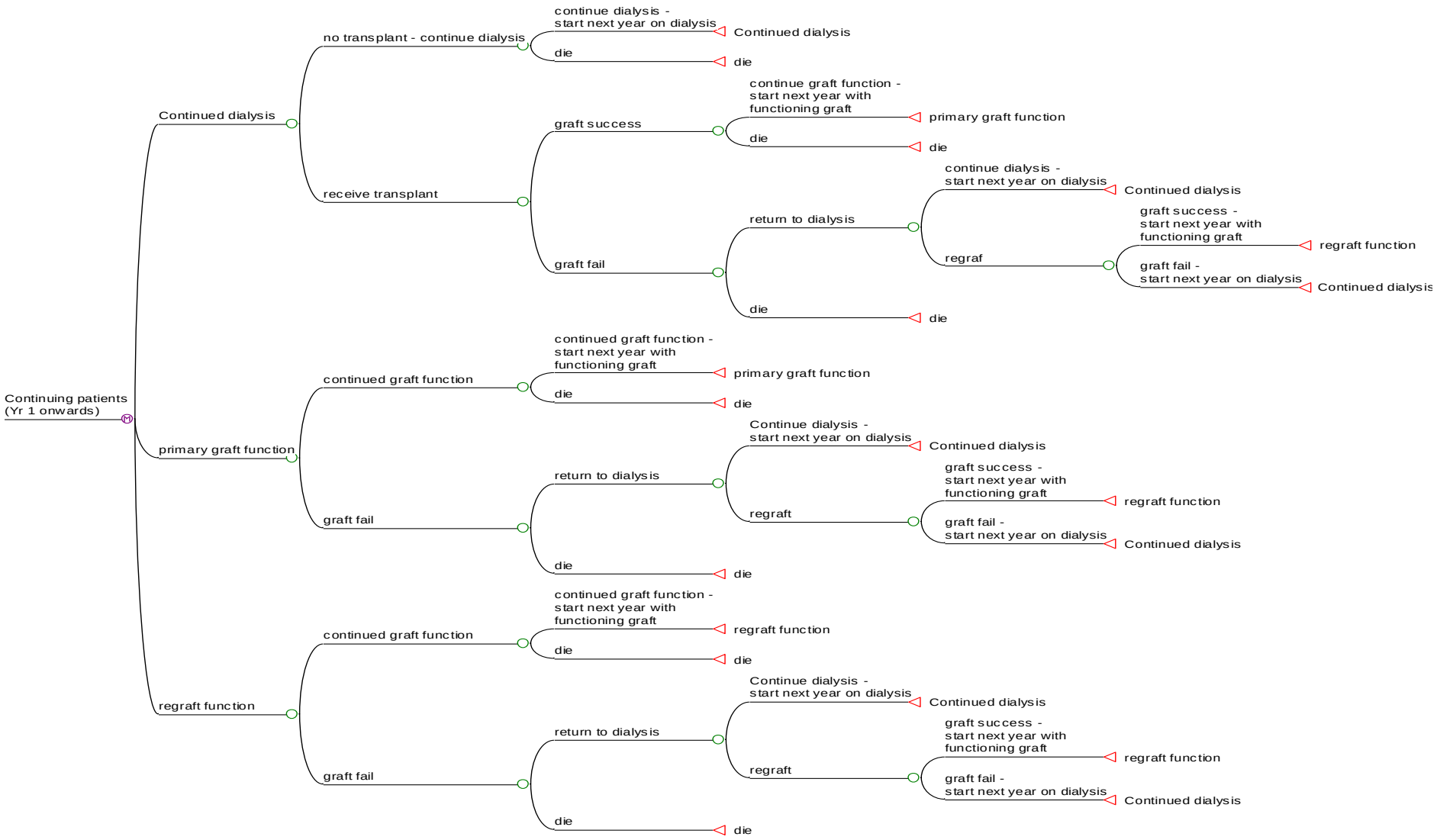


Figure 13: Treatment and outcome in the 2nd and subsequent years (yr 1 onwards)



6.2.2 Transition probabilities

Published Australian data on the probability of an ESKD patient undergoing a particular type of RRT, on the probability of switching between treatment modalities, and on the outcomes of this transition were not available. For that reason a dedicated secondary data analysis was conducted, assessing data on the RRT modality received and treatment outcomes for the cohort of ESKD patients commencing RRT in the period 2004-2008, as recorded in the ANZDATA Registry. The data were grouped by age (25-44 years, 45-64 years, 65-74 years, and 75 years and older) and Aboriginality. An annual transition probability was estimated for each of the first four years of treatment, with the year 4 rate applied as a constant transition probability from year 5 onwards. All transitions between states occur at 6 months (that is, midway through the yearly cycle).

As an example, Tables 24 to 28 indicate, for the 25-44 aged non-Indigenous cohort, the total number of patients in each modality at the beginning and end of each model year. Comparable data was used for older patients and Indigenous patients. Figure 14 shows current (31 December 2008) Australian patterns of RRT modality usage by number of years on RRT, as recorded by ANZDATA.

Table 24: Modality transitions, non-Indigenous patients 25-44 years, Year 0

	Starting RRT modality				
Modality at 31 Dec of Year 0	Hospital	Satellite	PD	Preemptive transplant	Total
Hospital HD	487	0	7	0	494
Satellite HD	145	60	3	0	208
Home HD	35	8	0	0	43
PD	96	1	341	0	438
Functioning transplant	33	2	13	149	197
Loss to follow up	1	0	0	0	1
Recovered renal function	3	0	0	0	3
Dead	8	0	2	0	0
Total	808	71	366	149	1394

Table 25: Modality transitions, non-Indigenous patients 25-44 years, Year 1

	Modality at 31 Dec of year 0					
Modality at 31 Dec of Year 1	Hospital HD	Satellite HD	Home HD	PD	Functioning transplant	Total
Hospital HD	69	4	0	19	0	92
Satellite HD	123	71	0	27	0	221
Home HD	49	37	34	8	0	128
PD	49	7	0	189	1	246
Functioning Transplant	73	35	5	95	151	359
Loss to follow up	0	2	0	0	0	2
Recovered renal function	5	0	0	7	0	12
Dead	28	8	1	12	0	49
Total	396	164	40	357	152	1109

Table 26: Modality transitions, non-Indigenous patients 25-44 years, Year 2

	Modality at 31 Dec of year 1					
Modality at 31 Dec of Year 2	Hospital HD	Satellite HD	Home HD	PD	Functioning transplant	Total
Hospital HD	35	6	1	12	0	54
Satellite HD	9	108	3	13	0	133
Home HD	2	14	69	4	0	89
PD	2	6	0	93	0	101
Functioning Transplant	14	32	21	46	257	370
Loss to follow up	0	1	1	0	0	2
Recovered renal function	0	1	0	3	0	4
Dead	9	4	0	7	2	22
Total	71	172	95	178	259	775

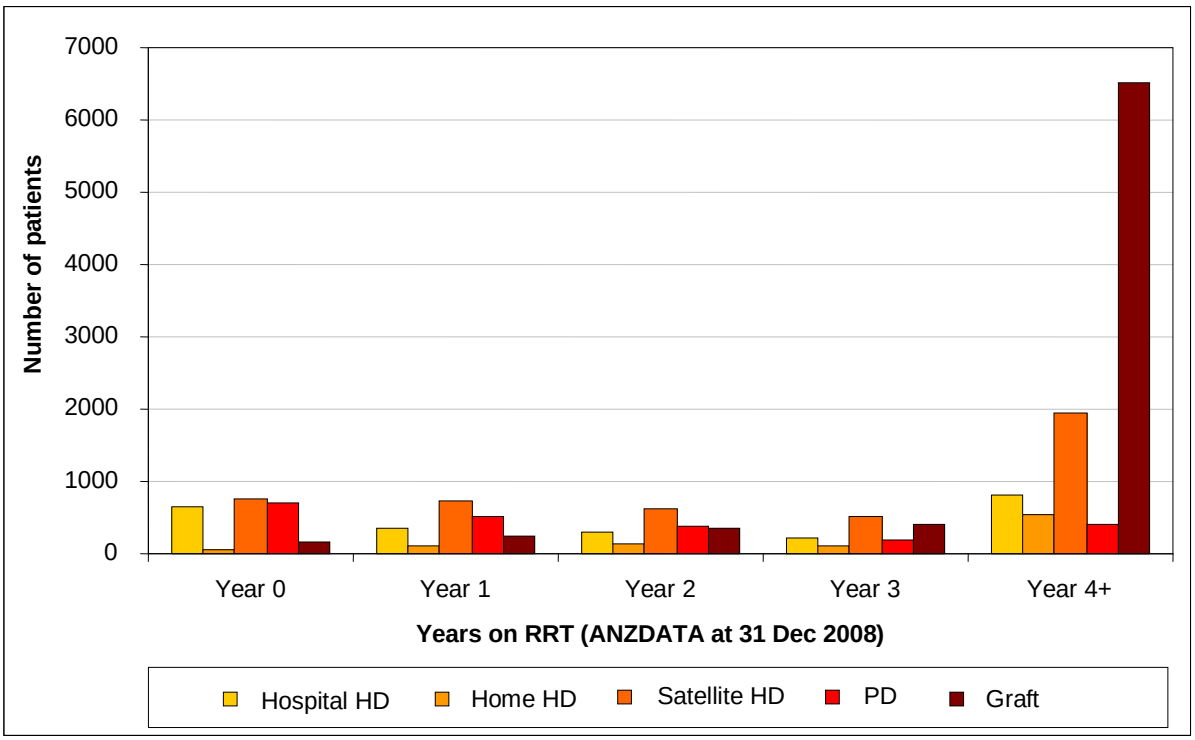
Table 27: Modality transitions, non-Indigenous patients 25-44 years, Year 3

	Modality at 31 Dec of year 2					
Modality at 31 Dec of Year 3	Hospital HD	Satellite HD	Home HD	PD	Functioning transplant	Total
Hospital HD	22	2	1	3	1	29
Satellite HD	5	60	1	3	1	70
Home HD	4	3	44	2	0	53
PD	2	1	0	31	1	35
Functioning Transplant	7	13	10	19	235	284
Loss to follow up	0	0	0	0	0	0
Recovered renal function	0	0	0	0	0	0
Dead	1	6	1	4	2	14
Total	41	85	57	62	240	485

Table 28: Modality transitions, non-Indigenous patients 25-44 years, Year 4+

	Modality at 31 Dec of year 3					
Modality at 31 Dec of Year 4	Hospital HD	Satellite HD	Home HD	PD	Functioning transplant	Total
Hospital HD	10	0	0	1	2	13
Satellite HD	2	30	1	2	2	37
Home HD	0	3	19	0	0	22
PD	0	0	0	9	1	10
Functioning Transplant	2	5	2	0	128	137
Loss to follow up	0	0	0	0	0	0
Recovered renal function	0	0	0	0	0	0
Dead	1	1	1	2	0	5
Total	15	39	23	14	133	224

Figure 14: Pattern of RRT modality usage by years on RRT in existing Australian patients aged 25 years and older (at December 2008)



6.3 Calculation of present value of costs and benefits

6.3.1 Costs and health outcomes of prevalent and incident patients

The formula for calculating the present value of the cost of treating current ESKD patients is summarised in Equation 1. The prevalent cohort is based on the number of ESKD patients in Australia, by modality of treatment, as recorded on the ANZDATA registry to end December 2008. Patients are followed up until the end of 2020.

Prevalent Patients

Equation 1

$$PVTC_p = \int_{t}\int_{2005\,prevalentcohort} \sum_{n=13} (P_{1tp})\,[(P_{2tp})\,(C_{2p}) + (P_{3tp})\,(C_{3p})]$$

$PVTC_p$	=	present value of the total cost of treatment for the ESKD prevalent cohort as at 2009 out to end 2020
$P1_{tp}$	=	probability of being alive in year *t*
$P2_{tp}$	=	probability of having dialysis in that year
C_{2p}	=	present value of the annual cost of dialysis (by modality)
P_{3tp}	=	probability of having a kidney transplant in that year
C_{3p}	=	present value of the annual cost of transplant (by type of transplant)

Incident Patients

The formula for calculating the present value of the cost of treating new ESKD patients (2009 to 2020) is summarised in Equation 2.

Equation 2 :

$$\mathbf{PVTC_i} = \sum_{\int t \int 2006-2017 incidentcohort}^{n=13} (P_{1ti})\,[(P_{2ti})\,(C_{2i}) + (P_{3ti})\,(C_{3i})]$$

$PVTC_i$	=	present value of the total cost of treatment for the ESKD incident cases out to end 2018
P_{1ti}	=	probability of being alive in year *t*
P_{2ti}	=	probability of having dialysis in that year
C_{2i}	=	present value of the annual cost of dialysis (by modality)
P_{3ti}	=	probability of having a kidney transplant in that year
C_{3i}	=	present value of the annual cost of transplant (by type of transplant)

Benefits are calculated using a similar formula, where the present value of annual cost of dialysis and transplant in Equation 1 is replaced by the present value of the health outcomes (life years and QALYs) generated by dialysis and transplant.

The total present value of cost and benefits of treating existing and new cases of ESKD projected out to end 2020, is the sum of Equation 1 and 2 ($PVTC_p + PVTC_i$)

6.3.2 Costs and health outcomes of alternative service provision distribution

A number of analyses have also been conducted to examine the effect of changing patterns of RRT modality on costs and health outcomes. Specific questions address the effect of increasing transplant rates, and the effect of different proportions of patients receiving alternative dialysis modalities.

Increasing the proportion of new ESKD patients who receive a kidney transplant

The formula for estimating the incremental cost effectiveness of increasing the number of new ESKD patients who receive a kidney transplant by between 10% and 50% over current levels is summarised in Equation 3.

Equation 3:

$$\mathbf{ICER_{transplant} = (TC_{low/high\ transplant\ increase} - TC_{current\ practice}) \div (TB_{low/high\ transplant\ increase} - TB_{current\ practice})}$$

$TC_{low/high\ transplant\ increase}$	=	the total cost of treatment for the ESKD incident cohort out to 2020 assuming an increase in the number of transplants by 10% to 50% (and concomitant reduction in dialysis rate)
$TC_{current\ practice}$	=	the total cost of treatment for the ESKD incident cohort out to 2020 with current transplant rates
$TB_{low/high\ transplant\ increase}$	=	the total number of LY or QALYs for the ESKD incident cohort out to 2020, assuming an increase in the number of transplants by 10% to 50% (and concomitant reduction in dialysis rate)
$TB_{current\ practice}$	=	the total number of LY or QALYs out to 2020 for the ESKD incident cohort with current transplant rates

Changing the proportion of new ESKD patients who receive different dialysis modalities

The formula for estimating the incremental cost effectiveness of switching the proportion of current ESKD patients receiving different types of dialysis is summarised in Equation 4. The proportion of patients receiving each dialysis modality in each year under this sensitivity analysis is shown in Table 8. As the utility based QoL is the same for each dialysis modality, we have assumed no additional health benefits are gained from any modality shifts. This is likely a conservative assumption.

Equation 4:

Cost (saving) = ($TC_{current\ practice} - TC_{switch\ mode\ of\ dialysis}$)

$TC_{current\ practice}$	=	the total cost of treatment for the ESKD incident cohort
$TC_{switch\ mode\ of\ dialysis}$	=	the total cost of treatment for the ESKD incident cohort assuming the changes in dialysis modality as specified below

List of Footnotes

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資料4

Chronic Kidney Disease (CKD) Management in General Practice

Kidney Health Australia

Guidance and clinical tips to help identify, manage and refer patients with CKD in your practice

3rd Edition 2015 • www.kcat.org.au

Prevent, Detect, Support.

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Key clinical tips

Management of early CKD includes steps to reduce cardiovascular disease risk. Recommend lifestyle changes and prescribe ACE Inhibitors or ARBs to lower blood pressure and slow the progression of albuminuria.

People with moderate or severe CKD, defined as persistently having a urine ACR >25 mg/mmol (males) or >35 mg/mmol (females) or eGFR <45 mL/min/1.73m^2, are considered to already be at the highest risk (>15% probability in five years) of a cardiovascular event, and therefore should not be assessed using the absolute cardiovascular risk tool. Failure to recognise the presence of moderate to severe CKD may lead to a serious under-estimation of CVD risk in that individual.

ACE inhibitors and ARBs cause a reversible reduction in glomerular blood flow and GFR can decline when treatment is initiated. Provided the reduction is less than 25% within two months of starting therapy, the ACE inhibitor or ARB should be continued. If the reduction in GFR is more than 25% below the baseline value, the ACE inhibitor or ARB should be ceased and consideration given to referral to a Nephrologist.

CKD in itself is not a diagnosis. Attempts should be made to identify the underlying cause of CKD.

If eGFR is < 60 mL/min/1.73 m^2, retest within 7 days and consider:

- *clinical situations where eGFR results may be unreliable and/or misleading*
- *acute kidney damage*

Anyone with rapidly declining eGFR and/or signs of acute nephritis (oliguria, haematuria, acute hypertension and oedema) should be regarded as a medical emergency and referred without delay.

The combination of ACE inhibitor (or ARB), diuretic and NSAID or COX-2 inhibitor (except low-dose aspirin) can result in acute kidney injury (the "triple whammy"), especially if volume-depleted or CKD present. Ensure individuals on blood pressure medication are aware of the need to discuss appropriate pain relief medication with a General Practitioner or Pharmacist.

ACE inhibitors and ARBs may be temporarily discontinued during acute illness, but should be recommenced when the condition stabilises.

An eGFR < 60 mL/min/1.73 m^2 is common in older people, but is nevertheless predictive of significantly increased risks of adverse clinical outcomes, and should not be considered physiological or age-appropriate.

Care of elderly patients with CKD requires an individualised approach to address comorbidities, together with variability in functional status, life expectancy and health priorities.

Stone recurrence can be prevented in the majority of patients who comply with a regimen that is devised after initial evaluation of the stone type and the risk factors present in the individual.

The Australian Kidney Foundation
Trading as Kidney Health Australia
ABN 37 008 464 426 | Charity No. CH 0614

How to use this booklet

This booklet has been specifically designed to be easy to use and interactive. The front/back cover can be removed and used as a quick reference guide. Relevant links to patient fact sheets, websites, and additional resources are interspersed throughout the booklet.

This booklet is available in hard copy and electronic soft copy (free download from www.kidney.org.au). The electronic copy contains interactive hyperlinks, and all tables, algorithms and figures are also available as individual downloads.

Resources for you

CKD education

Kidney Health Australia provides accredited education for health professionals through our Kidney Check Australia Taskforce (KCAT) program. Accredited (RACGP, ACRRM, ACN, APNA) face to face and online learning modules are available free of charge to Australian health professionals.

KCAT education sessions support the recommendations made in this booklet and will facilitate translating these recommendations into best practice detection and management of CKD in primary care.

If you would like to undertake some education related to the contents of this booklet, please visit www.kcat.org.au for further information.

CKD Management in General Practice App

CKD-Go! is a free web-based app that allows you to view a personalised CKD Clinical Action Plan based on an individual's eGFR and urine albumin creatinine ratio results. Smart-phone compatible, the app can be viewed and downloaded at www.kidney.org.au.

Resources for your patients

Kidney Health Australia has a suite of brochures, health fact sheets, publications and self-management resources that give precise, up to date health promotion and disease prevention messages. A range of translated resources is also available.

Recommended consumer resources for people with early stages of CKD:

- Fact sheet: All about chronic kidney disease
- Fact sheet: Looking after yourself with chronic kidney disease
- Fact sheet: eGFR
- Fact sheet: How to look after your kidneys
- Publication: Back on the Menu

Recommended consumer resources for people with later stages of CKD:

- Fact sheet: Common kidney disease symptoms and management options
- Fact sheet: Treatment options
- Publication: Living with Kidney Failure
- Publication: Back on the Menu

Visit www.kidney.org.au to download a pdf or request a hard copy.

Foreword

This third edition of Chronic Kidney Disease (CKD) Management in General Practice is the synthesis of the evolving evidence that the management of kidney disease matters. The Kidney Check Australia Task Force (KCAT) -now in its 13th year- has produced this book in the hope that practitioners will find the recommendations helpful in individuals at risk or with kidney disease and above all be inspired to identify kidney disease in their patients. I wish to acknowledge Professor David Johnson – Chair of KCAT for the last 9 years - who has provided strong and consistent leadership without which KCAT may well have faltered.

Three facts drive KCAT in its task. The outstanding fact, confirmed in the recent Australian Health Survey, is that evidence of kidney disease exists in 10% of Australian adults yet only one in ten of those with it are aware of that fact. Truly this is a silent and under-recognised condition. Increased recognition of kidney disease in high risk people is our top priority and this can only realistically happen in the general practice setting.

The second fact is that even early kidney disease is associated with increased morbidity and mortality and this can be impacted by using the clinical action plans outlined in this book. The kidney world is waiting on a specific fix or treatment for kidney disease, hopefully applicable to most people at risk of progression, but until that comes much can be done that is effective and affordable.

Thirdly, to put this in perspective there is building high-level evidence that the presence of CKD is a greater risk factor for cardiovascular disease than is diabetes. Kidney disease is not just another risk – it is a strong and independent risk factor that when identified and managed properly will contribute significantly to the striking and continuing fall in cardiovascular mortality in Australia.

Our only hope of reducing the burden of kidney disease is to better identify and manage individuals with this condition. Our hope is that this book, wholly evidence-based and presented in a summary, practical style, will add to the ability of general practitioners to take on this task.

I must thank Dr Marie Ludlow who again used her great skill in collating the evidence, drawing all the contributions together and writing this book whilst maintaining unfailing good humour and positivity. The kidney world is in her debt.

Associate Professor Tim Mathew
AM, MBBS, FRACP

National Medical Director
Kidney Health Australia

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What's new?

The 3rd edition of CKD Management in General Practice contains new sections on management of ***acute kidney injury*** (see page 28), and ***kidney stones*** (see page 30) as a response to demand for information about these common conditions.

Australian statistics show that for every new individual treated with dialysis or transplant there is one who is not, with the majority of these being elderly individuals[1]. Additional sections on ***treatment for Stage 5*** CKD (including greater acknowledgement of the non dialysis supportive care pathway) (see page 24), ***advance care plans*** (see page 26), and ***CKD in the elderly*** (see page 27) provide important primary health care education on these issues.

Shared decision making is a concept that is gaining traction in Australian clinical practice, and a new section on page 26 provides guidance on this topic.

There have been no changes to the key recommendations regarding detection and management of CKD from the 2nd to the 3rd edition, with targeted early detection using the 3-step ***Kidney Health Check*** (eGFR, urine ACR, blood pressure) (see page 11) still best practice.

The publication of the Kidney Disease: Improving Global Outcomes (KDIGO) guideline on ***lipid management*** in CKD[2] recommended lipid lowering medications for many people with CKD, and removed the recommendation to use statins to achieve specified lipid targets[2]. The new guidance adopts a 'set and forget' approach whereby prescription of statin or statin/ezetimibe combination is based on age, eGFR level, and cardiovascular disease risk, irrespective of CKD stage (see page 41). Once statin therapy (or combination statin/ezetimibe) is initiated there is no evidence to support ongoing monitoring of lipid levels.

The new anticoagulants (apixaban, dabigatran, rivaroxaban) have also been added to the list of ***commonly prescribed drugs*** that may need to be reduced in dose or ceased in CKD, and additional prescribing information regarding non loop diuretics and loop diuretics has been added (see page 21).

New resources that support the CKD Management in General Practice book include a web-based app (CKD-GO!), downloadable care plan templates, and sample referral letters.

Visit www.kcat.org.au to view these resources.

Why worry about chronic kidney disease (CKD)?

CKD is defined as the occurrence of kidney damage and/or reduced kidney function that lasts for three months or more.

In Australia, CKD is:

Common

- Approximately 1.7 million Australians (1 in 10) aged 18 years and over have indicators of CKD such as reduced kidney function and/or albumin in the urine[3].
- Fewer than 10% of the people with CKD are aware they have this condition[4].
- This means over 1.5 million Australians are unaware they have indicators of CKD.

How much CKD in Australia?

1 in 1400 on dialysis or living with a transplant

Harmful

- Kidney and urinary tract diseases are the 9th leading cause of death in Australia, killing more people each year than breast cancer, prostate cancer and road deaths[5].
- CKD is a stronger risk factor for future coronary events and all-cause mortality than diabetes[6].

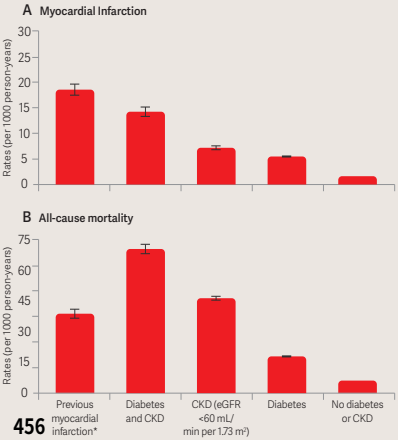
Treatable

- Early management of CKD (lifestyle changes, prescription of ACE inhibitors or ARBs) includes cardiovascular disease risk reduction.
- If CKD is detected early and managed appropriately, then the otherwise inevitable deterioration in kidney function can be reduced by as much as 50% and may even be reversible[7].

Clinical tip

Management of early CKD includes steps to reduce cardiovascular disease risk. Recommend lifestyle changes and prescribe ACE Inhibitors or ARBs to lower blood pressure and slow the progression of albuminuria.

Risk of coronary events and all-cause mortality according to the presence or absence of CKD, diabetes, and previous myocardial infarction [6]



Who is at risk of CKD?

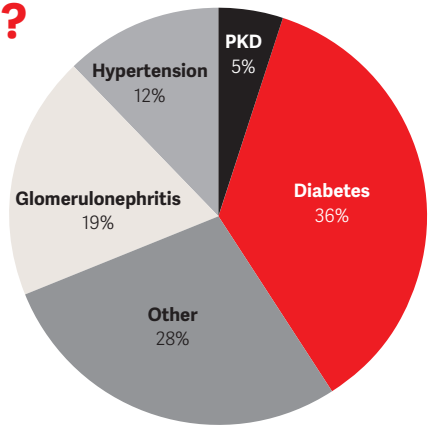
Adult Australians are at increased risk of developing CKD if they[8]:

- have diabetes
- have hypertension
- have established cardiovascular disease
- have a family history of kidney failure
- are obese (body mass index ≥ 30 kg/m^2)
- are a smoker
- are 60 years or older
- are of Aboriginal or Torres Strait Islander origin
- have a history of acute kidney injury (AKI)

What are the causes of end stage kidney disease (ESKD)?

The most common causes of ESKD in Australia are[9]:

- diabetic kidney disease
- glomerulonephritis
- hypertensive vascular disease
- polycystic kidney disease (PKD)



Clinical presentation of CKD

CKD is generally asymptomatic.

- Up to 90% of kidney function may be lost before symptoms are present, so annual checking of those at risk is essential.
- People with CKD may not notice any symptoms until they reach Stage 5 CKD (see Staging Table on page 19).

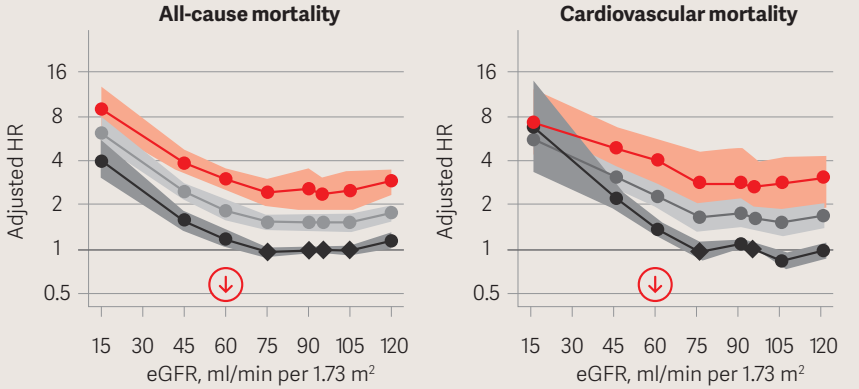
The first signs of CKD may be general, and include but are not limited to:

- hypertension
- pruritus
- nocturia
- restless legs
- haematuria
- dyspnoea
- lethargy
- nausea/vomiting
- malaise
- anorexia

CKD and cardiovascular disease

- CKD is a more important risk factor for cardiovascular disease than diabetes[6].
- Both reduced eGFR and significant albuminuria are independent risk factors for cardiovascular disease[10].
- Recent studies have confirmed that even early CKD constitutes a significant risk factor for cardiovascular events and death[11].
- For people with CKD, the risk of dying from cardiovascular events is up to 20 times greater than the risk of requiring dialysis or transplantation[12].

Higher urinary albumin excretion increases relative risk of all-cause mortality and cardiovascular mortality at all levels of eGFR[10]



Black - normal albuminuria • **Grey** - microalbuminuria • **Red** - macroalbuminuria
HR = Hazard Ratio for mortality

Absolute cardiovascular risk assessment[13, 14]

- A comprehensive risk assessment, using an absolute risk approach, is recommended to assist general practitioners effectively manage their patient's cardiovascular risk by providing a meaningful and individualised risk level.
- Absolute risk is the numerical probability of an event occurring within a specified period, expressed as a percentage. For example, if your patient's risk is 15%, there is a 15% probability that they will experience a cardiovascular event within 5 years.

How to assess absolute cardiovascular risk

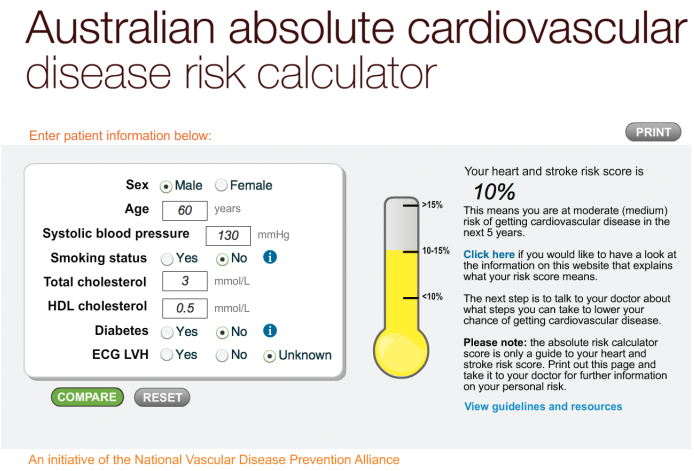
Who to target for risk assessment	All adults aged ≥45 years (or ≥ 35 years if of Aboriginal and Torres Strait Islander origin) *without* existing cardiovascular disease or other clinically determined high risk factor

Clinically determined high risk factors
Adults with any of these conditions are automatically at HIGH risk of cardiovascular disease
	• Moderate or severe CKD
	  • persistent urine ACR > 25 mg/mmol in males or > 35 mg/mmol in females
	  or
	  • eGFR < 45 mL/min/1.73m^2
	• Diabetes and age > 60 years
	• Diabetes with microalbuminuria
	  • persistent urine ACR > 2.5 mg/mmol in males or > 3.5 mg/mmol in females
	• Previous diagnosis of familial hypercholesterolaemia
	• Systolic blood pressure ≥ 180 mmHg or diastolic blood pressure ≥ 110 mmHg
	• Serum total cholesterol > 7.5 mmol/L
	• Aboriginal and Torres Strait Islander peoples aged > 74 years

How to perform risk assessment	Web calculator www.cvdcheck.org.au
What do results mean*	• *High:* greater than 15% risk of cardiovascular disease within next five years • *Moderate:* 10-15% risk of cardiovascular disease within next five years • *Low:* Less than 10% risk of cardiovascular disease within next five years

* Provide lifestyle and pharmacological management strategies (if indicated) based on the patient's risk level and clinical judgement (e.g., high risk require more intensive intervention and follow up).

Australian absolute cardiovascular disease risk calculator and associated health professional and patient resources are available at www.cvdcheck.org.au



Clinical tip

People with moderate or severe CKD, defined as persistently having a urine ACR >25 mg/mmol (males) or >35 mg/mmol (females) or eGFR <45 mL/min/1.73m^2, are considered to already be at the highest risk (>15% probability in five years) of a cardiovascular event, and therefore should not be assessed using the absolute cardiovascular risk tool. Failure to recognise the presence of moderate to severe CKD may lead to a serious under-estimation of CVD risk in that individual.

Reducing cardiovascular risk - lifestyle modification[13]

- People at all cardiovascular risk levels can make improvements to their health and reduce their risk of cardiovascular disease by making lifestyle changes.
- See the table on page 53 for guidance on basic lifestyle advice. For more detailed advice refer to the relevant guidelines.

Reducing cardiovascular risk - pharmacotherapy[13]

- CKD can cause and aggravate hypertension, and hypertension can contribute to the progression of CKD.
- Reducing blood pressure to below target levels is one of the most important goals in management of CKD (see blood pressure targets on page 39).
- In people with CKD, blood pressure lowering therapy should begin with either ACE inhibitor or ARB.
  - Combined therapy of ACE inhibitor and ARB is not recommended.
  - Maximal tolerated dose of ACE inhibitor or ARB is recommended.
- Hypertension may be difficult to control and multiple (3 - 4) medications are frequently required.
- Assess risk of atherosclerotic events and consider treating with an anti-platelet agent unless there is an increased bleeding risk[15].
- See page 39 for more information regarding management of hypertension in people with CKD.

Consumer fact sheets 'Cardiovascular disease and chronic kidney disease' and 'Blood pressure and chronic kidney disease' are available to download at www.kidney.org.au

Clinical tip

ACE inhibitors and ARBs cause a reversible reduction in glomerular blood flow and GFR can decline when treatment is initiated. Provided the reduction is less than 25% within two months of starting therapy, the ACE inhibitor or ARB should be continued. If the reduction in GFR is more than 25% below the baseline value, the ACE inhibitor or ARB should be ceased and consideration given to referral to a Nephrologist.

Early detection of CKD

- Increasing amounts of albumin in the urine correlate directly with an increased rate of progression to ESKD, and increased cardiovascular risk.
- eGFR correlates well with complications of CKD and an increased risk of adverse outcomes such as cardiovascular morbidity and mortality.
- Early intervention with blood pressure reduction and use of ACE inhibitors or ARBs can reduce progression and cardiovascular risk by up to 50%, and may also improve quality of life.
- Testing for CKD should not be universal, but should be targeted and performed in individuals at increased risk of developing CKD[16].
- Serum creatinine is an insensitive marker for detecting mild to moderate kidney disease – eGFR is the preferred test[17].
- 50% or more of kidney function can be lost before the serum creatinine rises above the upper limit of normal.

Early detection of CKD using Kidney Health Check[18, 19]

Indications for assessment*	Recommended assessments	Frequency
Diabetes Hypertension Established cardiovascular disease** Family history of kidney failure Obesity (BMI ≥30 kg/m^2) Smoker Aboriginal or Torres Strait Islander origin aged ≥ 30 years¶	Urine ACR, eGFR, blood pressure If urine ACR positive repeat twice over 3 months (preferably first morning void). If eGFR < 60mL/min/1.73m^2 repeat within 7 days.	Every 1-2 years§
History of acute kidney injury	See recommendations on page 28	

* Whilst being aged 60 years of age or over is considered to be a risk factor for CKD, in the absence of other risk factors it is not necessary to routinely assess these individuals for kidney disease.

** Established cardiovascular disease is defined as a previous diagnosis of coronary heart disease, cerebrovascular disease or peripheral vascular disease.

§ Annually for individuals with diabetes or hypertension.

¶ See page 12 for more detail regarding recommendations for testing in Aboriginal and Torres Strait Islander peoples.

Aboriginal and Torres Strait Islander peoples

Latest data from the Australian Aboriginal and Torres Strait Islander Health Survey[20] showed:

- Age-standardised incidence of Stage 5 CKD is significantly higher in Aboriginal and Torres Strait Islander peoples compared with non Aboriginal and Torres Strait Islander peoples.
- Indigenous Australians are twice as likely to have signs of CKD, and four times as likely to have Stages 4-5 CKD, than non-Indigenous Australians.
- 90% of Aboriginal and Torres Strait Islanders with CKD are not aware that they have this condition.

Recommendations for CKD detection in Aboriginal and Torres Strait Islander peoples[19]

Indications for assessment*	R ecommended assessments	Frequency
People 18-29 years without any CKD risk factors	Screen for CKD risk factors (overweight or obesity, diabetes, elevated blood pressure, smoking, family history of kidney disease)	As part of annual health assessment
People 18-29 years with one of the following CKD risk factors: • Family history of CKD or premature CVD • Overweight/obesity • Smoking • Diabetes • Elevated blood pressure All people ≥30 years	Urine ACR, eGFR, blood pressure If urine ACR positive repeat twice over 3 months (preferably first morning void). If eGFR < 60mL/min/1.73m^2 repeat within 7 days.	Every two years (or more frequently if CVD risk is elevated)

For further detailed information refer to the National Guide to a Preventive Health Assessment for Aboriginal and Torres Strait Islander People[19] (www.naccho.org.au)

Benefits of identifying Aboriginal and Torres Strait Islander peoples:

- awareness of increased risk of CKD and cardiovascular disease and importance of screening other family members for CKD
- able to access annual health check (Medicare item 715)
- eligible for Aboriginal and Torres Strait Islander peoples-specific pharmaceutical benefits
- may be eligible for "Closing the Gap" scheme

Definition of CKD

CKD is defined as:

- an estimated or measured glomerular filtration rate (GFR) < 60 mL/min/1.73m^2 that is present for ≥3 months with or without evidence of kidney damage

or

- evidence of kidney damage with or without decreased GFR that is present for ≥3 months as evidenced by the following, irrespective of the underlying cause:
  - albuminuria
  - haematuria after exclusion of urological causes
  - structural abnormalities (e.g., on kidney imaging tests)
  - pathological abnormalities (e.g., renal biopsy)

Three components to a diagnosis of CKD

CKD Stage	with...	due to...
1/2/3a/3b/4/5	normoalbuminuria or microalbuminuria or macroalbuminuria	presumed/ confirmed pathology
eGFR	Urine ACR	Various recommended tests
See page 15	See page 18	See page 14

Clinical tip

CKD in itself is not a diagnosis. Attempts should be made to identify the underlying cause of CKD.

The following diagnostic evaluation tests for CKD are always indicated[8]:

- Renal ultrasound scan
- Repeat (within 1 week) serum urea/electrolytes/creatinine/eGFR/albumin. If eGFR continues to decrease refer to acute kidney injury management plan (see page 28)
- Full blood count, CRP, ESR
- Urine ACR (preferably on a first morning void to minimise postural effect on albumin excretion, although a random urine is acceptable)
- Fasting lipids and glucose
- Urine microscopy for dysmorphic red cells, red cell casts or crystals

The following diagnostic evaluation tests for CKD are sometimes indicated[8]:

If the following is present:	Carry out the following test:
Signs of systemic disease (e.g., rash, arthritis, features of connective tissue disease, pulmonary symptoms or deteriorating kidney function)	Anti-glomerular basement membrane antibody Anti-neutrophil cytoplasmic antibody Anti-nuclear antibodies Extractable nuclear antigens Complement studies
Risk factors for HBV, HCV or HIV (these conditions are associated with an increased risk of glomerular disease)	HBV, HCV, HIV serology
Age > 40 years and possible myeloma is suspected	Serum and urine protein electrophoresis

Tests used to investigate CKD

Glomerular Filtration Rate (GFR)[17]

- GFR is accepted as the best overall measure of kidney function.
- eGFR is a more sensitive marker for CKD than serum creatinine alone.
- 50% or more of kidney function can be lost before the serum creatinine rises above the upper limit of normal.
- Normal serum creatinine measurements do not exclude serious loss of kidney function.
- GFR can be estimated (eGFR) from serum creatinine using prediction equations.

How to assess eGFR[17]

- eGFR is automatically reported (using the CKD-EPI equation) with requests for serum creatinine in individuals aged ≥ 18 years.
- The CKD-EPI equation has been shown to have greater accuracy and precision for eGFR when compared to the Modification of Diet in Renal Disease (MDRD) and Cockcroft-Gault formulae.
- Further investigation of reduced eGFR is only required if the eGFR is < 60 mL/min/1.73 m^2.

Clinical tip

If eGFR is < 60 mL/min/1.73 m^2, retest within 7 days and consider:

- *clinical situations where eGFR results may be unreliable and/or misleading*
- *acute kidney damage*

Clinical situations where eGFR results may be unreliable and/or misleading[21]

- Acute changes in kidney function (e.g., acute kidney injury)
- People on dialysis
- Recent consumption of cooked meat (consider re-assessment when the individual has fasted or specifically avoided a cooked meat meal within 4 hours of blood sampling)
- Exceptional dietary intake (e.g., vegetarian diet, high protein diet, creatine supplements)
- Extremes of body size
- Diseases of skeletal muscle, paraplegia, or amputees (may overestimate eGFR)
- High muscle mass (may underestimate eGFR)
- Children under the age of 18 years
- Severe liver disease present
- eGFR values above 90 mL/min/1.73m^2
- Drugs interacting with creatinine excretion (e.g., fenofibrate, trimethoprim)
- Pregnancy (see below)

eGFR and drug dosing[17]

- Dose reduction of some drugs is recommended for people with reduced kidney function (see page 21).
- Manufacturers' renal dosing recommendations for medications are often based on Cockcroft-Gault estimates of creatinine clearance (CrCl mL/min).
- However, eGFR provides a valid estimate of renal drug clearance and is widely available on laboratory reports.
- If using eGFR for drug dosing, body size should be considered, in addition to referring to the approved Product Information.
- For drugs with a narrow therapeutic index, therapeutic drug monitoring or a valid marker of drug effect should be used to individualise dosing.
- For drug dosing in very large or very small people, it may be preferred to calculate an eGFR that is not normalised to 1.73m^2 body surface area (BSA).
- To revert to an uncorrected eGFR:

$$\text{CKD-EPI eGFR result in mL/min/1.73m}^2 \times \frac{\text{Individual's BSA}}{1.73} = \text{eGFR result in mL/min}$$

Where BSA = 0.007184 x Weight in kg $^{0.425}$ x Height in cm $^{0.725}$ (Du Bois formula)

Use of eGFR in various ethnic populations

- The CKD-EPI formula has been validated as a tool to estimate GFR in some non-Caucasian populations, including Aboriginal and Torres Strait Islander people[22], and South-East Asian, African, Indian and Chinese individuals living in Western countries[23].

eGFR and pregnancy[17]

- The validity of eGFR in pregnancy is not known.
- The use of eGFR to assess kidney function in pregnant women is not recommended.
- Serum creatinine should remain the standard test for renal function in pregnant women.

Consumer fact sheet 'eGFR – estimated glomerular filtration rate' is available to download at www.kidney.org.au

Urine albumin creatinine ratio (ACR)[16]

- Excessive amounts of proteins in the urine are a key marker of kidney damage and of increased renal and cardiovascular disease risk.
- These proteins are mainly albumin (albuminuria), but also consist of low molecular weight immunoglobulin, lysozyme, insulin and beta-2 microglobulin.
- It is rare for an individual to have increased excretion of non-albumin proteins without concomitant increased excretion of albumin.
- Urine ACR accurately predicts renal and cardiovascular risks in population studies.
- Reduction in urine ACR predicts renoprotective benefit in intervention trials.
- Elevated urine ACR is a more common sign of CKD than a decreased eGFR. In the latest Australian Health Survey, 8% of adults had abnormal urine ACR, while 4% had an abnormal eGFR result[3].

How to detect albuminuria[16]

- The preferred method for assessment of albuminuria in both diabetes and non-diabetes is urinary ACR measurement in a first morning void spot specimen.
- Urinary protein excretion follows a circadian pattern and tends to be highest in the afternoon, so ACR tests are most accurate when performed on early morning (first-void)[24].
- Where a first void specimen is not possible or practical, a random spot urine specimen for urine ACR is acceptable.
- A positive ACR test should be repeated on a first void sample to confirm persistence of albuminuria.
- Albuminuria is said to be present if at least two out of three ACR results are positive. CKD is present if the albuminuria is persistent for at least three months.
- Dipstick for protein in the urine is now no longer recommended as the sensitivity and specificity are not optimal.
- Urine ACR exhibits greater sensitivity than protein:creatinine ratio (PCR) for detecting lower amounts of clinically important albuminuria.

Factors other than CKD known to increase urine albumin excretion[16]

- Urinary tract infection
- High dietary protein intake
- Congestive cardiac failure
- Acute febrile illness
- Heavy exercise within 24 hours
- Menstruation or vaginal discharge
- Drugs (especially NSAIDs)

Consumer fact sheet 'Albuminuria' is available to download at www.kidney.org.au

Algorithm for initial detection of CKD

Offer Kidney Health Check to people with any of the following indications:

- Diabetes
- Hypertension
- Established cardiovascular disease
- Family history of kidney failure
- Obesity
- Smoking
- Aboriginal or Torres Strait Islander origin aged ≥ 30 years

Indication not present → Kidney Health Check not recommended

eGFR | Urine ACR

If urine ACR and eGFR are normal repeat Kidney Health Check in 1-2 years (annually if diabetes or hypertension present)

eGFR < 60 mL/min/1.73m^2

Repeat eGFR within 7 days

≥ 20% reduction in eGFR → Possible acute kidney injury - discuss with Nephrologist

Stable reduced eGFR

Repeat eGFR twice within 3 months

Minimum 3 reduced eGFR's present for ≥3 months

Elevate urine ACR (males ≥2.5mg/mmol, females ≥3.5 mg/mmol)

Repeat urine ACR twice within next 3 months (preferably first morning void)

Minimum 2 out of 3 elevated urine ACR's present for ≥3 months

		Albuminuria Stage		
Kidney Function Stage	**GFR (mL/min/1.73m^2)**	**Normal (urine ACR mg/mmol) Male: < 2.5 Female: < 3.5**	**Microalbuminuria (urine ACR mg/mmol) Male: < 2.5 -25 Female: < 3.5-35**	**Macroalbuminuria (urine ACR mg/mmol) Male: > 25 Female: > 35**
1	≥90	Not CKD unless haematuria, structural or pathalogical abnormalities present		
2	60-89			
3a	45-59			
3b	30-44			
4	15-29			
5	<15 or on dialysis			

Investigations to determine underlying diagnosis

Combine eGFR stage (1-5), albuminuria stage and underlying diagnosis to fully specify CKD (e.g., stage 2 CKD with microalbuminuria due to diabetic kidney disease).

Refer to colour-coded action plans for management strategies

Indications for referral to a Nephrologist[8, 25]

Appropriate referral is associated with:

- reduced rates of progression to ESKD
- decreased patient morbidity and mortality
- decreased need for and duration of hospitalisation
- increased likelihood of timely preparation of permanent dialysis access prior to dialysis onset
- increased likelihood of kidney transplantation

Referral to a specialist renal service or Nephrologist is recommended in the following situations:

- eGFR < 30 mL/min/1.73m^2 (Stage 4 or 5 CKD of any cause)
- Persistent significant albuminuria (urine ACR ≥30 mg/mmol)
- A sustained decrease in eGFR of 25% or more OR a sustained decrease in eGFR of 15 mL/min/1.73m^2 within 12 months
- CKD with hypertension that is hard to get to target despite at least three anti-hypertensive agents

The individual's wishes and comorbidities should be taken into account when considering referral.

In the absence of other referral indicators, referral is not necessary if:

- Stable eGFR ≥30 mL/min/1.73m^2
- Urine ACR < 30 mg/mmol (with no haematuria)
- Controlled blood pressure

The decision to refer or not must always be individualised, and particularly in younger individuals the indications for referral may be less stringent. Discuss management issues with a specialist by letter, email or telephone in cases where it may not be necessary for the person with CKD to be seen by the specialist.

Recommended tests prior to referral:

- Current blood chemistry and haematology
- Urine ACR and urine microscopy for red cell morphology and casts
- Current and historical blood pressure
- Urinary tract ultrasound

Tests not recommended prior to referral:

- Urine culture
- Spiral CT angiogram for hypertension (without specialty advice)

For a sample referral letter template, visit www.kcat.org.au.

Clinical tip

Anyone with rapidly declining eGFR and/or signs of acute nephritis (oliguria, haematuria, acute hypertension and oedema) should be regarded as a medical emergency and referred without delay.

Medications

- It is important to review renally excreted medications, as well as avoid nephrotoxic medications in people with CKD.
- Dosage reduction or cessation of renally excreted medications is generally required once the GFR falls below 60 mL/min/1.73m^2.
- Home Medicines Reviews and Residential Medication Management Reviews support General Practitioner/Pharmacist collaboration and are funded by Medicare item numbers.

Commonly prescribed drugs that may need to be reduced in dose or ceased in CKD include, but are not limited to:

Acarbose	Fenofibrate	Metformin*
Antivirals	Gabapentin	Opioid analgesics
Apixaban	Glibenclamide	Rivaroxaban
Benzodiazepines	Gliclazide	Saxagliptin
Colchicine	Glimeprimide	Sitagliptin
Dabigatran	Glipizide	Sotalol
Digoxin	Insulin	Spironolactone
Exanatide	Lithium	Valaciclovir
		Vildagliptin

* Metformin should be used with caution if GFR 30-60 mL/min/1.73m^2, and is not recommended if GFR < 30 mL/min/1.73m^2. It should be temporarily interrupted during periods of ill health and/or change in kidney function.

Commonly prescribed drugs that can adversely affect kidney function in CKD:

- Aminoglycosides
- Calcineurin inhibitors
- Gadolinium
- Lithium
- NSAIDs and COX-2 inhibitors - beware the 'triple whammy' (See Clinical tip)
- Radiographic contrast agents

Clinical tip

The combination of ACE inhibitor (or ARB), diuretic and NSAID or COX-2 inhibitor (except low-dose aspirin) can result in acute kidney injury (the "triple whammy"), especially if volume-depleted or CKD present. Ensure individuals on blood pressure medication are aware of the need to discuss appropriate pain relief medication with a General Practitioner or Pharmacist.

Managing hypertension medications in people with CKD

- ACE inhibitors or ARBs are an essential part of the best care approach for many patients in all stages of CKD.
- They cause a reduction in glomerular blood flow, and GFR can decline when treatment is initiated.
- Providing the reduction is less than 25% within two months of starting therapy, the ACE inhibitor or ARB should be continued.
- If the reduction in GFR is more than 25% below the baseline value, the ACE inhibitor or ARB should be ceased and consideration given to referral to a Nephrologist.
- Combined therapy with ACE inhibitor and ARB should be avoided except with specialist advice.
- Caution should be exercised if baseline K+ is ≥5.5 mmol/L, as rises in serum K+ of approximately 0.5 mmol/L are expected (see page 38).
- ACE inhibitors and ARBs can safely be prescribed at all stages of CKD and should not be deliberately avoided just because GFR is reduced.
- Both non-loop diuretics (e.g., thiazides) and loop diuretics (e.g., frusemide) are effective in all stages of CKD as adjunct antihypertensive therapy.
- Frusemide can be used safely for management of fluid overload in all stages of CKD, including when GFR is severely reduced to < 30 mL/min/1.73m^2
  - Typical doses are 20-120 mg/day, but higher doses (up to 500 mg/day) may be required, especially at lower levels of eGFR.
  - When more than 80 mg/day is required, the efficacy is improved by dividing the daily dose.
  - The dose may need frequent adjustment, and is best guided by tracking the fluid status and the daily weight at home with the instructions to the patient being to use "as little frusemide as needed to control the swelling".
- Beta-blockers may be useful in people with coronary heart disease, tachyarrhythmias and heart failure, but are contraindicated in asthma and heart block.
- Calcium channel blockers may be used for people with angina, the elderly and those with systolic hypertension.

Clinical tip

ACE inhibitors and ARBs may be temporarily discontinued during acute illness, but should be recommenced when the condition stabilises.

Other medication resources for people with CKD:

- Appendix 1 from the "Australian Diabetes Society Position Statement on A New Blood Glucose Management Algorithm for Type 2 Diabetes"[26] for a list of medication options for people with diabetes and CKD www.mja.com.au/sites/default/files/issues/201_11/gun01187_Appendix1.pdf
- "A practical approach to the treatment of depression in patients with chronic kidney disease and end-stage renal disease" for a list of the most common classes of antidepressant medications with suggested dosing in kidney impairment, and potential adverse effects www.nature.com/ki/journal/v81/n3/fig_tab/ki2011358t2.html[27])
- Australian resource focusing on drug therapy in people with CKD www.renaldrugreference.com.au

Nutrition[8]

- People with CKD should be encouraged to eat a balanced and adequate diet according to energy requirements in line with the Dietary Guidelines of Australian Adults recommended by NMHRC.
- Australian guidelines recommend that people with eGFR < 30 mL/min/1.73m^2 should have individualised diet intervention involving an Accredited Practising Dietitian.
- Overweight or obese people with CKD should be prescribed caloric restriction under the management of an Accredited Practising Dietitian.

Nutrition targets for people with CKD and eGFR ≥ 30mL/min/1.73m^2[8]*

Parameter	Target
Protein	0.75-1.0 g/kg/day (no restriction necessary)
Salt	No greater than 100 mmol/day (or 2.3 g sodium or 6 g salt per day) Avoid adding salt during cooking or at the table Avoid salt substitutes that contain high amounts of potassium salts
Phosphate	No restriction necessary
Potassium	If persistent hyperkalaemia is present, consult Accredited Practising Dietitian regarding restricting intake and avoiding foodstuffs high in potassium
Fluid	Drink water to satisfy thirst Increased fluid intake is not necessary
Carbonated beverages	Avoidance is preferable Minimise intake to less than 250 mL per day

* People with eGFR < 30 mL/min/1.73m^2 should have nutrition targets set by an Accredited Practising Dietitian

Consumer fact sheet 'Nutrition and kidney disease' available to download at www.kidney.org.au

Treatment options for Stage 5 CKD

- Patients and their families or carers should receive sufficient information and education regarding the nature of Stage 5 CKD, and the options for the treatment to allow them to make an informed decision about the management of their condition.
- Treatment choice has more effect on lifestyle than it does on mortality or morbidity.
- A shared decision making approach is highly recommended.
- This is best supported by a decision aid, such as the My Kidneys My Choice Decision Aid, available at www.homedialysis.org.au/choosing/my-decision

Brief comparison of treatment options

Treatment	Types	Involves	Lifestyle impact/outcomes
Transplant	Living donor Deceased donor	• Surgery • Lifetime imunosuppressants • May wait 3-7 years for a deceased donor • Compatible live donor	• Freedom to work and travel once kidney function stabilised • Need to maintain a healthy diet, but no other restrictions • Survival rates good • Higher infections and cancer rate
Home Peritoneal Dialysis (PD)	Continuous Ambulatory Peritoneal Dialysis (CAPD)	Four daytime bags changed manually	• Need PD catheter • Simple, gentle and portable • 1 week training • Freedom to work and travel • Good quality of life • Usually lasts 2-5 years
	Automated Peritoneal Dialysis (APD)	Overnight exchanges managed by a machine	• As above with no requirement to change bags during the day
Home Haemodialysis	Daytime, 3-5 treatments weekly, 4-6 hrs duration	• Blood cleansed by artificial filter. • Surgery for fistula at least at least 3 months prior to use	• Average of 3 months for training • Flexible daily routine
	Night-time, 3-5 nights per week, 8 hrs duration		• As above, with more hours of dialysis offering better health outcomes

Brief comparison of treatment options cont.

Treatment	Types	Involves	Lifestyle impact/outcomes
Centre Based Haemodialysis	• Hospital or satellite centre • 3 x weekly • 4-6 hrs (individualised) • Occasional clinics offer overnight	• As above	• Strict routine • Strict diet • Transport to hospital or satellite centre needed • No training required • Infection risk
Non Dialysis Supportive Care	• No dialysis or transplant • Managed in the community • Supported by palliative care	• Medication and diet control • Advance care planning	• In most people, life expectancy will be decreased compared with dialysis or transplant • Dialysis therapy may not be associated with a survival advantage compared with non dialysis supportive care in elderly patients with two or more comorbidities

Shared decision making[28]

- Enables the clinician and patient to participate jointly in making an informed health decision.
- Involves discussing the options and their benefits and harms, and considering the patient's values, preferences and circumstances.
- Is not a one-off discussion, but an ongoing process that can be used to guide decisions about screening, investigations and treatments.
- Benefits include:
  - acknowledges patient values and preferences
  - enhances patient engagement
  - improves patient knowledge
  - supports evidence based care
- Although shared decision making can occur without tools, various decision support tools now exist. For more information visit www.safetyandquality.gov.au/our-work/shared-decision-making/

Five questions that clinicians can use to guide shared decision making[28]:

1. What will happen if we watch and wait?
2. What are your test or treatment options?
3. What are the benefits and harms of these options?
4. How do the benefits and harms weigh up for you?
5. Do you have enough information to make a choice?

Advance care plans

- This can be a mix of any actions that leads to planning towards the end of life.
- Advance care planning is distinct from dialysis treatment decision making, and can occur whilst treatment is still 'active'.
- Advance care planning should be initiated in:
  - all competent patients aged 65 years and above

  and
  - all competent patients, irrespective of age, who fulfil one or more of the following criteria:
    - the treating clinician considers that existing medical conditions will reduce life expectancy
    - two or more significant comorbidities
    - poor functional status
    - chronic malnutrition
    - poor quality of life
- Visit www.advancecareplanning.org.au for information and resources.

Special issues in the elderly

- Most elderly people with CKD are asymptomatic.
- Relying on creatinine alone causes under-recognition of CKD.
- eGFR (which is adjusted for age) improves diagnostic accuracy.

Clinical tip

An eGFR < 60 mL/min/1.73 m^2 is common in older people, but is nevertheless predictive of significantly increased risks of adverse clinical outcomes, and should not be considered physiological or age-appropriate.

Appropriate referral

- Elderly patients with a stable eGFR ≥ 30 mL/min/1.73m^2, microalbuminuria, and controlled blood pressure can be managed successfully in primary care.
- Discuss management issues with a specialist by letter, email or telephone in cases where it may not be necessary for the person with CKD to be seen by the specialist.

Manage cardiovascular risk

- In people with CKD, death from cardiovascular disease is more common than ESKD at all ages.
- Manage cardiovascular risk (see page 8) using lifestyle and pharmacological management strategies (if indicated) based on the patient's risk level and clinical judgement.
- The goal of treatment is to improve the patient's functional capacity and quality of life, and to prevent injury from falls (e.g., postural hypotension, polypharmacy), rather than to achieve a target BP.

Medication considerations

- Diminished tolerance of side-effects and increased risk of adverse events is common with increased age.
- Reduced eGFR should lead to reduced doses of many drugs in the elderly.
- Polypharmacy is common in the elderly and increases the risk of falls, confusion and functional decline.
- Home Medicines Reviews and Residential Medication Management Reviews support General Practitioner/ Pharmacist collaboration and are funded by Medicare item numbers.

Shared decision making

- Treatment choice has more effect on lifestyle than it does on mortality or morbidity.
- Dialysis therapy may not be associated with a survival advantage compared with non dialysis supportive care in elderly patients with two or more comorbidities.
- Utilise decision aid tools such as the My Kidneys My Choice Decision Aid, available at www.homedialysis.org.au/choosing/my-decision

Clinical tip

Care of elderly patients with CKD requires an individualised approach to address comorbidities, together with variability in functional status, life expectancy and health priorities.

Acute kidney injury (AKI)[29,30]

- AKI is a common syndrome, especially in hospitalised patients, and is independently and strongly associated with increased morbidity and mortality.
- AKI is diagnosed either by detection of a sudden increase in serum creatinine, OR with persistent oliguria (see below).

Risk factors for AKI

Pre-existing risk factors	Modifiable kidney insults
CKD	Hypovolaemia
Other chronic disease	Sepsis
Diabetes	Critical illness
Heart/lung/liver disease	Circulatory shock
Cancer	Burns
Anaemia	Trauma
Advanced age	Drugs (e.g., triple whammy)
Female gender	Radiocontrast agents
	Poisonous plants and animals (e.g., snakes, spiders)

- CKD increases the risk of AKI, and an episode of AKI in turn increases the likelihood of subsequent development of CKD, highlighting the need for ongoing surveillance.
- General practice is in a unique position to identify people at increased of AKI and address potentially modifiable exposures to prevent the occurrence of AKI.

AKI management plan

How to prevent AKI	• Identify all CKD 3-5 patients as increased risk for AKI • Early identification of patients at risk with acute illness, and consider temporary cessation of ACE Inhibitor/ARB/diuretics with hypovolaemia/hypotension • Minimise and monitor NSAIDs with CKD
How to diagnose AKI	• Increase in serum creatinine ≥ 25 µmol/l within 48 hours; or • Increase in serum creatinine to ≥ 1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or • Significant reduction in urine output compared with normal output
What to do during an AKI episode	• Remove risks in early stage of illness • Seek specialist advice early • Systematic fluid assessment and medication review for all patients at risk when acute illness occurs
What to do after an AKI episode	• Follow-up within 30 days after discharge, and then GP or Nephrology follow-up as required. • Annual Kidney Health Check for subsequent 3 years • Self-management to monitor and reduce risk of subsequent exposures

Kidney stones[31]

- Kidney stones are one of the most common disorders of the urinary tract.
- The lifetime risk of developing kidney stones is 1 in 10 for Australian men and 1 in 35 for women. The risk increases with age, family history and Indigenous status.
- After having one kidney stone, the chance of a second stone is about 5-10% each year. About 30-50% of people with a first kidney stone will get a second one within five years, and then the risk declines.

Stone workup

- A general chemistry screen including uric acid, calcium and parathyroid status.
- Stone analysis (when available).
- 24 hour urine volume and chemistries (including calcium, oxalate, citrate and uric acid) are the mainstay of initial assessment and monitoring of response to interventions in adults.

Prevention of recurrence

- Existing calcium stones typically cannot be dissolved.
- The goal of therapy is to reverse the abnormalities detected during the initial workup (e.g., low urine volume, hypercalciuria, hypocitraturia, and hyperoxaluria). Both dietary and fluid input changes and the use of medications may be necessary to achieve this.
- Refer to an Accredited Practising Dietitian for a 3-6 month trial of diet and fluid changes before initiating drug therapy.
- Dietary changes to reduce calcium oxalate stones include:
  - increasing the fluid intake throughout the day (to maintain at least 2L of urine per day)
  - increasing dietary potassium and phytate (e.g., nuts, beans) and maintain normal calcium intake
  - decreasing the intake of oxalate, animal protein, sucrose, fructose, sodium, supplemental calcium
- Drug therapy should be commenced if there is evidence of continued new stone formation or if there is no or little improvement in the baseline urine chemistries with fluid and diet changes:
  - thiazides to reduce calcium excretion
  - allopurinol to reduce hyperuricosuria
  - citrate for hypocitraturia

Acute management

- The acute management of a stone episode is usually performed in an Emergency Department with Urologist involvement.
- The management of a stone episode where the stone is known to be of a size able to be spontaneously passed (<5mm) should include the use of an alpha blocker such as prazosin or tamsulosin.

Clinical tip

Stone recurrence can be prevented in the majority of patients who comply with a regimen that is devised after initial evaluation of the stone type and the risk factors present in the individual.

Consumer fact sheet 'Kidney stones' available to download at www.kidney.org.au

Multidisciplinary care

The management of CKD is always a collaborative effort, involving at least the individual and their General Practitioner. As kidney function declines, and as complications and comorbidities increase, it is likely that the contribution of others will be needed for optimal care.

The efficient integration of their various contributions becomes more challenging as the number of health professionals involved in the individual's care increases. The General Practitioner plays a crucial role, sustaining an ongoing relationship with the patient and their family, coordinating the care provided by others and ensuring that this care remains focused on the person's own goals and priorities.

At times the General Practitioner may be required to advocate for the patient with other professionals. In addition, he or she has continuing responsibility for the patient's primary care, which may include:

- supporting and assisting the patient in the management of their kidney disease and other chronic health problems
- responding appropriately to new symptoms
- screening for developing problems and comorbidities
- provision of health promotion and disease prevention advice and interventions
- providing appropriate vaccinations
- assistance with addressing psychosocial issues

Even if the patient progresses to Stage 5 CKD and has regular contact with the dialysis or transplant team, the General Practitioner, practice nurse, practice staff and other primary healthcare professionals remain vital to optimal care.

In Australia, a number of Medicare items are designed to support proactive, integrated, and multidisciplinary care for people with chronic disease. More information can be found at www.health.gov.au/mbsprimarycareitems.

Yellow clinical action plan

eGFR ≥60 mL/min/1.73m² with microalbuminuria or
eGFR 45-59 mL/min/1.73m² with normoalbuminuria

Goals of management

- Investigations to determine underlying cause
- Reduce progression of kidney disease
- Assessment of Absolute Cardiovascular Risk
- Avoidance of nephrotoxic medications or volume depletion

Management strategies

Frequency of review

- Every 12 months

Clinical assessment

- blood pressure
- weight

Laboratory assessment

- urine ACR (see page 18)
- eGFR (see page 15)
- biochemical profile including urea, creatinine and electrolytes
- HbA1c (for people with diabetes)
- fasting lipids

Other assessments

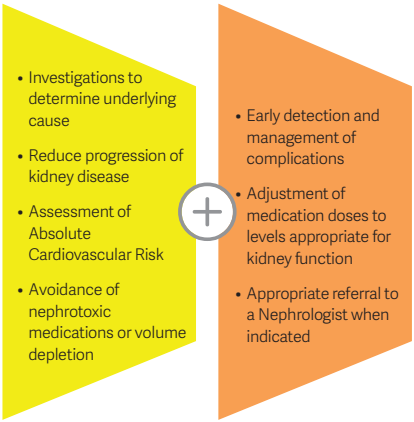
- assess absolute cardiovascular risk (see page 8)
- blood pressure reduction (see page 10)
- lifestyle modification (see page 10)
- lipid lowering treatment (where appropriate for risk factor reduction) (see page 41)
- glycaemic control (see page 37)
- avoid nephrotoxic medication or volume depletion (see page 21)
- multidisciplinary care (see page 31)

Care Plan Template available to download at www.kcat.org.au

Orange clinical action plan

eGFR 30-59 mL/min/1.73m² with microalbuminuria or
eGFR 30-44 mL/min/1.73m² with normoalbuminuria

Goals of management



Management strategies

Frequency of review

- Every 3-6 months

Clinical assessment

- blood pressure
- weight

Laboratory assessment

- urine ACR (see page 18)
- eGFR (see page 15)
- biochemical profile including urea, creatinine and electrolytes
- HbA1c (for people with diabetes)
- fasting lipids
- full blood count
- calcium and phosphate
- parathyroid hormone (6-12 monthly if eGFR < 45 mL/min/1.73m²)

Other assessments

- assess absolute cardiovascular risk (see page 8)
- blood pressure reduction (see page 10)
- lifestyle modification (see page 10)
- lipid lowering treatment (where appropriate for risk factor reduction) (see page 41)
- assess risk of atherosclerotic events and consider treating with an anti-platelet agent unless there is an increased bleeding risk
- glycaemic control (see page 37)
- avoid nephrotoxic medication or volume depletion and adjust doses to levels appropriate for kidney function (see page 21)
- assess for common complications (see pages 35-44)
- appropriate referral to Nephrologist when indicated (see page 20)
- multidisciplinary care (see page 31)

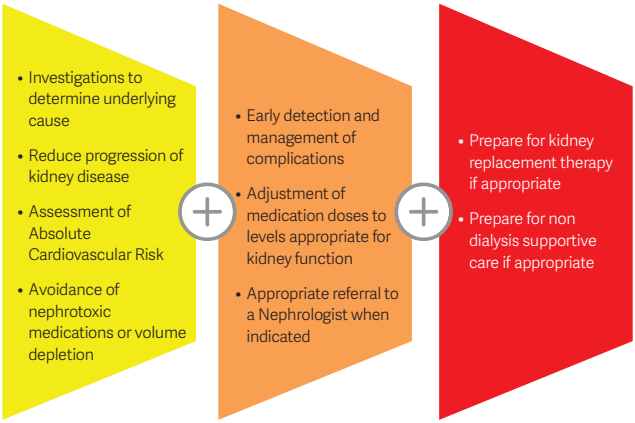
Care Plan Template available to download at www.kcat.org.au

Red clinical action plan

Macroalbuminuria irrespective of eGFR or

eGFR <30 mL/min/1.73m² irrespective of albuminuria

Goals of management



Management strategies

Frequency of review
- Every 1-3 months

Clinical assessment
- blood pressure
- weight
- oedema

Laboratory assessment
- urine ACR (see page 18)
- eGFR (see page 15)
- biochemical profile including urea, creatinine and electrolytes
- HbA1c (for people with diabetes)
- fasting lipids
- full blood count (if anaemic, page 35)
- calcium and phosphate
- parathyroid hormone (6-12 monthly if eGFR < 45 mL/min/1.73m²)

Other assessments
- assess absolute cardiovascular risk (see page 8)
- blood pressure reduction (see page 10)
- lifestyle modification (see page 10)
- lipid lowering treatment (where appropriate for risk factor reduction) (see page 41)
- assess risk of atherosclerotic events and consider treating with an anti-platelet agent unless there is an increased bleeding risk
- glycaemic control (see page 37)
- avoid nephrotoxic medication or volume depletion and adjust doses to levels appropriate for kidney function (see page 21)
- assess for common complications (see pages 35-44)
- appropriate referral to Nephrologist when indicated (see page 20)
- multidisciplinary care (see page 31)
- discuss treatment options, including dialysis, transplant and non dialysis supportive care if eGFR < 30 and progressing to kidney replacement therapy (see pages 24-35)
- discuss advance care plans if appropriate (see page 26)
- In patients with stage 4-5 CKD who are suitable for dialysis, the arm veins suitable for placement of vascular access should be preserved. In particular the cephalic veins of the non-dominant arm should not be used for venepuncture for blood testing or for the insertion IV catheters.

Care Plan Template available to download at www.kcat.org.au

CKD and its complications

Early detection and intervention has been shown to reduce the progression of CKD and its complications. It is essential to regularly check for the known complications of CKD and to monitor treatment targets.

Acidosis

People with eGFR < 30 mL/min/1.73m^2 are at increased risk of metabolic acidosis. The main factor is decreased renal acid excretion compounded by a reduction in bicarbonate production. Acidosis contributes to demineralization of bone and increased protein degradation, which may be associated with increased morbidity.

Management

- Supplementation with sodium bicarbonate (SodiBic 840 mg capsule) may be considered in people with acidosis
  - Typical starting dose would be 1 capsule od or bd, increasing up to 2 tablets bd if needed, and titrating to keep the HCO_3 level above 22mmol/L
  - Higher doses can be prescribed, but carry a higher risk of fluid overload
- Increased sodium load may worsen blood pressure control

Albuminuria[8]

Target:
50% reduction in urine ACR

Albuminuria is an important prognostic feature in CKD. The degree of albuminuria relates to the severity of the kidney disease and with a greater likelihood of progression to end stages of CKD. The amount of albuminuria can be reduced significantly by the use of an ACE inhibitor or ARB agent. Reduction in the amount of albuminuria is associated with improved outcomes.

Management

- ACE inhibitor or ARB as first-line therapy
- Reduction in salt output through reducing oral salt intake
- Spironolactone (use with caution on specialist advice and ensure regular monitoring of serum potassium)

Consumer fact sheet 'Albuminuria' available to download at www.kidney.org.au

Anaemia[32]

Target:
Hb 100 – 115 g/L

Prior to commencement of ESA a trial of iron supplementation maintaining: Ferritin >100 µg/L; TSAT >20%

Once ESA commenced, maintain: Ferritin 200-500 µg/L; TSAT 20-30%

- Anaemia of CKD is related to:
  - reduced erythropoietin production by the kidney
  - resistance to the action of ESA
  - reduced absorption of iron
- Anaemia related to CKD usually starts to develop when the GFR is less than 60 mL/min/1.73m^2. The prevalence of anaemia increases markedly with decreasing GFR.

Management

- Other forms of anaemia should be considered and excluded.
  - B12 and folate levels should be checked and corrected if deficient.

- Iron deficiency is a common cause of anaemia in people with CKD.
- If iron deficiency is identified, other cause should be excluded (e.g., blood loss).
- Prior to commencement of ESA a trial of IV iron should be considered to maintain ferritin >100 µg/L; TSAT >20%.

- Thyroid stimulating hormone should be assessed and hypothyroidism treated if present.
- Both significant hyperparathyroidism and systemic inflammation may contribute to anaemia and may cause refractoriness to erythropoietin therapy.
- Treatment with ESA must be commenced by or in consultation with a Nephrologist. There are several ESAs currently available for this indication in Australia. All are available as pre-filled syringes and are usually administered subcutaneously to pre-dialysis or peritoneal dialysis patients.
- ESAs are available either through hospital pharmacies or on Authority prescription under section 100 of the PBS for 'treatment of anaemia requiring transfusion, defined as a haemoglobin level of less than 100 g/L, where intrinsic renal disease as assessed by a Nephrologist, is the primary cause of the anaemia'. A private hospital provider number is required to access the drug on Authority prescription through a community pharmacy.
- It is recommended that ESA therapy is used with great caution, if at all, in CKD patients with active malignancy. If used in this setting, target Hb levels are lower in those patients, and the lowest dose of ESA is used to prevent blood transfusion.
- ESA treatment can be divided into two phases:
  - Correction: treatment commenced with the aim of achieving target Hb. It is reasonable in this phase to monitor Hb ~2-4 weekly and iron stores monthly. The aim is a rise of Hb at a rate of approximately 10g/L/month. Rapid correction of anaemia has been associated with hypertension and seizures.
  - Maintenance: target Hb is not fully defined in CKD, but the range is between 100-115 g/L. There is evidence of potential harm when Hb is targeted to exceed 130 g/L. Monitoring of Hb and iron studies is generally at three monthly intervals during this phase.

Consumer fact sheet 'Anaemia' available to download at www.kidney.org.au

Depression[27]

Depression can affect 1 in 5 people with CKD, and 1 in 3 individuals on dialysis. Depression in people with CKD has detrimental effects on mortality, rates of hospitalisation, medication and treatment adherence, nutrition, and overall quality of life. Treatment of depressive symptoms in people with CKD has the potential to improve health outcomes.

Management

- Screen recurrently and maintain a high level of clinical awareness for depression.
- Modifiable causes of depression that are commonly experienced by people with CKD (e.g., insomnia, medication

side-effects, inadequate dialysis) should be considered and excluded.

- Treatment of persistent depressive symptoms involves a combination of nonmedication therapies (e.g., education, cognitive behavioural therapy, exercise programs) and antidepressant medication.
- SSRIs (selective serotonin reuptake inhibitors) have established safety in people with CKD (for a detailed list of the most common classes of antidepressant medications with suggested dosing in kidney impairment, and potential adverse effects see www.nature.com/ki/journal/v81/n3/fig_tab/ki2011358t2.html27).

Consumer fact sheet 'Depression and chronic kidney disease' available to download at www.kidney.org.au

Dietary protein[8]

Target:

No lower than 0.75 g/kg body weight/day

Dietary protein restriction has been shown to result in modest slowing of CKD progression. However, the beneficial effect of protein restriction is typically outweighed by the deleterious effects of nutritional restriction. See page 23 for more information on nutrition and CKD.

Management

- Dietary advice (refer to an Accredited Practising Dietitian)

Glycaemic control[33]

Target:

BGL: 6-8mmol/L fasting; 8-10 mmol/L postprandial

HbA1c: Generally: ≤53 mmol/mol (range 48-58); ≤7% (range 6.5-7.5). Needs individualisation according to patient circumstances (e.g., disease duration, life expectancy, important comorbidities, and established vascular complications).

Optimal blood glucose control significantly reduces the risk of developing microalbuminuria, macroalbuminuria and/or overt nephropathy in people with Type 1 or Type 2 diabetes. The definition of 'optimal' will vary depending on the balance between benefits and risks and the individual's priorities (see General Practice Management of Type 2 Diabetes - 2014-15[33] for individualised recommendations).

Some medications may need to be reduced in dose or ceased in CKD (see page 21). See also Appendix 1 from the "Australian Diabetes Society Position Statement on A New Blood Glucose Management Algorithm for Type 2 Diabetes"[26] for a list of medication options for people with diabetes and CKD www.mja.com.au/sites/default/files/issues/201_11/gun01187_Appendix1.pdf.

Management

- Lifestyle modification (see page 10)
- Oral hypoglycaemics
- Gliptins
- Incretin mimetics
- Insulin

Consumer fact sheet 'Diabetic kidney disease' available to download at www.kidney.org.au

Haematuria[34]

- The most common causes of haematuria are non-glomerular conditions such as menstrual contamination or urological conditions (urinary tract infection (UTI), renal calculi, prostatic disease, or urinary tumours).
- Visible (or macroscopic) haematuria must always be investigated.
- Haematuria due to kidney disease is called glomerular haematuria.
- Persistent haematuria, or haematuria found in conjunction with other indicators of kidney damage necessitates investigation.
- Under the age of 40, isolated haematuria (haematuria without albuminuria, reduced GFR, or urinary tract malignancy) is usually due to a mild underlying glomerulonephritis with a low propensity for progression.

Management

- Use dipsticks rather than urine microscopy as dipsticks are more sensitive and accurate.
- Evaluate further if there is a result of 1+ or more.
- Do not use urine microscopy to confirm a positive result. However, urine microscopy may be useful in distinguishing glomerular haematuria from other causes.
- Persistent invisible (microscopic) haematuria in the absence of albuminuria can be differentiated from transient haematuria if 2 out of 3 reagent strip tests are positive.
- Persistent invisible haematuria, with or without albuminuria, should prompt investigation for urinary tract malignancy in appropriate age groups.
- Persistent invisible haematuria in the absence of albuminuria should be followed up annually with repeat testing for haematuria, albuminuria, eGFR and blood pressure monitoring as long as the haematuria persists. Family members should also be screened for haematuria.

Consumer fact sheet 'Blood in the urine' available to download at www.kidney.org.au

Hyperkalaemia[8]

Target:
K+ ≤ 6.0 mmol/L

In CKD, excretion of potassium (K+) in the urine is impaired. Levels may also rise with ACE inhibitors and ARBs used to treat hypertension or with use of spironolactone. Levels consistently above 6.0 mmol/L are of concern and should be managed. Hyperkalaemia, especially levels > 6.5 mmol/L, predisposes to cardiac arrhythmias.

Management

- Low K+ diet (discuss with an Accredited Practising Dietitian)
- Correct metabolic acidosis (target serum HCO_3 > 22 mmol/L)
- Potassium wasting diuretics (e.g., thiazides)
- Avoid salt substitutes which may be high in K+
- Resonium A powder
- Cease ACE inhibitor/ARB/ spironolactone if K+ persistently > 6.0 mmol/L and not responsive to above therapies
- Refer to nearest Emergency Department if K+ > 6.5 mmol/L

Hypertension[13, 35]

Target:

≤ 140/90 mmHg

or ≤ 130/80 mmHg in people with albuminuria (urine ACR >3.5 mg/mmol in females and >2.5 mg/mmol in males) or diabetes

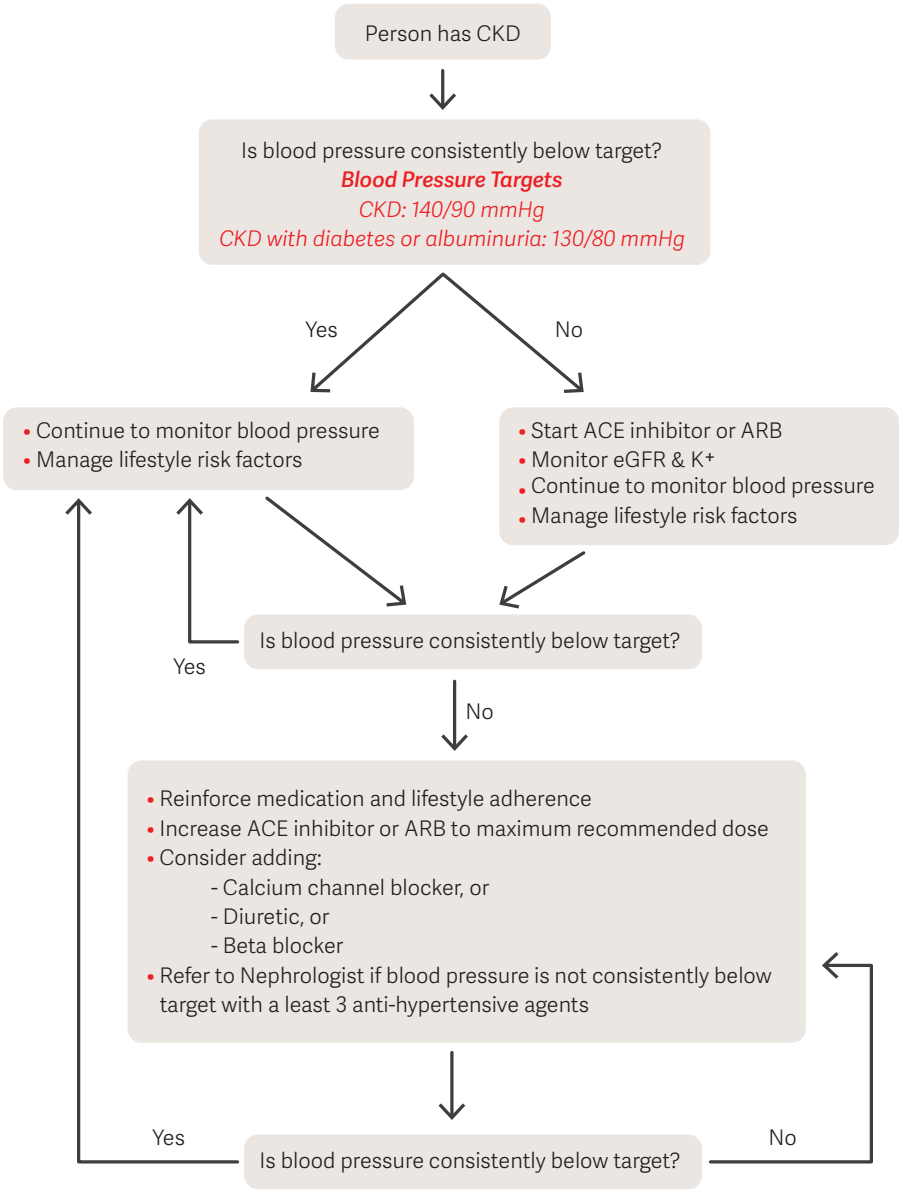
Hypertension is both a cause of CKD and a complication of CKD and can be difficult to control. The risks of uncontrolled hypertension include progression of kidney disease and increased risk of coronary heart disease and stroke. Hypertension should be considered as part of absolute cardiovascular risk (see page 8).

Management

- Lifestyle – See page 10 for guidance on basic lifestyle advice. For more detailed advice refer to relevant guidelines.
- Multiple medications (often 3 or more drugs) are needed to control hypertension adequately in most people with CKD.
- Consider sleep apnoea as a cause of resistant hypertension.
- People with diabetes or proteinuria should be treated with an ACE inhibitor or ARB as first line therapy.
- When treatment with an ACE inhibitor or ARB is initiated, the GFR can decrease and potassium levels can rise (see page 22 for more information).
- If the serum potassium concentration is greater than 6 mmol/L despite dose reduction, diuretic therapy and dietary potassium restriction, then any ACE inhibitor, ARB or spironolactone should be stopped.
- Diuretics should be used in most individuals. Both non loop diuretics (e.g., thiazides) and loop diuretics (e.g., frusemide) are effective at all stages of CKD as adjunct antihypertensive therapy.
- Additional antihypertensive agents can be chosen based on cardiovascular indications and comorbidities.
- Beta-blockers may be useful in people with coronary heart disease, tachyarrhythmias and heart failure, but are contraindicated in asthma and heart block.
- Calcium channel blockers may be used for people with angina, the elderly and those with systolic hypertension.
- Combined therapy with ACE inhibitor and ARB is not recommended.

Consumer fact sheet 'Blood pressure and chronic kidney disease' available to download at www.kidney.org.au

Algorithm for management of hypertension in people with CKD



Lipids[36, 37]

CKD is associated commonly with substantial abnormalities of lipid metabolism, including increased low-density lipoproteins, triglycerides, very-low-density lipoproteins, and lipoprotein (a), and reduced levels of high-density lipoprotein cholesterol. Dyslipidaemia is more severe in individuals with albuminuria, particularly those with nephrotic syndrome.

Management

- In adults with newly identified CKD, evaluation with a fasting lipid profile is recommended.
- Consider secondary causes and specialist evaluation if severely elevated fasting lipid levels (LDL-cholesterol >4.9 mmol/L or triglycerides >11.3 mmol/L).
- Follow-up measurement of lipid levels is not required for the majority of patients.
- If aged ≥50 years with any stage of CKD (irrespective of lipid levels):
  - Statin if eGFR is > 60 mL/min/1.73m^2
  - Statin or statin/ezetimibe combination if eGFR is ≤ 60 mL/min/1.73m^2.
- If aged < 50 years with any stage of CKD (irrespective of lipid levels):
  - Statin if presence of one or more of: coronary disease, previous ischaemic stroke, diabetes or estimated 10-year incidence of fatal or non-fatal myocardial infarction above 10%
- Lifestyle advice if hypertriglyceridaemia is present.

Malnutrition[8, 38]

Target:

Serum albumin ≥35 g/L

Poor food intake due to the symptoms of CKD can lead to malnutrition and low serum albumin. See page 23 for more information on nutrition and CKD.

Management

- Dietary advice (refer to an Accredited Practising Dietitian)

Mineral and bone disorder[8, 39, 40]

Target:

Keep PO_4 in normal range (0.8-1.5 mmol/L)

Keep Ca in normal range (2.2-2.6 mmol/L)

Vitamin D (25-hydroxyvitamin D) levels are adequate if > 50 nmol/L

Refer to Nephrologist if PTH is persistently elevated above the upper limit of normal and rising

Changes in the metabolism of calcium, phosphate, parathyroid hormone and Vitamin D typically start to occur once GFR ≤ 60 mL/min/1.73m^2. As kidney function decreases, the renal clearance of phosphate is diminished, leading to higher serum phosphate levels. Levels of calcitriol, the most active form of vitamin D, fall because kidney function is required for its synthesis. Calcium levels may fall as a result of less vitamin D dependent calcium uptake from the gastrointestinal tract.

The combined effects of higher phosphate, lower calcium and lower vitamin D levels all serve to stimulate parathyroid hormone production, and in turn elevated levels of PTH increase the resorption and release of mineral from bone. These changes are associated with an increased risk of fracture and also increased cardiovascular mortality, perhaps mediated by accelerated vascular calcification.

Management

- Phosphate
  - Dietary restriction of phosphate (refer to an Accredited Practising Dietitian).
  - Use of phosphate binders, which bind dietary phosphate to prevent absorption. Commonly used binders are typically calcium-based.
  - Sevelamer and lanthanum are available for individuals on dialysis.
- Calcium
  - If phosphate is controlled, calcium will typically remain in normal range. If the level is low with normal phosphate level consider Vitamin D supplementation.
  - Excess calcium administration should be avoided as this may be associated with increased risk of vascular calcification in CKD.
- Vitamin D
  - Cholecalciferol, the form of vitamin D that comes from sun exposure, can be given as a dietary supplement and will be converted to 25-hydroxyvitamin D by the liver.
  - If kidney function is still intact, it will then be converted to calcitriol, the most active form and will help to suppress the development of secondary hyperparathyroidism.
  - Calcitriol, the most active form of vitamin D is used in CKD for suppression of secondary hyperparathyroidism and is the preferred vitamin D in later stages of CKD when kidney function is very poor. Cholecalciferol should still be used for 25-hydroxyvitamin D deficiency in advanced CKD, including in combination with calcitriol.
  - Calcitriol is available on PBS Authority for "the indication of hypocalcaemia due to renal disease". The major side effect of therapy with calcitriol is hypercalcaemia and hyperphosphataemia.
- Cinacalcet
  - Cinacalcet, a calcimimetic agent, can be used to treat hyperparathyroidism for individuals on dialysis.
  - In people with CKD and severe hyperparathyroidism who fail to respond to medical/pharmacological therapy, parathyroidectomy should be considered, particularly when calcium or phosphate levels cannot be satisfactorily controlled.

What to measure	GFR 45-59 mL/min/1.73m^2	GFR < 45 mL/ min/1.73m^2
Calcium & phosphate	6-12 months	3-6 months
PTH & alkaline phosphatase*	Baseline	6-12 months
25-hydroxyvitamin D	Baseline	Baseline

*ALP or bone-specific ALP will help to give information on the rate of bone turnover

Consumer fact sheet 'Calcium and phosphate' available to download at www.kidney.org.au

Muscle cramps

Many people with kidney failure may experience muscle cramps due to imbalances in fluid and electrolytes, peripheral neuropathy or peripheral vascular disease.

Management

- Encourage stretching and massaging of the affected area
- Tonic water can be effective for frequent cramps

Pruritus[41]

Itchy skin is a common and debilitating side-effect of kidney disease, and can affect up to 70% of people with Stage 4 or 5 CKD. The causes are multifactorial, including calcium and phosphate imbalance, inadequate dialysis, overactive parathyroid gland activity, high levels of magnesium and vitamin A, and nerve changes in the skin.

Management

- Ensure that there are no other causes for pruritus (e.g., allergies, scabies, inadequate dialysis, calcium/phosphate)
- Evening Primrose Oil
- Skin emollients
- Avoid use of soaps/detergents
- Topical capsaicin (may not be tolerated because of transient burning feeling on the skin)
- If both pruritus and restless legs is present, consider gabapentin
- For persistent pruritus, consider referral to a dermatologist for ultraviolet light B (UVB) therapy

Restless legs

Restless Legs Syndrome (RLS) is common in CKD. As many as 8 in 10 people with eGFR < 15 mL/min/1.73m^2 have RLS or a related movement disorder called periodic limb movements in sleep (PLMS).

Management

- Check iron status and replace if deficient
- Home therapies such as massage, warm baths, warm/cool compresses, relaxation techniques, exercise
- Dopaminergic agents or dopamine agonists
- Benzodiazepines

Sleep apnoea

Sleep apnoea can affect up to 50% of people with eGFR < 15 mL/min/1.73m^2, and is a significant cause of refractory hypertension.

Management

- Weight reduction (see page 10 lifestyle modification)
- Avoid central nervous system depressants (including alcohol)
- CPAP therapy (if obstructive pattern)

Uraemia

Uraemia is a syndrome seen in Stage 4 or 5 CKD, and is caused by the accumulation of the breakdown products of protein metabolism. The symptoms include anorexia, nausea, vomiting, lethargy, confusion, muscle twitching, convulsions and coma. Although urea and creatinine are the substances we measure, the symptoms are most likely due to the accumulation of other toxic end products. These symptoms can lead to poor food intake and malnutrition. By the time uraemia becomes symptomatic, dialysis is typically indicated.

Management

- Dialysis should be commenced as soon as uraemic symptoms develop
- If non-dialysis pathway is planned:
  - a low protein diet will help control gastrointestinal symptoms
  - fluid control should be strict to avoid pulmonary oedema
  - avoid unnecessary medications
  - anti-emetics are of limited value

Resources

Kidney Health Australia

www.kidney.org.au

1800 454 363 – Free call Kidney Health Information Service Line

Kidney Health Australia is a not for profit organisation whose mission is to advance the public health agenda through awareness, detection, prevention and management of kidney disease in Australia and our region.

Programs available to assist health professionals include:

- CKD-GO! Clinical Action Plan app
- Downloadable Care Plan templates
- Downloadable referral letter templates
- eGFR calculator and resources
- Interactive workshop education programs (accredited with RACGP, ACCRM, RCNA)
- Online learning modules (www.thinkgp.com.au/kha)
- Patient resources - fact sheets, brochures, books, DVDs
- Scientific reports and publications
- Renal unit locations in Australia

Kidney Check Australia Taskforce (KCAT)

KCAT education sessions support the recommendations made in this booklet and will facilitate translating these recommendations into best practice detection and management of CKD in primary care.

If you would like to undertake some education related to the contents of this booklet, please visit www.kcat.org.au for further information.

KHA-CARI Guidelines

www.cari.org.au

Evidence-based clinical practice guidelines for the management of adult and paediatric patients with CKD.

The "Early Chronic Kidney Disease" guideline is particularly relevant for primary care health professionals.

Guidelines available to download online.

Royal Australian College of General Practitioners

www.racgp.org.au

Guidelines for preventive activities in general practice (8th edition). http://www.racgp.org.au/your-practice/guidelines/redbook/

National guide to a preventive health assessment for Aboriginal and Torres Strait Islander people (2nd edition). http://www.racgp.org.au/your-practice/guidelines/national-guide/chronic-kidney-disease-prevention-and-management/

Renal Resource Centre

www.renalresource.com

A community health service of Northern Sydney Central Coast Health which provides renal patients with information and educational material to assist them in managing the effects of renal disease on their lifestyle.

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Abbreviations

ACE inhibitor	Angiotensin-converting enzyme inhibitor
ACRRM	Australian College of Rural and Remote Medicine
ACN	Australian College of Nursing
ACR	Albumin:creatinine ratio
AKI	Acute kidney injury
ALP	Alkaline phosphatase
APD	Automated peritoneal dialysis
APNA	Australian Primary Health Care Nurses Association
ARB	Angiotensin II receptor blocker
BMI	Body mass index
BP	Blood pressure
BSA	Body surface area
BGL	Blood glucose level
CAPD	Continuous ambulatory peritoneal dialysis
CARI	Caring for Australasians with Renal Impairment
CKD	Chronic kidney disease
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration
CPAP	Continuous positive airway pressure
CrCl	Creatinine clearance
CRP	C-reactive protein
CVD	Cardiovascular disease
DASH	Dietary Approaches to Stop Hypertension
eGFR	Estimated glomerular filtration rate
ESA	Erythropoiesis stimulating agent
ESKD	End stage kidney disease
ESR	Erythrocyte sedimentation rate
GFR	Glomerular filtration rate
Hb	Haemoglobin
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HIV	Human immunodeficiency virus
HR	Hazard ratio
IV	Intravenous
KCAT	Kidney Check Australia Taskforce
KDIGO	Kidney Disease Improving Global Outcomes
KHA	Kidney Health Australia
NHMRC	National Health and Medical Research Council
NSAIDs	Non-steroidal anti-inflammatory drugs
PBS	Pharmaceutical benefits scheme
PCR	Protein:creatinine ratio
PD	Peritoneal dialysis
PKD	Polycystic kidney disease
PLMS	Periodic limb movement in sleep
PTH	Parathyroid hormone
RACGP	Royal Australian College of General Practitioners
RLS	Restless legs syndrome
Spiral CT	Spiral computed tomography
SSRI	Selective serotonin reuptake inhibitor
TSAT	Transferrin saturation
UTI	Urinary tract infection
UVB	Ultraviolet light B

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Treatment targets for people with CKD

Parameter	Target	Approximate reduction in systolic BP[42]
Smoking	Stop smoking using counselling and, if required, nicotine replacement therapy or other medication.	
Nutrition	Consume a varied diet rich in vegetables, fruits, wholegrain cereals, lean meat, poultry, fish, eggs, nuts and seeds, legumes and beans, and low-fat dairy products. Limit salt to < 6 g salt per day (≤100 mmol/day). Limit foods containing saturated and trans fats. See Australian Dietary Guidelines[43].	Sodium restriction: 4-7 mHg (for reduction by 6g salt intake daily) DASH diet: 5.5 mmHg for normotensives; 11.4 mmHg for hypertensives
Alcohol	Limit alcohol intake to ≤2 standard drinks per day. See Australian Guidelines to Reduce Health Risks from Drinking Alcohol[44].	3 mmHg (for 67% reduction from baseline of 3-6 drinks per day)
Physical activity	At least 30 minutes moderate physical activity on most or preferably every day of the week.	5 mmHg
Obesity	Limit energy intake to maintain a healthy weight. Ideal weight should be BMI < 25 kg/m^2 and waist circumference < 94 cm in men (< 90 cm in Asian men) or < 80 cm in women (including Asian women).	4.4 mmHg (for 5.1kg weight lost)

The NHMRC recommends immunisation against influenza and invasive pneumococcal disease for people with diabetes and/or ESKD.

Clinical tip

People with CKD should be treated with blood-pressure lowering drugs to maintain a blood pressure that is consistently below 140/90 mmHg. If albuminuria is present (urine ACR >3.5 mg/mmol in females and >2.5 mg/mmol in males) a consistent blood pressure below 130/80 mmHg should be achieved. If diabetes is present, the blood pressure should be consistently maintained below 130/80 mmHg. Consistent blood pressure control will often require the use of more than one agent. As eGFR declines more drugs will typically be required to achieve consistent blood pressure control.

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Stages of CKD

		Albuminuria Stage		
Kidney Function Stage	GFR (mL/min/1.73m²)	Normal (urine ACR mg/mmol)Male: < 2.5 Female: < 3.5	Microalbuminuria (urine ACR mg/mmol) Male: 2.5-25 Female: 3.5-35	Macroalbuminuria (urine ACR mg/mmol) Male: > 25 Female: > 35
1	≥90	Not CKD unless haematuria, structural or pathological abnormalities present		
2	60-89			
3a	45-59			
3b	30-44			
4	15-29			
5	<15 or on dialysis			

Goals of management

- Investigations to determine underlying cause
- Reduce progression of kidney disease
- Assessment of Absolute Cardiovascular Risk
- Avoidance of nephrotoxic medications or volume depletion

+

- Early detection and management of complications
- Adjustment of medication doses to levels appropriate for kidney function
- Appropriate referral to a Nephrologist when indicated

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- Prepare for kidney replacement therapy if appropriate
- Prepare for non dialysis supportive care if appropriate

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