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An overview of CHRONIC KIDNEY DISEASE IN AUSTRALIA 2009

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Australian Institute of Health and Welfare

Board Chair
Hon. Peter Collins, AM, QC

Director
Penny Allbon

Any enquiries about or comments on this publication should be directed to:

National Centre for Monitoring Chronic Kidney Disease
Australian Institute of Health and Welfare
GPO Box 570
Canberra ACT 2601
Phone: (02) 6244 1000

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Abbreviations

AIHW	Australian Institute of Health and Welfare
ANZDATA	Australia and New Zealand Dialysis and Transplant Registry
AusDiab	Australian Diabetes, Obesity and Lifestyle Survey
BEACH	Bettering the Evaluation and Care of Health
CAPD	continuous ambulatory peritoneal dialysis
CKD	chronic kidney disease
CVD	cardiovascular disease
GFR	glomerular filtration rate
eGFR	estimated glomerular filtration rate
ESKD	end-stage kidney disease
GP	general practitioner
K/DOQI	Kidney Disease Outcome Quality Initiative
NHS	National Health Survey
NDSHS	National Drug Strategy Household Survey

Summary

This report provides the latest picture of chronic kidney disease in Australia and updates information from *Chronic Kidney Disease in Australia 2005*. Drawing on numerous data sources, it explains what chronic kidney disease is and describes its extent and patterns in the Australian community.

The picture

Based on the latest Australian data:

- Chronic kidney disease is a common and serious problem.
- More and more Australians are having dialysis or transplant for the disease's most severe form, end-stage kidney disease.
- Diabetes is increasing and is now the leading cause of end-stage kidney disease.
- Chronic kidney disease is especially common among Indigenous Australians.

Some numbers behind the picture

A common and serious problem: 1 in 7 Australian adults over the age of 25 years had some degree of chronic kidney disease in 1999–2000. Chronic kidney disease contributed to nearly 10% of all deaths in 2006 and over 1.1 million hospitalisations in 2006–07.

Treatment on the rise: the rate of people with a kidney transplant or receiving dialysis rose by 26% between 2000 and 2007.

Diabetes increasing: over the period 2000 to 2007, the number of new cases of end-stage kidney disease attributed to diabetes increased by two-thirds in those aged 55 years and over.

Common in Indigenous Australians: based on recent data, Indigenous Australians were 6 times as likely as other Australians to be receiving dialysis or to have had a kidney transplant. Death rates from chronic kidney disease were 7 and 11 times as high as for non-indigenous males and females respectively.

CHRONIC KIDNEY DISEASE AT A GLANCE

What are the kidneys and what do they do?

The kidneys are bean-shaped organs, about the size of an adult fist, located in the back, above the waist and below the lower ribs. They continuously filter the bloodstream, playing a vital role in controlling the body's level of water and various chemicals and in clearing waste products. They also produce certain essential hormones. The kidneys are highly active and selective filters, with vital substances first being filtered then reabsorbed into the bloodstream through the kidneys' 'process line'. This includes glucose (fully reabsorbed) and water and sodium (almost fully). Waste products and any excess water filtered out by the kidneys are eliminated from the body through the bladder in the form of urine.

What is chronic kidney disease?

Chronic kidney disease (CKD) refers to all conditions of the kidney, lasting at least three months, where a person has had evidence of kidney damage and/or reduced kidney function, regardless of the specific diagnosis of disease or condition causing the disease (National Kidney Foundation of America 2002). Evidence of kidney damage manifests as either urinary protein (proteinuria) or albumin (a type of protein that is a more sensitive and specific marker of kidney disease, albuminuria), blood in the urine (haematuria) or scarring detected by imaging tests.

Measuring CKD

Kidney function is measured by the glomerular filtration rate (GFR) which is the amount of blood the kidneys clear of waste products in one minute. As GFR cannot be measured directly, current practice is to estimate GFR (eGFR) by applying a formula which requires age, gender and creatinine levels in the blood.

Stage 1: Kidney damage (GFR at least 90 mL/min/1.73 m^2)

Evidence of kidney damage but without decreased GFR. Usually no symptoms.

Stage 2: Kidney damage (GFR 60 to 89 mL/min/1.73 m^2)

Evidence of kidney damage with some reduction in GFR. Most patients have no symptoms.

*Stage 3: GFR 30 to 59 mL/min/1.73 m^2**

GFR significantly reduced. May show signs of kidney damage and often indications of dysfunction in other organs. Often asymptomatic despite a reduction in kidney function of up to 70%.

*Stage 4: GFR 15 to 29 mL/min/1.73 m^2**

Kidney function significantly reduced. Blood levels of urea and creatinine increase, and greater evidence of dysfunction in other organs. Usually only mild symptoms.

*Stage 5: End Stage Kidney Disease (ESKD) GFR less than 15 mL/min/1.73 m^2**

Range of symptoms and laboratory abnormalities in several organ systems, collectively referred to as uraemia. Kidney replacement therapy (dialysis or transplant) is required when kidney function is no longer sufficient to sustain life, typically at a GFR of around 7–8mL/min/1.73m^2.

* with or without evidence of kidney damage

Source: Adapted from Obrador & Pereira 2002.

1 Introduction

Purpose

This report presents the latest available national data on chronic kidney disease (CKD) in Australia. It presents a national snapshot of CKD with inclusion of selected data covering:

- prevalence and incidence
- risk factors
- related health service usage
- contribution to mortality
- impact on Australian Indigenous populations
- overall impact.

Background

Chronic kidney disease is a long-term health condition that in many cases is preventable. Many people do not know they have kidney disease, because up to 90% of kidney function can be lost before symptoms are evident. Fortunately, simple tests performed by a general practitioner can identify most cases of CKD when the disease is in its early stages, enabling treatment to prevent or slow progression.

CKD is usually categorised into five stages (stages 1 through 5) according to the level of reduced kidney function and evidence of kidney damage, such as blood or protein in the urine (National Kidney Foundation of America 2002). In the most severe stage of CKD (known as end-stage kidney disease or stage 5) regular dialysis or a kidney transplant is almost always required for a person to survive.

The major risk factors for CKD include fixed factors such as age, being male, and ethnicity. Other risk factors, which are common in the Australian population, include behavioural factors such as smoking, and biomedical factors such as high blood pressure and obesity. Progression of CKD can often be slowed by controlling these modifiable risk factors and by improving disease treatment and management.

The Australian Government's National Chronic Disease Strategy has highlighted the importance of reducing the burden of chronic disease through monitoring and improved data quality (National Health Priority Action Council 2006). In response to this need, the National Centre for Monitoring Chronic Kidney Disease was established at the Australian Institute of Health and Welfare (AIHW) in late 2007 (AIHW 2009). This report is the first publication of the National Centre that presents up-to-date national data on CKD. Future publications will focus in more depth on some of the topics covered in this report.

2 Prevalence and incidence of CKD

Estimating the prevalence and incidence of a disease provides an important foundation for determining its burden on the health of Australians and its impact on the health system. Further, policy makers can use this information to develop strategies to reduce the burden of a disease. In Australia, the prevalence of treated end-stage kidney disease can be accurately determined using data from the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA, see Appendix 1). However, due to the lack of symptoms in the earlier stages of chronic kidney disease, the true prevalence of CKD stages 1–4 is difficult to estimate.

Current methods for estimating the prevalence of many chronic conditions rely on self-reported data from national surveys. While this approach provides an estimate of diagnosed CKD, frequently CKD has no symptoms and most cases go undiagnosed (Chadban et al. 2003). Therefore, the best way to estimate its prevalence is through surveys in which blood and urine are taken for measurement. Ideally, survey respondents would be required to give two repeat samples, at least 3 months apart, to exclude acute kidney disease cases (National Kidney Foundation of America 2002). However, this would be costly and difficult to perform, so a single measurement could be used with the possibility of including some cases of acute kidney disease in the estimate.

Stage of CKD

The most recent national survey that collected measured data about CKD was the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). The study was a national population-based cross-sectional survey undertaken in 1999–2000, of non-institutionalised Australians aged 25 years and over (Dunstan et al. 2002) (Appendix 1). Indicators of kidney damage in the AusDiab were based on a single measurement for proteinuria, albuminuria, haematuria and blood creatinine (to determine eGFR—see *Chronic kidney disease at a glance*, page vi). Although the study did not measure kidney function twice at least three months apart, and therefore may include some cases of acute kidney disease, it provides the best estimate of diagnosed and undiagnosed CKD to date.

The 1999–2000 AusDiab survey showed that 2.4% of participants had proteinuria, 6.6% had albuminuria and 4.6% had haematuria, with a total of 16% having at least one indicator of kidney damage (Atkins et al. 2004; Chadban et al. 2003). Using the recently recommended formula for calculating eGFR (Mathew et al. 2007), 13.4% of participants had some degree of CKD, with more than half (7.8%) in stages 3–5 (eGFR less than 60 mL/min/1.73 m^2) (Table 1). CKD is strongly related to age, with nearly 30% of those aged over 65 years in stages 3–5.

Table 1: Age-specific prevalence of chronic kidney disease in Australia, 1999–2000

		Prevalence[(b)] (%)		
Stage of chronic kidney disease[(a)]	Age group	Males	Females	Persons
Stages 1 and 2	25–64	4.2	4.5	4.4
	65+	14.2	8.8	11.2
	All ages	5.9	5.4	5.6
Stages 3–5	25–64	1.9	3.0	2.5
	65+	25.7	34.6	30.6
	All ages	5.9	9.5	7.8

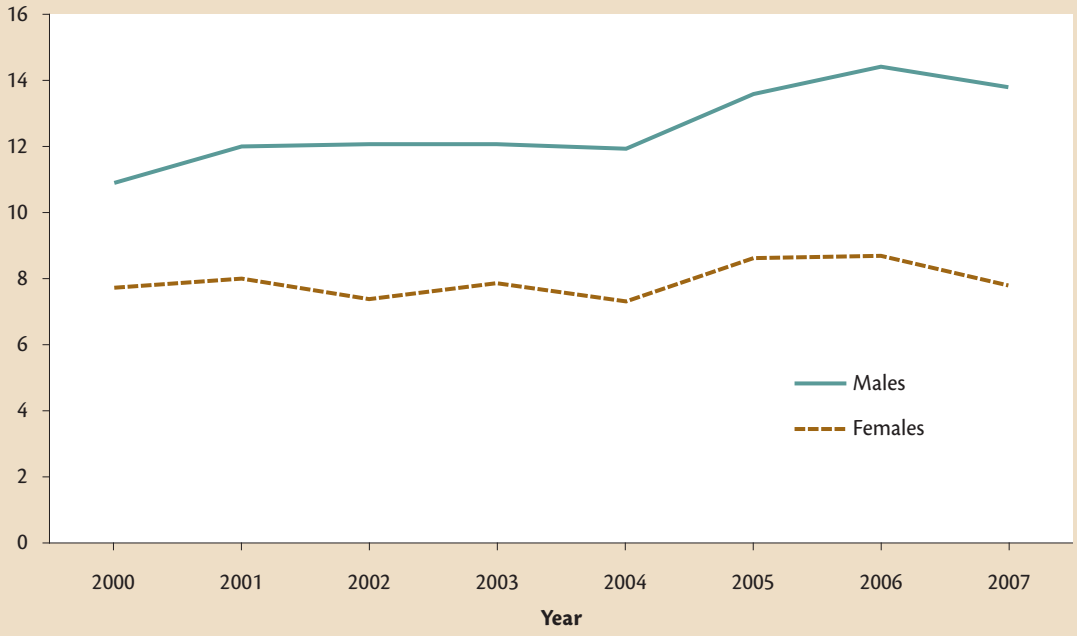
(a) Stages of CKD were developed by the United States Kidney Disease Outcome Quality Initiative (K/DOQI) (National Kidney Foundation of America 2002).
(b) Prevalence estimates were determined by calculating estimated glomerular filtration rates based on blood creatinine levels. The Modification of Diet in Renal Disease '175' formula was used as recommended by the Australasian Creatinine Consensus Working Group (Mathew et al. 2007).
Note: Evidence of kidney damage for stages 1 and 2 was determined by presence of albuminuria or proteinuria.
Source: AIHW analysis of the1999–2000 AusDiab Study.

End-stage kidney disease

The Australian and New Zealand Dialysis and Transplant Registry is a valuable resource for determining the number of people commencing and receiving treatment for end-stage kidney disease (Appendix 1). It should be noted that the incidence and prevalence of treated ESKD will underestimate the incidence and prevalence of ESKD among the whole community, as not all people will be suitable candidates for kidney replacement therapy and some others may choose not to take it up (AIHW 2005). At the end of 2007, 16,770 people were receiving kidney replacement therapy in Australia. Of these, 9,642 were on dialysis and 7,128 were living with a functioning kidney transplant.

The number of new cases of people commencing treatment for ESKD has increased from 1,751 in 2000 to 2,311 in 2007. The age-standardised rate has also increased over this period for both males and females; however this increase is only statistically significant for males (Figure 1). Overall the age-standardised rate of new cases of ESKD has increased by 19% between 2000 and 2007, from 9.2 to 10.6 per 100,000; however the majority of this increase has been between 2004 and 2007.

Changes over time in the incidence rate of treated ESKD vary between age groups, with much of the increase occurring in those aged over 65 years (AIHW 2005). The reasons for this are complex, with the increasing prevalence of diabetes, high prevalence of blood pressure in the past, and reduced cardiovascular mortality all possible contributors. Acceptance policies into the kidney replacement therapy program for patients in the older age groups have also changed, meaning more people in these age groups are being treated for ESKD.



Note: Age-standardised to the 2001 Australian population.
Source: AIHW analysis of ANZDATA Registry data.

Figure 1: Trend in incidence of treated end-stage kidney disease, 2000–2007

Recent trends show that in 2004 diabetic nephropathy became the leading cause of treated ESKD—overtaking glomerulonephritis (McDonald et al. 2008). Of the 2,311 new cases of treated ESKD in 2007, the major underlying disease causes were diabetic nephropathy (31%), glomerulonephritis (25%) and high blood pressure (16%) (Box 1).

Over the period 2000 to 2007 the number of new cases of ESKD attributed to diabetic nephropathy increased by two-thirds in those aged 55 years and over. However, no significant increase was seen in the under 55 year age group and no significant decrease in other causes was seen in either age group. This reflects an increase in the number of new cases caused by diabetic nephropathy among those aged 55 years and older, rather than a decrease in other causes. Glomerulonephritis remains the major cause of ESKD in those aged less than 55 years.

Box 1: Major underlying disease causes of end-stage kidney disease

Diabetes and diabetic nephropathy

The most common cause of ESKD can be attributed to diabetes—a chronic condition in which blood sugar levels are too high (McDonald et al. 2008). Diabetes occurs when the body produces too little or none of the sugar regulating hormone insulin, or cannot use it properly. High blood sugar levels can damage the blood-filtering capillaries in the kidneys.

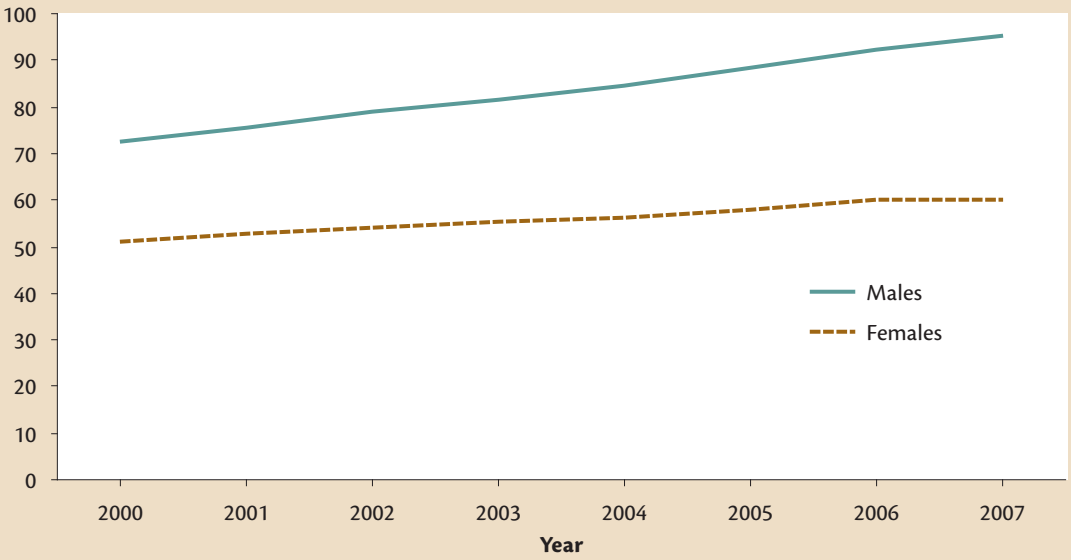
Glomerulonephritis

Glomerulonephritis involves inflammation and damage of the filtering units of the kidneys (glomeruli), affecting their ability to filter waste products and excess water from the blood. Chronic glomerulonephritis can be caused by infections, immune diseases, inflammation of the blood vessels or conditions that scar the glomeruli, however often the cause is unknown (Chadban & Atkins 2005).

High blood pressure

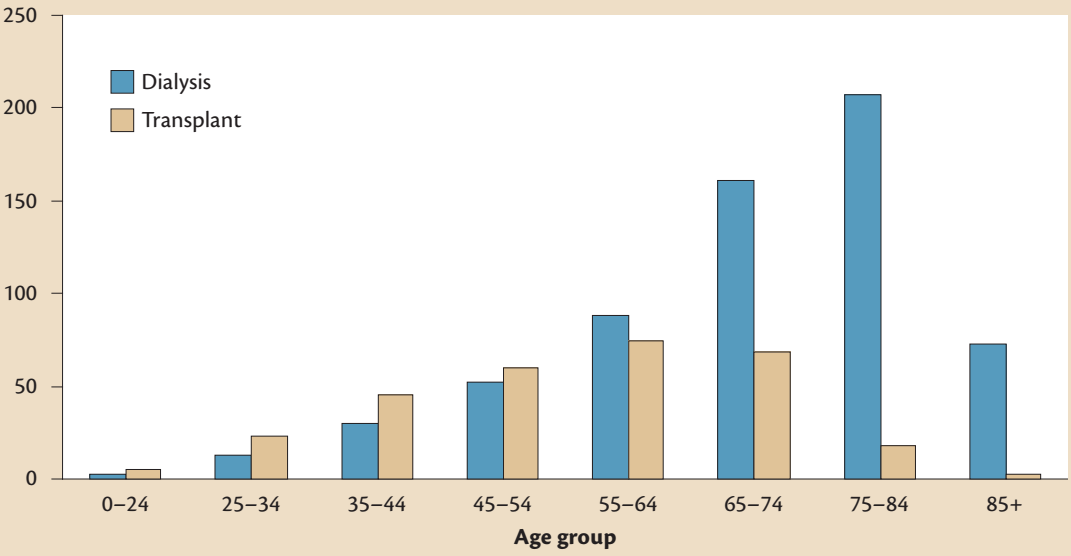
High blood pressure (hypertension) can damage the blood vessels supplying the kidneys. The walls of these blood vessels become thick and the internal diameter narrowed, leading to reduced blood supply and decreased kidney function. Factors that contribute to high blood pressure include, age, obesity, high alcohol consumption and high dietary salt (National Heart Foundation of Australia 2008).

Recent trends in the age-standardised prevalence rates of treated ESKD in the population show a significant increase from 2000 to 2007, particularly in males (Figure 2). Over this period the prevalence of ESKD increased by 31% for males (from 73 to 95 per 100,000 population) and by 19% for females (from 51 to 60 per 100,000). Overall, the number of people receiving dialysis treatment increased from 6,409 people at the end of 2000 to 9,642 at the end of 2007, whilst the number of people with a transplant increased from 5,296 to 7,128. The age profile of people receiving treatment for ESKD highlights the higher prevalence of ESKD in older Australians (Figure 3), with the highest rates among those aged 65–84 years.



Note: Age-standardised to the 2001 Australian population.
Source: AIHW analysis of ANZDATA Registry data.

Figure 2: Trends in prevalence of treated end-stage kidney disease, 2000–2007



Source: AIHW analysis of ANZDATA Registry data.

Figure 3: Prevalence of dialysis and functioning kidney transplants, 2007

3 Risk factors for CKD

An important step in reducing the burden of chronic kidney disease is to identify and monitor factors that contribute to susceptibility, initiation and progression of the disease. Monitoring CKD risk factors can help to explain trends in prevalence, incidence, hospitalisations and deaths, as well as help to indicate the success of health-related campaigns.

Risk factors for CKD can be grouped into three broad categories of risk factors: fixed, behavioural and biomedical (Table 2). Many of the risk factors for CKD also apply to other chronic diseases such as cardiovascular disease and diabetes, which in turn are risk factors for CKD. Many people have multiple risk factors, which can considerably increase the risk of developing CKD. More detailed information on CKD risk factors is available in *Chronic Kidney Disease in Australia, 2005* and *Outline of the National Centre for Monitoring Chronic Kidney Disease* (AIHW 2005; AIHW 2009).

Table 2: Risk factors for chronic kidney disease

Fixed	Behavioural	Biomedical
Family history and genetics	Tobacco smoking	Diabetes
Increasing age	Physical inactivity	High blood pressure
Previous kidney disease or injury	Poor nutrition	Cardiovascular disease
Low birth weight		Overweight and obesity
Male sex		Systemic kidney inflammation

The 1999–2000 AusDiab Survey and the 2004–05 National Health Survey (NHS) can provide prevalence estimates for many of the common risk factors for CKD, while the 2007 National Drug Strategy Household Survey (NDSHS) provides the most recent estimate of smoking rates. One of the major differences between the surveys is that the AusDiab Survey collected measured risk factor information for high blood pressure, diabetes and obesity, while the NHS and NDSHS collected self-reported information for all risk factors. The measured prevalence of diabetes and high blood pressure taken from the AusDiab survey was more than double those identified by self-report in both the AusDiab and the NHS. This was due, at least partly, to the measurement survey being able to identify undiagnosed cases. A major advantage of the AusDiab survey is that risk factor data can be compared between people with and without CKD (Table 3). However, a disadvantage is that these data are now almost 10 years old and response rates in the survey were low compared with the NHS (Dunstan et al. 2002).

Table 3: Prevalence of major risk factors for chronic kidney disease people aged 25 years and over, 1999–2000

Risk factor[a]	People without CKD	People with CKD stages 1–5[b]	All people
		Per cent[c]	
Diabetes	6.6	14.2	7.6
Cardiovascular disease	6.4	10.2	7.8
High blood pressure	27.8	39.1	30.0
Smoking	15.7	17.6	16.0
Obesity	20.0	25.7	20.6

(a) AusDiab 1999–2000 only surveyed persons aged 25 years and over. Measurements were taken to assess diabetes status, blood pressure and obesity, whilst participants self-reported cardiovascular disease and smoking status.
(b) Stages of CKD were developed by the United States Kidney Disease Outcome Quality Initiative (K/DOQI) (National Kidney Foundation of America 2002)
(c) Prevalence estimates were determined by calculating estimated glomerular filtration rates based on blood creatinine levels. The Modification of Diet in Renal Disease '175' formula was used as recommended by the Australasian Creatinine Consensus Working Group (Mathew et al. 2007).

Notes

1. Evidence of kidney damage for stages 1 and 2 was determined by presence of proteinuria or haematuria.
2. Directly age-standardised to the 2001 Australian population.
3. Missing values were excluded from the numerator and denominator.

Source: AIHW analysis of the1999–2000 AusDiab Survey.

From the 2004–05 NHS, the percentage of people who reported having diabetes, cardiovascular disease or high blood pressure, or who were currently smoking or obese, are listed below (Table 4). This table highlights the large number of people who have an increased risk of CKD.

Table 4: Prevalence of major risk factors for chronic kidney disease, self-reported data, 2004–05

Risk factor	Age group				
	Under 25	25–44	45–64	65+	All ages
			Per cent		
Diabetes[a]	0.2	1.3	5.7	13.7	3.6
Cardiovascular disease[b]	2.0	10.7	30.4	60.4	18.8
High blood pressure[c]	0.2	3.3	19.2	39.4	10.7
Smoking[d]	16.1	26.3	19.2	8.8	16.6
Obesity[e]	5.8	16.6	21.3	14.5	15.9

(a) Diabetes included all persons self-reporting type 1, type 2 and unknown type diabetes but excludes gestational diabetes.
(b) Cardiovascular disease prevalence methodology available at <http://www.aihw.gov.au/cvd/methodological_issues.cfm>.
(c) High blood pressure included all persons self-reporting high blood pressure.
(d) Recent smokers data is from the 2007 National Drug Strategy Household Survey. Includes persons 14 years and over (under 25 = 14 to 24 years), who were currently smoking daily, weekly or less than weekly and had smoked 100 cigarettes (manufactured and/or roll-your-own) or the equivalent tobacco, and had not since permanently ceased smoking.
(e) Self-reports of height and weight, for all persons aged 15 years and above, were used to determine body mass. Body mass index (BMI) was calculated by dividing the weight (kg) of a person by the square of their height (m). Obese category included all persons with a BMI ≥30.

Source: AIHW analysis of the 2004–05 ABS National Health Survey and 2007 National Drug Strategy Household Survey.

4 Health service use for CKD

Visits to general practitioners

General practitioners (GPs) are the usual source of initial assessment and diagnosis of chronic kidney disease. GPs have a variety of options available to treat and manage CKD, including referral to a specialist, ordering imaging or pathology tests and prescribing medications. Information about the use of GP services by people with CKD can be gained from the Bettering the Evaluation and Care of Health (BEACH) annual survey of general practice (Appendix 1). A coding list to identify CKD in the BEACH survey has previously been defined (AIHW 2009, see Appendix 2). In 2007–08, CKD problems were managed at a rate of around 4 per 1,000 GP encounters. This equates to nearly 400,000 Medicare-paid GP consultations across Australia. The most common CKD problem managed was described as 'chronic kidney failure'.

Recently, a sub-study of the BEACH annual survey conducted between May and June of 2008 provided more insight into the management and treatment of CKD in general practice. General practice data are classified according to the International Classification of Primary Care, 2nd edition (ICPC-2) (AIHW 2005, see Appendix 2). Based on 2,474 GP encounters of patients aged 24 years and over, 10.4% of patients attending general practice in this sample had diagnosed CKD. Of these 258 patients: 11.4% were at stage 1; 30.7% at stage 2; 45.7% at stage 3; 9.1% at stage 4, and 1.6% at stage 5. Of the 143 patients with stage 3–5 CKD, 95% provided information about the management of their CKD. These data show that just over half had undergone a kidney ultrasound in the previous 5 years, almost 60% had their level of proteinuria assessed, almost 40% had been referred to a nephrologist and 75% were taking cardiovascular medications (ACE inhibitors and angiotensin II receptor antagonists) (unpublished data AGPSCC 2008, provided courtesy of AGPSCC and Abbott Australia).

Hospitalisations

People with CKD, particularly those with end-stage kidney disease, often require hospitalisation for treatment and management. In Australia, information about hospital services is available from the AIHW National Hospital Morbidity Database (NHMD, see Appendix 1). A coding list to identify CKD in Australian hospital data has previously been defined (AIHW 2009, see Appendix 2). A recent update to this coding implemented in June 2008 will in the future allow hospitalisations to be reported by stages of CKD.

For CKD, the NHMD captures three distinct types of hospitalisation: episodes of treatment for people with ESKD who receive dialysis (regular or same day dialysis as a principal diagnosis); other hospitalisations where CKD is the primary reason for admission (principal diagnosis); and hospitalisations for other diseases where CKD coexists or affects that admission (additional diagnosis).

In 2006–07 there were 933,772 episodes of regular dialysis where CKD was the principal diagnosis, 29,943 other hospitalisations where CKD was the principal diagnosis and 157,633 where CKD was recorded as an additional diagnosis. Admission for regular dialysis and other hospitalisations where CKD was the principal diagnosis equated to 12.7% of all hospitalisations—occupying over 1 million hospital bed days or 4% of all bed days in that year.

Regular dialysis

There were 933,772 hospitalisations for dialysis as a principal diagnosis in 2006–07, equating to approximately 12.3% of all hospitalisations and 3.7% of all bed days in Australia that year. This highlights the burden dialysis places on the hospital system. However, admissions for dialysis are nearly always for a partial day and in specialised facilities, and therefore do not use the same facilities as most other hospitalisations.

The high number of dialysis hospitalisations reflects the need for people with ESKD to receive regular dialysis—usually three times per week. Haemodialysis represents almost all of the CKD dialysis hospitalisations (929,427 hospitalisations or 99.5%), with only 4,345 hospitalisations for peritoneal dialysis in 2006–07. As described in Box 2 (page 12), haemodialysis requires specialised equipment and while some haemodialysis is now performed at home, a large proportion is still performed in hospital. Regular peritoneal dialysis requires less complex apparatus and is nearly always performed at home and therefore not captured by hospital data.

CKD as a principal diagnosis (excluding dialysis)

If CKD is the primary reason for hospitalisation, it is recorded as the principal diagnosis. In 2006–07, CKD (excluding regular dialysis) was recorded as the principal diagnosis in 29,943 hospitalisations. Kidney tubulo-interstitial diseases (7,213 hospitalisations) were the largest group; however, hospitalisations for diabetic nephropathy accounted for the most number of hospital bed days (44,455 days), with an average length of stay of almost 8 days (Table 5). Transplant procedures had the longest average length of stay of over 11 days per procedure.

Table 5: Chronic kidney disease hospitalisations, 2006–07

Principal diagnosis	Number of hospitalisations	Number of bed days	Average length of stay
Diabetic nephropathy	5,669	44,455	7.8
Hypertensive kidney disease	667	3,941	5.9
Glomerular diseases	2,551	8,547	3.4
Kidney tubulo-interstitial diseases	7,213	25,622	3.6
Chronic kidney failure	5,148	30,329	5.9
Unspecified kidney failure	370	2,012	5.4
Other disorders of kidney and ureter	1,870	6,737	3.6
Congenital malformations	1,261	4,290	3.4
Complications related to dialysis and kidney transplant	1,163	3,777	3.2
Preparatory care for dialysis	4,031	5,720	1.4
Total	**29,943**	**135,430**	**4.5**
Transplant procedures[(a)]	*659*	*7,423*	*11.3*

(a) The number of kidney transplants was determined using kidney transplant procedure coding, rather than principal diagnosis coding.
Source: AIHW National Hospital Morbidity Database.

CKD as an additional diagnosis

In situations where CKD coexisted with another principal diagnosis and required treatment during hospitalisation, CKD is recorded as an additional diagnosis (Table 6). In 2006–07, there were 157,633 hospitalisations where this occurred. Some common principal diagnoses recorded, where CKD was an

additional diagnosis, included cardiovascular diseases (34,181), respiratory diseases (12,788), digestive system disease (11,838) and diabetes (9,136).

Comorbidity of cardiovascular disease (CVD), diabetes and CKD has been reported elsewhere (AIHW: Tong & Stevenson 2007). In 2006–07, there were 74,285 hospitalisations with a diagnosis (principal and additional) of cardiovascular disease, diabetes and CKD, 48,784 with a diagnosis of CVD and CKD (without diabetes), and 12,674 with a diagnosis of diabetes and CKD (without CVD).

Table 6: Hospitalisations with an additional diagnosis of CKD, 2006–07

Principal diagnosis (ICD-10-AM code)	Number of hospitalisations	Per cent
Diseases of the circulatory system (I00–I99)[a]	34,181	21.7
Ischaemic heart disease (I20–I25)	*11,241*	*7.1*
Diseases of the respiratory system (J00–J99)	12,788	8.1
Pneumonia (J12–J18)	*5,153*	*3.3*
Endocrine, nutritional and metabolic diseases (E00–E89)[b]	13,371	8.5
Diabetes (E10–E14)[b]	*9,136*	*5.8*
Other diseases of the genitourinary system (N30–N99)	11,527	7.3
Diseases of the digestive system (K00–K93)	11,838	7.5
Symptoms, signs involving the circulatory and respiratory systems (R00–R09)	3,436	2.2
Complications of surgical and medical care, not elsewhere classified (T80–T88)	7,587	4.7
Neoplasms (C00–D48)	8,841	5.6
Care involving use of rehabilitation procedures (Z50.9)	7,335	4.8
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50–D89)	5,970	3.8
Infectious and parasitic diseases (A00–B99)	5,214	3.3
Diseases of the musculoskeletal system and connective tissue (M00–M99)	5,887	3.7
Other diseases and conditions	29,658	18.8
Total	**157,633**	**100**

(a) Excludes hypertensive kidney disease.
(b) Excludes diabetic nephropathy.
Source: AIHW National Hospital Morbidity Database.

Trends

From 2000–01 to 2006–07 both the number and rate of hospitalisations for CKD increased. Over this period hospitalisations where CKD was the principal diagnosis (excluding dialysis) increased by just over 10%, from 125 to 140 per 100,000 people. Hospitalisations where CKD was an additional diagnosis increased by 37%, from 518 to 711 per 100,000 people. Males had higher rates than females for hospitalisations where CKD was an additional diagnosis, whilst rates where CKD was the principal diagnosis were similar among males and females.

Ongoing treatment of CKD

The treatment and management of all stages of CKD involves addressing the underlying causes and ensuring that progression is slowed as much as possible. In many cases this may involve taking medications, avoiding substances that are toxic to the kidneys or making lifestyle changes to control risk factors. People with ESKD usually require kidney replacement therapy (dialysis or kidney transplant) in order to survive, in addition to taking medications regularly and continuing lifestyle modifications. Information relating to the kidney replacement therapy is available from the ANZDATA

registry (Appendix 1). The method and location of dialysis treatment for ESKD will depend on a variety of factors, including a person's specific clinical disease, where they live, advances in dialysis treatment and the types of services offered at their hospital or kidney clinic. The number of kidney transplants performed per year largely depends on the number of available donor kidneys. National and state-based allocation schemes determine who receives deceased donor kidneys, whereas close family members (not necessarily genetically related) are predominantly the source of live donor kidney transplants.

Medications

Taking medications is an important component of managing and treating all stages of CKD. Medications are used to slow the progression of disease, treat underlying causes and contributing factors (such as diabetes, high blood pressure, cardiovascular diseases and cholesterol), treat complications of disease, and replace lost kidney function.

The pharmaceutical benefits scheme (PBS) is a valuable source of data to monitor prescriptions filled for medications that are subsidised on the PBS or the repatriation pharmaceutical benefits scheme (RPBS). However, accurately monitoring the medications used to treat CKD and its complications is difficult because in many cases they are also used for other conditions and the PBS does not assign a diagnosis to each prescription. There are two highly specialised medications, however, which have recently been listed on the PBS and are only subsidised when prescribed for patients diagnosed with CKD on dialysis—sevelamer and cinacalcet. Sevelamer is used to reduce the level of phosphorous in the blood, reducing the incidence of high levels of calcium and cinacalcet is used to treat secondary hyperparathyroidism. Between its listing in December 2007 and 31 December 2008, sevelamer has been provided 12,712 times and $4,651,469 paid in benefits by the Australian Government (an average of $365.91 per prescription). Cinacalcet, which comes in three strengths, has been provided 1,434 times between its listing on the PBS in July 2008 and 31 December 2008, and $666,665 paid in benefits.

The ANZDATA registry provides some information on medications taken by people receiving kidney replacement therapy. People receiving dialysis are commonly prescribed erythropoietic medications for management of anaemia. In 2006, almost 90% of haemodialysis patients were taking these medications whereas just over 80% of peritoneal dialysis patients were. For those who receive a kidney transplant, medications known as immunosuppressants are prescribed to help prevent rejection of the transplanted kidney. In 2007, the most commonly used drugs as initial treatment for kidney recipients from deceased donors were prednisolone (prescribed for 99% of recipients), mycophenolate mofetil (85%), tacrolimus (49%) and cyclosporine (48%).

Dialysis

At the end of 2007, 9,642 people were receiving dialysis, of which 7,536 were receiving haemodialysis and 2,106 peritoneal dialysis. Haemodialysis is commonly performed in hospitals or specialised dialysis centres known as satellite centres (Box 2). Satellite dialysis centres are usually located away from their parent hospital. They decrease the travel burden that people living in regional areas face to access dialysis services, often removing the need for relocation. Over half (57%) of the people receiving haemodialysis treatment in 2007 did so at satellite centres, while 30% received it at a hospital and the remaining 13% performed haemodialysis at home. Since 2000, the number of people receiving haemodialysis markedly increased—from 4,670 people to 7,536 in 2007. The majority of this growth was in the number of people using satellite dialysis centres, which almost doubled between 2000 and 2007 (Figure 4).

Between 2000 and 2007, the number of ESKD patients using peritoneal dialysis increased from 1,739 to 2,106. However, over the same period the proportion of all ESKD patients using peritoneal dialysis steadily declined from 27% to 22%, reflecting the larger increase in haemodialysis use. Over the seven year period there was a shift in the type of peritoneal dialysis used. The number of patients using continuous ambulatory peritoneal dialysis (CAPD) decreased from 1,348 to 980 in 2007 (from 21% to 10% of all ESKD patients), whilst the number of patients using automated peritoneal dialysis increased from 391 to 1,126 over the same period (from 6% to 11.5%) (Figure 5).

Box 2: Dialysis

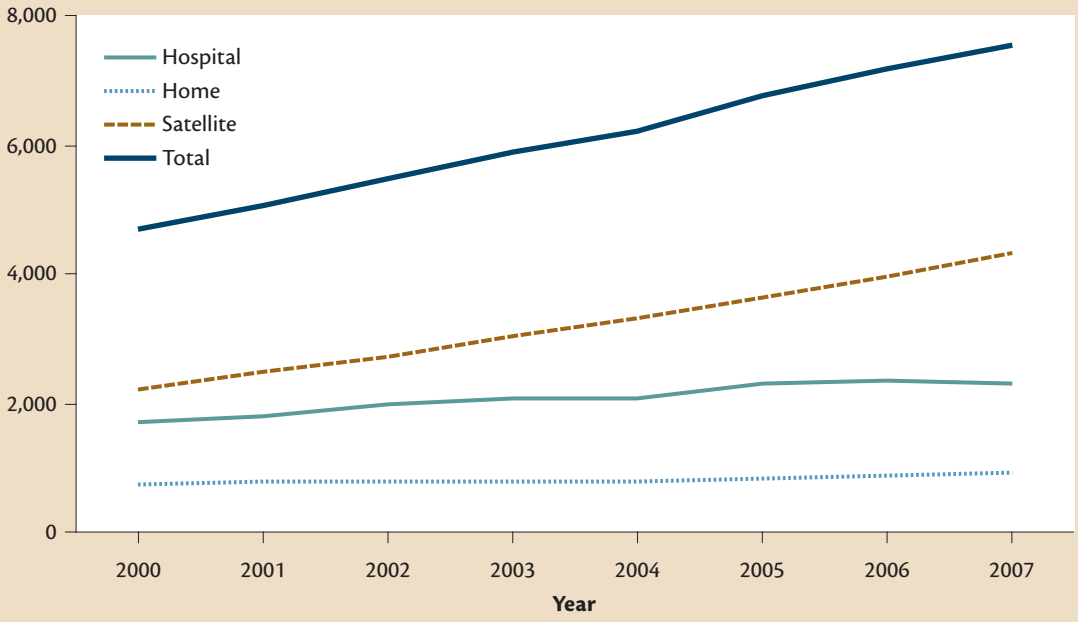
Dialysis is an artificial way of removing waste substances from the blood, a function usually performed by the kidneys. There are two main forms of dialysis: peritoneal dialysis, which occurs inside the body; and haemodialysis, which occurs outside the body. Which form is used depends on the patient's health, age and lifestyle and may also be influenced by the availability of local resources.

Haemodialysis

In haemodialysis blood is diverted from the body to a dialysis machine, where it is filtered before being returned to the body. This type of dialysis can be done at home, in hospital, or in satellite clinics; however, the machine requires special plumbing and therefore the patient must limit their travel to places where dialysis facilities are available. In most cases the patient requires assistance connecting to the machine, and a partner, relative or friend can be trained to do this for home dialysis patients. During haemodialysis the patient is usually connected to the machine for around 4–5 hours three times per week, during which time all their blood passes through the machine approximately six times. If performed at home patients may have the option of dialysing more frequently for a shorter period (5–7 times per week for around two hours) or nocturnally (six nights per week for around eight hours). During a haemodialysis session the patient cannot get up and move away from the machine, though they can perform activities which do not require much movement such as sleeping, reading, talking, or using a computer.

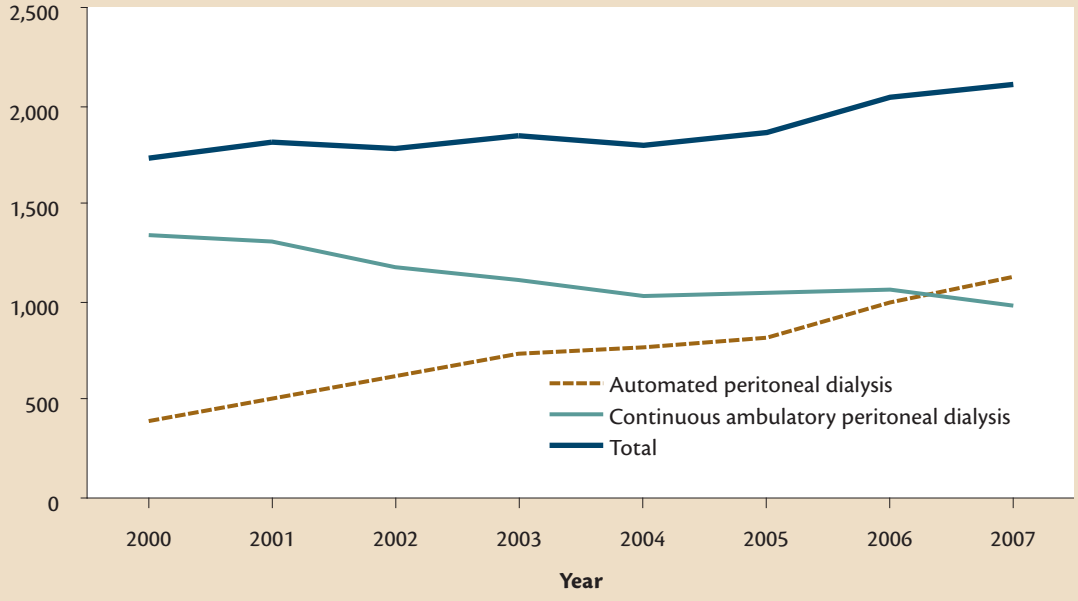
Peritoneal dialysis

In peritoneal dialysis, the dialysis solution is pumped into the abdomen and the blood is filtered through the peritoneal membrane (the abdominal cavity which covers organs such as the stomach, liver and intestines). The dialysis solution contains a type of sugar (usually glucose or dextrose) which draws the waste products and extra fluid out of the blood, through the peritoneal membrane and into the solution. After a few hours, the used solution, now containing the wastes and extra fluid, is drained out of the body and replaced with fresh solution. This process is called an exchange, and takes about 30–45 minutes. In between exchanges, the patient is free to continue their usual activities. Peritoneal dialysis can either be performed by the patient during the day (continuous ambulatory peritoneal dialysis), usually three or four times, or automatically by a machine at night for around 8–10 hours while the patient sleeps (automated peritoneal dialysis). As the necessary equipment is portable, peritoneal dialysis can be performed almost anywhere. The patient does not need to be in a hospital or clinic, and can usually manage the procedure without assistance.



Source: AIHW analysis of ANZDATA Registry data.

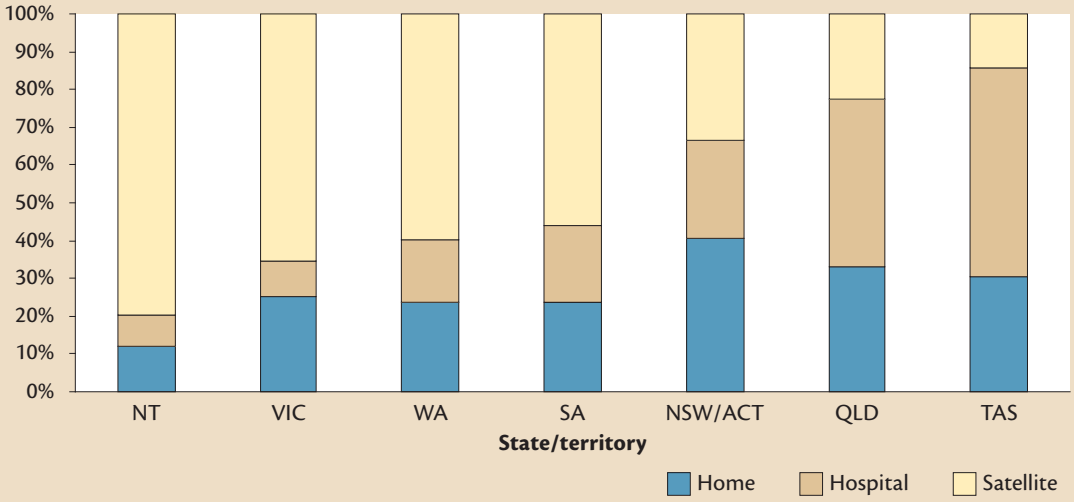
Figure 4: Trends in location of haemodialysis for ESKD, 2000–2007



Source: AIHW analysis of ANZDATA Registry data.

Figure 5: Trends in type of peritoneal dialysis for ESKD, 2000–2007

The type of dialysis treatment varies significantly between the states and territories of Australia. For example, in 2007 almost 80% of dialysis services were provide by satellite centres in the Northern Territory, whereas in Tasmania only 15% of dialysis was performed in satellite centres (Figure 6). The highest use of home dialysis was in New South Wales/Australian Capital Territory where 40% (1,367 people) were receiving haemodialysis or peritoneal dialysis at home.



Source: AIHW analysis of ANZDATA Registry data.

Figure 6: Dialysis treatment location by state and territory, 2007

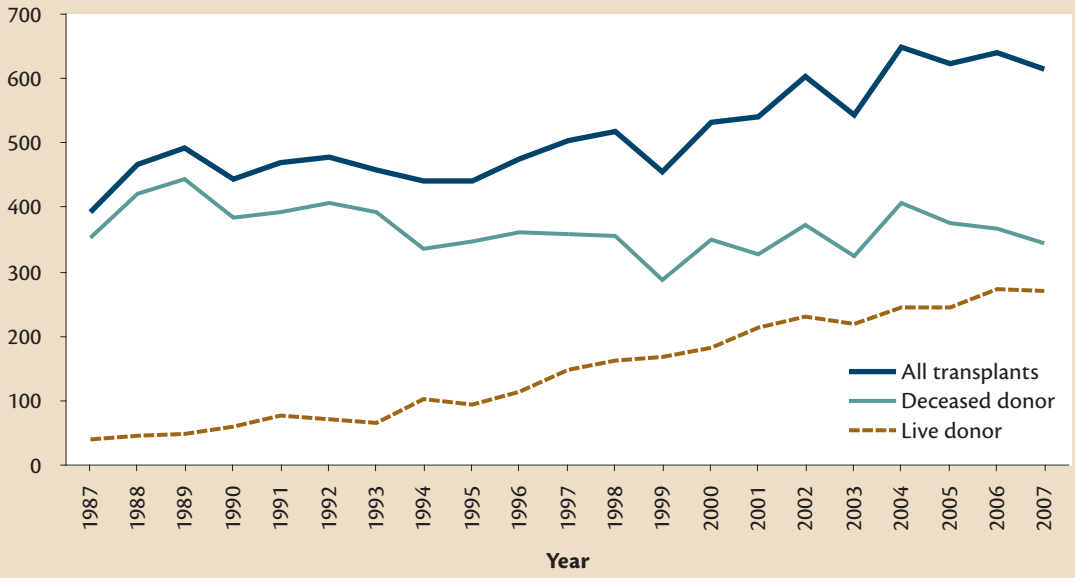
Transplant

Transplantation is considered the preferred option for kidney replacement therapy by patients and healthcare professionals (Mathew et al. 2005). Kidney transplantation is not a cure for ESKD however; recipients live with the possibility of chronic rejection and the loss of the donor kidney. This can mean a return to dialysis, as well as side-effects associated with anti-rejection medications and comorbid conditions. The advantages of transplantation over dialysis include a lower long-term mortality risk, increased quality of life, and lower costs (CARI 2007). As at 31 December 2007, only 13% (1,264) of the 9,642 patients receiving dialysis were on the kidney transplant waiting list.

A number of factors can prevent people from being considered for kidney transplantation in Australia, including: age, other health conditions, obesity, smoking, drug and alcohol abuse, or having a history of not taking appropriate medications while on dialysis. The rate of organ donation in Australia is low compared to other developed countries, and the largest transplant waiting list by far is for a kidney transplant (ABS 2002). Once on the kidney transplant waiting list, the average waiting time for a deceased donor is around three to four years (Kidney Health Australia 2006). The more time spent on dialysis prior to transplantation increases mortality risk and decreases donor kidney survival rates (CARI 2007).

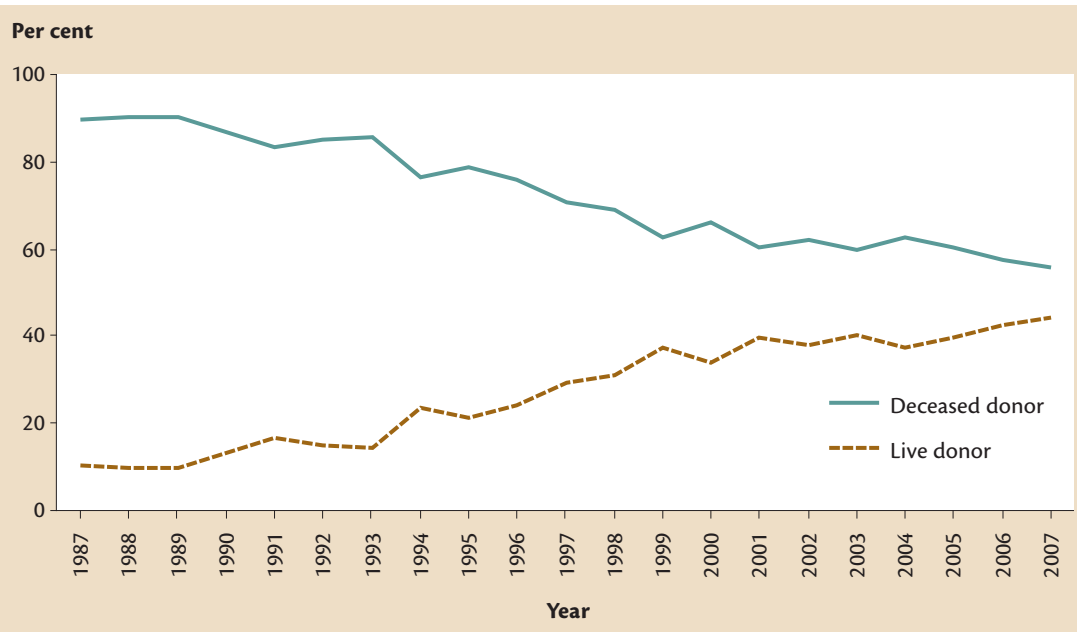
During 2007, there were 615 kidney transplant operations in Australia—a decrease of 4% from 2006 but still almost 16% higher than in 2000 (Figure 7). The proportion of dialysis patients receiving a kidney transplant has decreased each year, from 6.6% in 2004 to 5.2% in 2007. About 56% of kidney transplants performed in 2007 were from a deceased donor and the great majority (93%) were performed in people aged under 65. Most people (89%) who received a transplant had previously been on dialysis, whilst for the other 11% transplantation was their first mode of kidney replacement therapy (a pre-emptive transplant).

Although the number of deceased donor transplants decreased slightly over the past 20 years (since 1987, to 2007), the number of kidney transplant operations performed each year increased by more than 50%. This is due to a more than six-fold increase in the number of live donor transplants performed each year (Figure 7). As a result, live donor kidney transplants in 2007 represented about 44% of transplants, compared to 10% in 1987 (Figure 8). Around 23% of all live donor transplants in 2007 were pre-emptive, whilst 43% of recipients had been on dialysis for 12 months or more.



Source: AIHW analysis of ANZDATA Registry data.

Figure 7: Number of kidney transplants, 1987–2007



Source: AIHW analysis of ANZDATA Registry data.

Figure 8: Proportion of kidney transplants, by donor source, 1987–2007

5 CKD mortality

Chronic kidney disease is a significant contributor to mortality in Australia. This is supported by data from the AIHW National Mortality Database, which records cause of death information for all deaths registered in Australia. CKD can be recorded as the underlying cause (the condition that initiated the train of events leading directly to an individual's death), or an associated cause (any other condition that is considered to have contributed to the death).

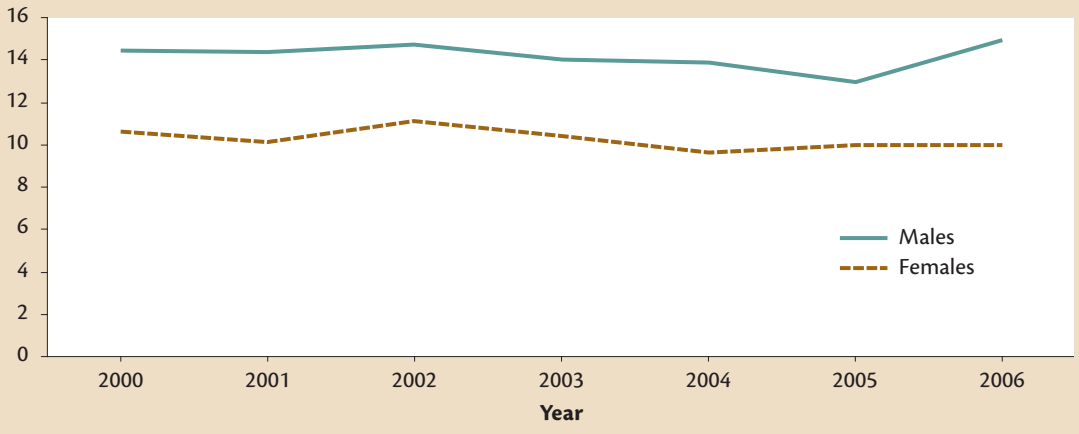
In 2006, CKD was listed as an underlying or associated cause of death (CKD related deaths) in 12,989 cases—9.7% of all deaths in that year. CKD was listed as the underlying cause in about one-fifth of these deaths (1,331 male and 1,374 female). 'Chronic kidney failure' (1,171 deaths) and 'unspecified kidney failure' (597 deaths) were the two leading types of CKD recorded as the underlying (and associated) cause of death from CKD in 2006 (Table 7).

The male and female age-standardised mortality rates have remained relatively stable between 2000 and 2006 (Figure 9).

Table 7: Number of deaths from CKD, 2006

Type of chronic kidney disease[a]	Underlying cause of death	Associated cause of death
Diabetic nephropathy	131	71
Hypertensive kidney disease	581	257
Glomerular diseases	73	110
Kidney tubulo-interstitial diseases	57	114
Chronic kidney failure	1,171	5,475
Unspecified kidney failure	597	4,176
Others disorders of the kidney and ureter	44	202
Congenital malformation of the kidney and ureter	51	51
Total	**2,705**	**10,284[b]**

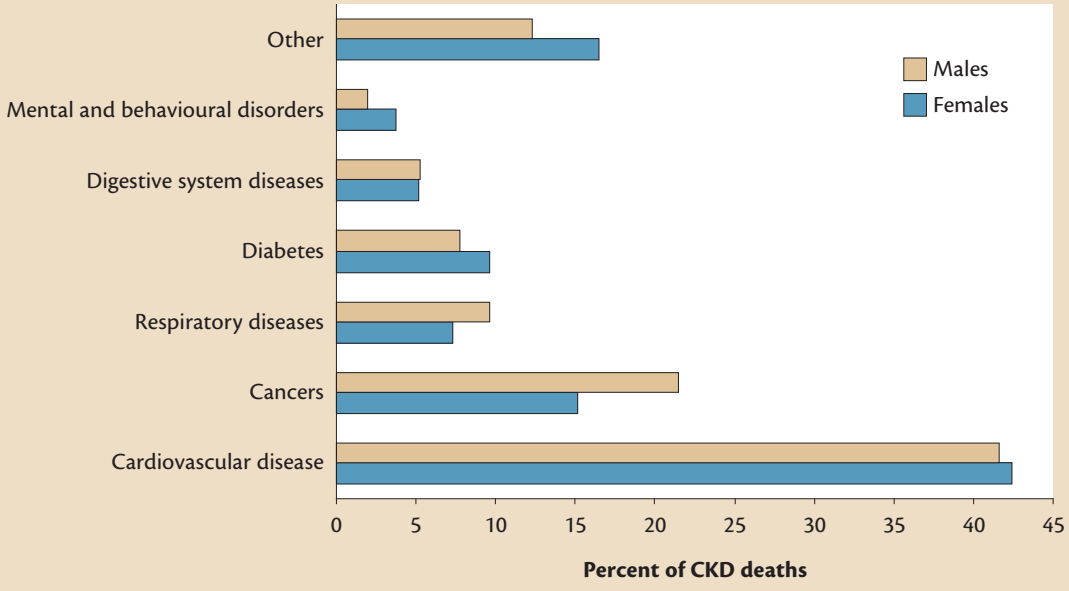
(a) ICD-10 codes used for diagnosis groups available in Appendix 2.
(b) Column will not add to total as more than one type of kidney disease may have been recorded.
Source: AIHW National Mortality Database.



Note: Directly age-standardised to the 2001 Australian population.
Source: AIHW National Mortality Database.

Figure 9: Trends in CKD mortality where CKD is the underlying cause of death, 2000–2006

In 2006, there were 10,284 deaths where CKD was recorded as an associated cause of death—5,681 male deaths and 4,603 female deaths. For 42% of these, the underlying cause was disorders of the circulatory system—highlighting the well-established relationship between cardiovascular disease and CKD (Figure 10).



Source: AIHW National Mortality Database.

Figure 10: Underlying causes of death when CKD is an associated cause, 2006

There are some limitations on cause of death data for CKD based on death certificates. In a study assessing the concordance of underlying and associated causes of death on death certificates with ANZDATA registry reports, Li et al. (2003) found that for 20% of ANZDATA patients who died during 1997–1999, no mention was made of chronic kidney failure as an underlying or associated cause of death on their death certificate. Further, despite being responsible for 22% of new ESKD cases in 2000, no deaths were attributed to diabetic kidney failure, either as an underlying or associated cause, for this period.

ANZDATA collects information on survival for people receiving kidney replacement therapy. For the period 2003–2005, 3-year survival for patients receiving haemodialysis was 64%, changing little since the 1994–1996 period. Conversely, there was some improvement in survival for people receiving peritoneal dialysis, increasing from 54% to 64%. Irrespective of the type of dialysis treatment people are receiving, a comorbidity of diabetes decreases their chance of survival (McDonald et al. 2008).

For people who have received a kidney transplant, survival outcomes are far more favourable, highlighting transplant as the best form of kidney replacement therapy. The most recent 5-year data, for those who had a kidney transplant in 2001–2002, show a 90% survival outcome for deceased donor kidney transplants and a 95% survival for live donor kidney transplants. Whilst the difference in survival rates between dialysis and transplant patients may be due to the better health and long-term survival chances of patients placed on the kidney transplant waiting list, an observational study of ESKD patients registered with ANZDATA between 1991 and 2000 found transplant recipients had a 80% lower long-term mortality risk than dialysis patients on the transplant waiting list (Cass et al. 2006).

6 CKD in Aboriginal and Torres Strait Islander peoples

Chronic kidney disease is a significant contributor to morbidity and mortality among Indigenous Australians (ABS & AIHW 2008). It has been well-established that the overall incidence rate of ESKD in Indigenous Australians is significantly higher than for non-Indigenous Australians (McDonald et al. 2008). A number of factors contribute to this, including the generally poorer socioeconomic situation of Indigenous Australians, their higher rates of risk factors, time to diagnosis and access to ESKD treatment centres (Cass et al. 2002a; 2002b; 2001b). However, although Indigenous Australians as a whole have higher rates of ESKD, vast differences are observed in rates between Indigenous communities (Cass et al. 2001a).

In addition to the risk factors previously outlined in this report, it is important to acknowledge that Indigenous Australians are also at increased risk of developing CKD from other risk factors (McDonald & Hoy 2005). These factors are less common in non-Indigenous Australians, and include low birthweight, which is linked to reduced nephron development and lower GFRs, and inflammation, among others (Hoy et al. 2006; Hughson et al. 2003).

Box 3: CKD data snapshot for Indigenous Australians

Prevalence

- An estimated 1.5%(7,500) of Indigenous Australians have kidney disease as a long-term health condition based on self-reported data (AIHW: Penm 2008).
- Of the 2,311 people commencing kidney replacement therapy in 2007, 218 (9%) identified as Aboriginal or Torres Strait Islander, although Indigenous Australians made up only 2.5% of the total population.
- At the end of 2007, there were 1,213 Indigenous Australians receiving treatment for their ESKD (7.2% of all treated ESKD and 6 times the rate of other Australians).

Hospitalisations

- In 2006–07 there were 104,727 dialysis hospitalisations for Indigenous Australians, representing around 11.5% of all dialysis hospitalisations (data presented for six states and territories only—see Appendix 1).
- There were also 10,684 other hospitalisations where CKD was the principal or additional diagnosis, a rate almost 7 times higher than for other Australians.

Mortality

- Between 2004 and 2006 in Queensland, Western Australia, South Australia and the Northern Territory, CKD was recorded as the underlying cause of death in nearly 4% of all Indigenous deaths (177 of 4,716 deaths).
- In the same period CKD was an associated cause in a further 557 Indigenous deaths.
- Rates where CKD was the underlying cause of death were 7 and 11 times as high as those for non-Indigenous males and females respectively in 2004–2006.
- The median age at death from CKD as the underlying cause among Indigenous Australians was 60 years for males and 62 years for females, compared with 82 years and 84 years among non-Indigenous Australian males and females respectively.

Sources: 2004–05 National Aboriginal and Torres Strait Islander Health Survey, ANZDATA registry, AIHW National Hospital Morbidity. Database and AIHW National Mortality Database.

7 Impact of CKD

Quality of life

Being diagnosed with CKD can significantly affect the quality of life of individuals, as well as their family and friends—particularly when kidney replacement therapy is required. The treatment and management of CKD, like other chronic diseases, may involve major lifestyle modifications. For the early stages, this can include controlling existing risk factors such as diabetes, high blood pressure, obesity and cardiovascular disease, through dietary modification, exercise and medications. Although there is little published information on the experience of the Australian CKD population, the AusDiab study of a cohort of the general population reported that people with CKD stage 3–5 have significantly poorer physical functioning, general health and vitality than the general population, and were more likely to report difficulties with their usual activities due to physical or emotional problems (Chow et al. 2003). It is when CKD progresses to the point where the kidneys do not function, and kidney replacement therapy becomes necessary, that the most significant impact on quality of life usually occurs.

Dialysis treatment only replaces some of the functions of the kidneys, such as the removal of waste products and excess fluids, and does not perform hormone and other homeostatic functions. Therefore relatively substantial pharmaceutical regimes are necessary to partly perform these other functions, and fluid restrictions and dietary control are also usually necessary. Common physical complaints identified by dialysis patients include muscle, bone and joint aches, sleep disturbances, itchy/dry skin, stomach upsets, poor concentration, coughing and shortness of breath, headaches, decreased sexual function, cramps and dizziness (Cass et al. 2006). Consequently, dialysis patients often have poor perceived health and vitality and are subject to progressive complications and accelerated co-morbidities.

Irrespective of the mode of dialysis, a very substantial time commitment is required for patients to receive adequate treatment. Satellite and hospital haemodialysis is usually carried out three times per week, each for 4–6 hours, whereas home haemodialysis can be carried out overnight (6–8 hours) on a more frequent basis. Continuous ambulatory peritoneal dialysis (CAPD) requires that the dialysis solution be exchanged every 4–6 hours, taking around 45 minutes each time. With an automated peritoneal dialysis (APD) these exchanges can occur automatically overnight, however an exchange may still be required during the day. Patients living in isolated areas may be able to access in-home dialysis, but otherwise need to frequently travel long distances or relocate. There is some evidence that long travel times to dialysis treatment is associated with higher mortality rates (Moist et al. 2008). Isolation and travel is a particular issue for Indigenous patients from remote communities, which may prevent such patients receiving adequate dialysis treatment and, in addition to cultural factors, contribute to persistently high rates of withdrawal (Spencer et al. 1998).

The combination of time demands and physical complaints experienced by those on dialysis treatment can lead to major changes in established patterns of social and economic participation. Dialysis patients can also face significant financial hardship from loss of income and higher out-of-pocket health costs. They have relatively high rates of depression and other psychological or interpersonal difficulties (Chilcot et al. 2008; Lew & Piraino 2005). Home life may be significantly disrupted and family members may be required to act as carers, particularly if people opt for home dialysis services.

Dialysis is a life saving treatment, but the above factors illustrate a high burden for patients that may extend over many years. Of the 1,452 deaths of dialysis dependent patients in 2007, 210 (14%) were attributed to voluntary withdrawal from treatment for psychosocial or access reasons and 290 (20%) to withdrawal from treatment for other medical reasons (McDonald et al. 2008).

Along with better survival rates, people with kidney transplants have better quality of life than those on dialysis (Cameron et al. 2000). Whilst a functioning kidney transplant affords those with ESKD a life without the frequent and time-consuming need for regular dialysis, medical supervision and medications are required for the life of the transplant. A number of side effects are associated with anti-rejection medications (immunosuppressants) such as infections, cardiovascular complications and higher rates of cancer. Nonetheless, it is almost universally accepted that post-transplant quality of life is superior to pre-transplant quality of life, mainly through gains in physical functioning. It is important to note that a kidney transplant does not return life to normal. People receiving kidney transplants still tend to have a lower quality of life compared with the general population (Dobbels et al. 2007).

Health expenditure

People with CKD are significant users of health care services—mainly due to the need for regular dialysis in end-stage kidney disease as discussed previously. In addition to these direct health care costs, other costs associated with CKD may include the costs of travelling for treatment, the social and economic burden on carers and family, and lost wages and productivity due to illness.

A summary of direct health care expenditure in 2000–01, drawn from the AIHW Disease Expenditure Database and additional analyses, has previously been published (AIHW 2005). This report estimated that the total recurrent health expenditure on CKD in 2000–01 was $647 million, of which just over 60% was for dialysis services. The report further outlined the expenditure relating to non-dialysis hospitalisations, out-of-hospital services, pharmaceuticals, research and other services. An updated analysis of CKD expenditure for 2004–05 will be presented in a forthcoming publication.

More recently, Kidney Health Australia have published a detailed analysis of the economic impact of ESKD in Australia (Cass et al. 2006). Their estimated costs of dialysis and transplant are shown in Table 8. Dialysis costs took into account the cost of equipment, buildings, maintenance, salaries and wages, consumables, revision of access, drugs, complications, and specialist consultations. Transplant costs included the cost of surgery and hospitalisation, immunosuppressive therapy, specialist review and consultations, and organ donor costs. The most expensive treatment is hospital dialysis, estimated to cost $82,764 per patient per year. At the end of 2007 hospital dialysis was used by 2,286 patients (23.7% of those on dialysis) at an estimated cost of $189.2 million per year. Satellite haemodialysis was the most commonly used dialysis treatment, with 4,308 patients (44.7%) using this form at cost of $48,031 per patient per year, or nearly $210 million per year. Transplant costs for the first year of patient's treatment were comparable to those for dialysis, but decrease significantly after that to around $10,700 per patient per year.

Table 8: Cost per person per year for different types of kidney replacement therapy, 2006

Type of kidney replacement therapy	Unit cost per year (AUD$)
Dialysis[a]	
Home haemodialysis	44,739
Satellite haemodialysis	48,631
Hospital haemodialysis	82,764
Continuous ambulatory peritoneal dialysis	56,828
Transplant[b]	
Live donor	70,553
Deceased donor	65,375

(a) Cost does not include initial access estimated to be $9,766 for haemodialysis and $9,259 for CAPD.
(b) Transplant cost is for the first year of a patient's treatment. From year 2 onwards, the ongoing cost per year was estimated at $10,749.
Source: Kidney Health Australia 2006.

Burden of disease

The *Burden of disease and injury in Australia 2003* report identifies and quantifies the impact of health problems in Australia, based in ICD-10 disease coding (AIHW: Begg et al. 2007). Chronic kidney disease, as defined in this report, is not a disease grouping in that report. However, the report presents data for 'renal failure', based on diabetes-related cases of ESKD from ANZDATA 2002 (AIHW: Begg et al. 2007). Renal failure was estimated to cause 2.6% of the total burden of disease and injury in Australia in 2003. Nearly 95% of this burden can be attributed to years of life lost due to premature death—representing just over 5% of the total years of life lost for all causes.

8 Conclusions and considerations

This report presents a national snapshot of available data on chronic kidney disease in Australia. The report highlights the burden of chronic kidney disease, in particular end-stage kidney disease, on hospital services and individuals—predominantly through the provision of dialysis services. With treated ESKD incidence and prevalence on the rise since 2000, this burden is expected to increase in the coming years. Addressing the common risk factors for CKD such as diabetes, high blood pressure and cardiovascular disease will be important for reducing incidence and the need for kidney replacement therapy.

The silent nature of the early stages of CKD presents challenges for monitoring the true impact of the disease. While the ANZDATA registry provides valuable information about ESKD, very little is known about the burden of CKD stages 1–4. The most recent biomedical survey, the 1999–2000 AusDiab survey, is a valuable source of information about undiagnosed CKD and measured risk factors, but was conducted almost 10 years ago. A recurring biomedical survey, in which blood, urine and body measurements are taken, would help to provide up-to-date information for ongoing monitoring and policy decisions.

Chronic kidney disease is a significant contributor of morbidity and mortality in the Australian population—particularly among Indigenous Australians. Recent developments in defining and conceptualising CKD has resulted in increased attention both nationally and internationally, however the burden of CKD in Australia is expected to rise through an increase in risk factors such as diabetes and an ageing population. Therefore obtaining national data from all stages of CKD will facilitate more effective monitoring of CKD in Australia.

Appendix 1 Data sources

AIHW National Hospital Morbidity Database contains demographic, diagnostic, procedural and duration of stay information on episodes of care for patients admitted to hospital. This annual data collection is compiled and maintained by the AIHW using data supplied by state and territory health authorities. The database is episode-based and it is not possible to count patients individually. Indigenous data in this report are presented for New South Wales, Victoria, Queensland, Western Australia, South Australia and public hospitals in the Northern Territory only, as these jurisdictions are considered to have adequate levels of Indigenous identification in morbidity data.

AIHW National Mortality Database contains information on the cause of death supplied by the medical practitioner certifying the death or by a coroner. Registration of deaths is the responsibility of the state and territory registrars of Births, Deaths and Marriages. Registrars provide the information to the ABS for coding of cause of death and the encoded data are then provided to AIHW. The database is updated annually. Indigenous data in this report are presented for Queensland, Western Australia, South Australia and the Northern Territory only, as these jurisdictions are considered to have adequate levels of Indigenous identification in mortality data.

Australia and New Zealand Dialysis and Transplant Registry (ANZDATA) collects information to monitor dialysis and transplant treatments from all renal units in Australia and New Zealand, on all patients receiving kidney replacement therapy where the intention to treat is long term. Cases of acute kidney failure are excluded. The Registry is coordinated within the Queen Elizabeth Hospital (South Australia). The data are published annually (see <www.anzdata.org.au>).

Australian Diabetes, Obesity and Lifestyle Study (AusDiab) conducted by the International Diabetes Institute in 1999–2000, was designed to provide national estimates of the prevalence of diagnosed and undiagnosed diabetes. It also provided national measurements of eGFR, albuminuria, proteinuria, haematuria, blood pressure, blood lipids, blood glucose, body fat, height and weight, and waist and hip circumference, as well as self-reported information on cardiovascular disease, anti-hypertensive and lipid lowering medication use, diet, smoking, alcohol consumption, physical activity, and general health and wellbeing. The study collected information in urban and non-urban areas in all states and the Northern Territory from more than 11,000 people aged 25 years and over who underwent a physical examination. This represents a response rate of 37% (Dunstan et al. 2002). Through linkage to the National Death Index, associations between indicators of CKD and mortality were also obtained.

Bettering the Evaluation and Care of Health, Survey of General Practice (BEACH) is an ongoing national survey looking at aspects of general practice in Australia, conducted by the General Practice Statistics and Classification Unit (an AIHW collaborating unit within the Family Medicine Research Centre, University of Sydney). BEACH began in April 1998 and involves a random sample of approximately 1,000 general practitioners per year, each of whom records details regarding 100 consecutive patient encounters.

National Health Surveys (NHS) are a series of surveys conducted by the ABS that collect information on long-term health conditions, use of health services, and health risk factors and behaviours. The most recent NHS was conducted in 2004–05, and included 25,906 people of all ages across urban and rural areas of Australia. Questions regarding long-term health conditions, including cardiovascular conditions and diabetes, were asked of the respondents at interview. Because it targeted the non-institutionalised population, non-private dwellings (e.g. hospitals, nursing homes, hotels and boarding houses) were excluded. Because it is a self-reported survey, the results were influenced by the questionnaires used, and by knowledge and awareness of specific conditions in the population. The next NHS is currently being conducted and is expected to be available for analysis in mid-2009.

Appendix 2 Statistical methods

Age-standardised rates

Age-standardisation is a technique used to eliminate the effect of differences in population age structures when comparing rates for different periods of time, and/or different geographic areas and/or different population groups. Definitions are included in the *National health data dictionary* (AIHW: Health Data Standards Committee 2006).

There are two methods of age-standardisation, direct and indirect. The method used in this report is direct age-standardisation, except in the case of Aboriginal and Torres Strait Islander hospital and mortality data where indirect age-standardisation has been used.

Direct age-standardisation

Direct age-standardisation applies the age-specific rates to a 'standard population' in order to determine the rate that would have occurred in the standard population. This allows direct comparison of different rates applied to the same standard population. The 2001 Australian population was used as the standard population in calculating age-standardised rates, as described below.

The method used for the calculation of age-standardised rates consists of three steps:

Step 1: Calculate the age-specific rate for each age group.

Step 2: Calculate the expected number of cases in each age group by multiplying the age-specific rate by the corresponding standard population to get the expected number of cases.

Step 3: Sum the expected number of cases in each age group, divide by the total of the standard population and multiply by 100,000. This gives the age-standardised rate.

Indirect age-standardisation

In situations where populations are small or where there is some uncertainty about the stability of age-specific rates, indirect standardisation has been used. This effectively removes the influence of the age structure, but does not provide a measure of prevalence in terms of a rate. Rather, the summary measure is a comparison of the number of observed cases compared to the number expected if the age-specific prevalence rates of the standard population are applied to the study population. The method used for this calculation entails three steps:

Step 1: Calculate the age-specific rates for each age group in the standard population.

Step 2: Apply these age-specific rates to the number in each age group of the study population and sum to derive the total expected number of cases for the study population.

Step 3: Sum the observed cases in the study population and divide this number by the expected number derived in Step 2 to calculate the Standardised Prevalence/Morbidity/Mortality Ratio (SPR/SMR).

An SPR/SMR of 1 indicates the same number of observed cases as were expected (suggesting rates in the study and standard populations are similar). A result greater than one indicates more cases than expected. A result less than one indicates fewer cases than expected. The indirect method is more appropriate when calculating standardised rates for the Indigenous population. In this report, the indirect method has been used for comparing death and hospitalisation rates between Indigenous and other Australians. Other Australians has been used as the standard population in these analyses.

For example, if there are twice as many deaths as expected (SMR of 2.0) then the rate of death in the Indigenous population can be assumed to be twice that of other Australians.

ICD-10 codes used

Table A1: ICD-10 and ICD-10-AM codes used to define diagnosis groups for CKD

Group of chronic kidney disease	ICD-10 codes
Regular dialysis	
Haemodialysis	Z49.1*
Peritoneal dialysis	Z49.2*
Other	
Diabetic nephropathy	E10.2, E11.2, E12.2, E13.2, E14.2
Hypertensive kidney disease	I12, I13, I15.0, I15.1
Glomerular diseases	N00–N07, N08*
Kidney tubulo-interstitial diseases	N11, N12, N14, N15, N16*
Chronic kidney failure	N18
Unspecified kidney failure	N19
Other disorders of kidney and ureter	N25–N28, N39, E85.1^, D59.3^, B52.0^
Congenital malformations	Q60–Q63
Complications related to dialysis and kidney transplant	T82.4, T86.1
Preparatory care for dialysis	Z49.0*
Kidney transplant and dialysis status[(a)]	Z94.0*, Z99.2*
Transplant procedures[(b)]	36503-00

(a) These codes were used in additional diagnosis counts only.
(b) The kidney transplantation code (36503-00) is an ICD-10-AM health intervention code, not an ICD-10-AM disease code.

^ These codes were used for identification in mortality data only.
* These codes were used for identification in hospital morbidity data only.

ICPC-2 PLUS

Table A2: ICPC-2 PLUS coding list for chronic kidney disease

ICPC-2 PLUS code	ICPC-2 PLUS label
K87002	Hypertension; renal disease
K87003	Hypertension; nephropathy
K87006	Hypertension; cardiorenal
U28001	Kidney transplant
U59001	Dialysis; kidney (renal)
U59007	Dialysis; peritoneal
U59008	Haemodialysis
U59009	Dialysis; CAPD
U85001	Polycystic kidney
U85003	Duplex kidney
U85004	Congenital anomaly; urological
U85005	Congenital anomaly; kidney
U88 (all)	Glomerulonephritis/nephrosis
U99002	Cyst; renal
U99016	Uraemia
U99020	Hypertrophic; kidney
U99021	Hydronephrosis
U99022	Insufficiency; renal
U99023	Failure; renal; chronic
U99024	Necrosis; renal; papillary
U99028	Stenosis; artery; renal
U99030	Failure; renal; not otherwise stated

Glossary

Albuminuria	The presence of albumin (a type of protein) in the urine. Two positive tests for albumin in the urine over several weeks indicate persistent albuminuria, a first sign of diabetic kidney disease.
Creatinine	A breakdown product of a molecule found in muscle that is important for energy storage.
Diabetes	A chronic condition in which blood glucose levels become too high. The body produces little or no insulin—the glucose regulating molecule—or cannot use it properly.
Diabetic nephropathy	Disease of the capillaries of the *glomeruli* resulting from diabetes.
eGFR	An estimation of the flow rate of filtered fluid through the kidney based on the levels of *creatinine* in the blood, using a formula that takes into account age, sex and ethnicity.
Erythropoietic medications	A class of medication that stimulates the production of red blood cells.
Glomerulus	A tiny set of blood vessels in the nephron (plural *glomeruli*).
Glomerulonephritis	Inflammation of the *glomeruli*, which are a component of the basic filtering unit in the kidney.
Haematuria	The presence of blood in the urine which may reflect a decline in kidney function.
Haemodialysis	A method of removing waste products and water from the blood, as well as regulating the levels of circulating chemicals. A machine is connected to a person's bloodstream to filter the blood externally to the body.
Hypertension (high blood pressure)	Blood pressure is the force exerted by the blood on the walls of the arteries and is written as systolic (force exerted as heart pumps)/diastolic (force against arteries as the heart relaxes and fills with blood). Australian surveys such as the AusDiab have defined high blood pressure as a systolic blood pressure (SBP) greater than or equal to 140 mmHg, or a diastolic blood pressure (DBP) greater than or equal to 90 mmHg, or receiving medication for high blood pressure.
Incidence	The number of new cases (of an illness, disease or event) occurring during a given period.
Kidney replacement therapy	Includes having a functional kidney transplant or receiving regular dialysis.
Nephron	The tiny parts of the kidney that filter blood to make urine—Each nephron consists of a *glomerulus* (filter) and tubule (for reabsorption). Each kidney is made up of approximately one million nephrons.
Peritoneal dialysis	A solution is pumped into the abdominal cavity where the body's own peritoneum acts as a dialysis filter to remove waste products and water.
Prevalence	The number or proportion (of cases, instances) present in a population at a given time.
Proteinuria	The presence of excess proteins (commonly albumin) in the urine that is likely to reflect a decline in kidney function.

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Tables

Figures

Boxes