2 The burden of chronic kidney disease

Highlights

- Up to 7.5% of Australians aged 25 years and over may have reduced kidney function.
- Although only a small proportion of people develop end-stage kidney disease, this accounts for the majority of the burden of CKD through use of hospital services, health expenditure and impacts on quality of life.
- In 2003, 13,625 Australians were receiving dialysis or living with a kidney transplant for end-stage kidney disease.
- In 2003–04, 11% of all hospital separations were for dialysis. The age-standardised hospital separation rate for same-day dialysis increased by 41% between 1998–99 and 2003–04.
- In 2003, CKD was recorded as the underlying cause of death in 2,431 cases. In a further 9,217 cases it was recorded as an associated cause of death.
- There is substantial evidence that CKD is an independent risk factor for cardiovascular disease, which is a common comorbidity and a major cause of death among people with CKD. In 2003, cardiovascular disease was recorded as the underlying cause of death in 44% of cases where CKD was an additional cause of death.

Introduction

Chronic kidney disease imposes a substantial burden on both communities and individuals. It mainly affects the older population, but can occur in people of any age. CKD usually develops without symptoms, and thus is often only detected at the very late stages. However, it begins to increase the risk of illness and death from other diseases and conditions from the very early stages.

CKD has profound impacts on wellbeing and quality of life, particularly at the final stage. Life expectancy is generally shortened. People with end-stage kidney disease require very expensive treatment and intensive health services.

This chapter provides an overview of the burden of CKD in Australia. The extent of the burden is illustrated through four components:

- the number of people who have CKD—described in terms of the prevalence of kidney damage or reduced kidney function, and the prevalence and incidence of treated ESKD;
- the impact of CKD on individuals—through description of its comorbidities and complications, effects on quality of life and disability, and mortality;
- the impact of CKD on health services—described in terms of use of GP and hospital services, and treatment for ESKD; and
- direct health expenditure on CKD.

Reduction in kidney function

How common is chronic kidney disease, what is the distribution of severity among those affected, and is CKD becoming more or less common over time? These questions are of interest to those developing strategies, allocating resources and planning services for preventing and managing CKD. The answers could also be useful in alerting primary care clinicians to the scope and need for early detection and intervention among their patients.

Unfortunately, current data sources provide limited answers. For example, the 2001 National Health Survey did not collect the biomedical data needed to examine the prevalence of CKD according to the US Kidney Disease Quality Outcome Initiative (K/DOQI) definition (see Box 1.1). Less than 0.5% of survey respondents self-reported having kidney disease as a long-term condition. This probably reflects the lack of symptoms in less severe CKD, so that many Australians would not be aware of any problems or have come to the notice of a doctor.

By contrast, the Australian Diabetes, Obesity and Lifestyle (AusDiab) study used biomedical measurements to explore the prevalence of CKD in its 1999–00 national survey of non-institutionalised Australians aged 25 years and over. Participants were tested for protein or blood in the urine (proteinuria and haematuria, respectively) as a sign of kidney damage and their GFR was also estimated as a measure of kidney function. The AusDiab Kidney Study investigators found that 11.2% of participants had a GFR of less than 60 mL/min/1.73m^2. A further 5.1% had protein or blood in the urine without significantly reduced kidney function (Chadban et al. 2003). If these conditions could be shown to have persisted for 3 months or longer, 16.3% of respondents would have met the K/DOQI criteria for CKD (Box 1.1).

However, important questions remain about these findings.

- The evidence of kidney problems in the study was based on a single measurement, or two measurements separated by a short interval, and so the K/DOQI criterion of 'three months or more' for CKD was not satisfied. Although it is reasonable to assume that many of the cases would show persistence, the proportion is not known.
- More importantly, GFR declines progressively with age (NKF 2002), so there is a question about the significance of the findings among older people. The K/DOQI criteria, although acknowledging that older people with reduced GFR may have normal kidney function for their age, make no allowance for age in defining CKD. As a result, if these criteria were applied literally to the AusDiab sample (assuming the kidney problems persisted for 3 months or more in all cases), over half of those aged 65 years and over would be described as having CKD (Table 2.1).

  But how many of these 'cases' of CKD in fact do not have disease but a normal age-related reduction in function that occurs slowly over time—a rate that is not accelerated consistent with CKD and that will not threaten their quality of life or life expectancy? The health implications of 'normal' age-related decline in kidney function are unclear (NKF 2002) and the issue remains a subject of intensive research.
- Two formulas are commonly used to calculate GFR: the MDRD (Modification of Diet in Renal Disease) formula and the Cockcroft-Gault formula. A US study has suggested that the MDRD formula provides a better estimate of GFR than the Cockcroft-Gault formula used to produce the prevalence statistics cited above, particularly in women and older people (Levey et al. 1999). The US National Kidney Foundation, the UK Renal Association and the Australasian Creatinine Consensus Working Group now recommend the use of the MDRD formula (NKF 2002; Joint Specialty Committee on

Renal Disease 2005; The Australasian Creatinine Consensus Working Group 2005), and the prevalence of CKD in the Australian population is currently being recalculated using this formula. Preliminary results suggest that the prevalence of significant reduction in kidney function (GFR less than 60 mL/min/1.73m^2) may be reduced from 11.2% to 7.5% (The Australasian Creatinine Consensus Working Group 2005). The final results of this re-investigation are not available at the time of writing.

Table 2.1: Prevalence of moderate or severe reduction in kidney function, by age and sex, 1999–00

Estimated kidney function		45–64 years	65 years and over	25 years and over
			(per cent)	
MDRD formula				
GFR <60 mL/min/1.73 m^2	**Persons**	**n.a.**	**n.a.**	**7.5**
Cockcroft-Gault formula				
GFR <60 mL/min/1.73 m^2	Males	1.8	51.8	9.3
	Females	3.2	57.2	13.0
	Persons	**2.5**	**54.8**	**11.2**
GFR 30–59 mL/min/1.73 m^2	Males	1.8	50.3	9.1
	Females	3.2	55.3	12.6
GFR <30 mL/min/1.73 m^2	Males	—	1.5	0.3
	Females	0	1.9	0.4

— Rounded to zero.

n.a. Not available.

Note: The prevalence of moderate or severe reduction in kidney function (as estimated using the Cockcroft-Gault formula) among people aged 25–44 years was 0.01%. Due to the small numbers, detailed data for this age group are not included in this table.

Sources: The Australasian Creatinine Consensus Working Group 2005; Chadban et al. 2003.

Despite these limitations, the AusDiab findings provide an indication of the number of people who might have CKD, and who are at increased long-term risk of developing end-stage kidney disease (ESKD). This is when a person's kidney function is no longer sufficient to sustain life, and dialysis or a kidney transplant is required. Although the ESKD population only represents a very small proportion of all people with CKD, a significant amount of the burden of CKD relates to the communities and individuals affected by ESKD. It is therefore very important to monitor the incidence and prevalence of ESKD so that adequate resources can be assigned to treat people with this illness.

Prevalence and incidence of treated end-stage kidney disease

People who are receiving dialysis or living with a kidney transplant are said to have 'treated ESKD'. Information on the incidence and prevalence of treated ESKD has been collected by the Australian and New Zealand Dialysis and Transplant (ANZDATA) Registry for the last 40 years. Data for the period 1981–2003 are presented below to illustrate recent trends in treated ESKD in Australia.

It should be noted that the incidence and prevalence of treated end-stage kidney disease will underestimate the incidence and prevalence of ESKD among the whole community, as not all people will accept or be suitable candidates for kidney replacement therapy. This is especially true for people in the older age groups. Information about the incidence and prevalence of ESKD among the general population is not currently available in Australia.

Prevalence of treated end-stage kidney disease

At the end of 2003, a total of 13,625 people (an age-standardised rate of 675 per million population) were being treated for ESKD in Australia. The prevalence rate increased rapidly with age to the 65–74 years age group, then declined. The prevalence of treated ESKD was higher in males (810 per million population) than in females (551 per million population) across all age groups.

Trends in prevalence

The number of people being treated for end-stage kidney disease has more than tripled over the last 20 years, from 3,181 patients in 1981 to 13,625 patients in 2003. Over this period, the prevalence rate of treated ESKD increased by 5.6% each year on average. However, the annual rate of change has gradually decreased from 7% (1981 to 1982) to 3% (2002 to 2003) (Figure 2.1). Although the rate of increase in the prevalence of ESKD has been slowing down in recent years, it is highly likely that the prevalence of ESKD will continue to increase in the near future. While a higher incidence of treated ESKD is a major factor in this increase, ageing population, improved management and new technologies have also contributed to these numbers by keeping people alive for longer.

Incidence of treated end-stage kidney disease

According to ANZDATA, 1,953 people (97 per million population) began kidney replacement therapy in 2003 (Excell & McDonald 2005a). The incidence rate in males (1,150 cases, 118 per million population) was higher than in females (803 cases, 77 per million population), and this pattern occurred across all age groups. The incidence rate increased progressively with age, peaking in the 65–74 years age group and then declining.

The average age at commencement of treatment in 2003 was 59.3 years, well above the average of 42.3 years 20 years earlier. This is predominantly due to increased numbers of new patients in the older age groups, rather than a decline in the number of young patients (see Figure 2.2).

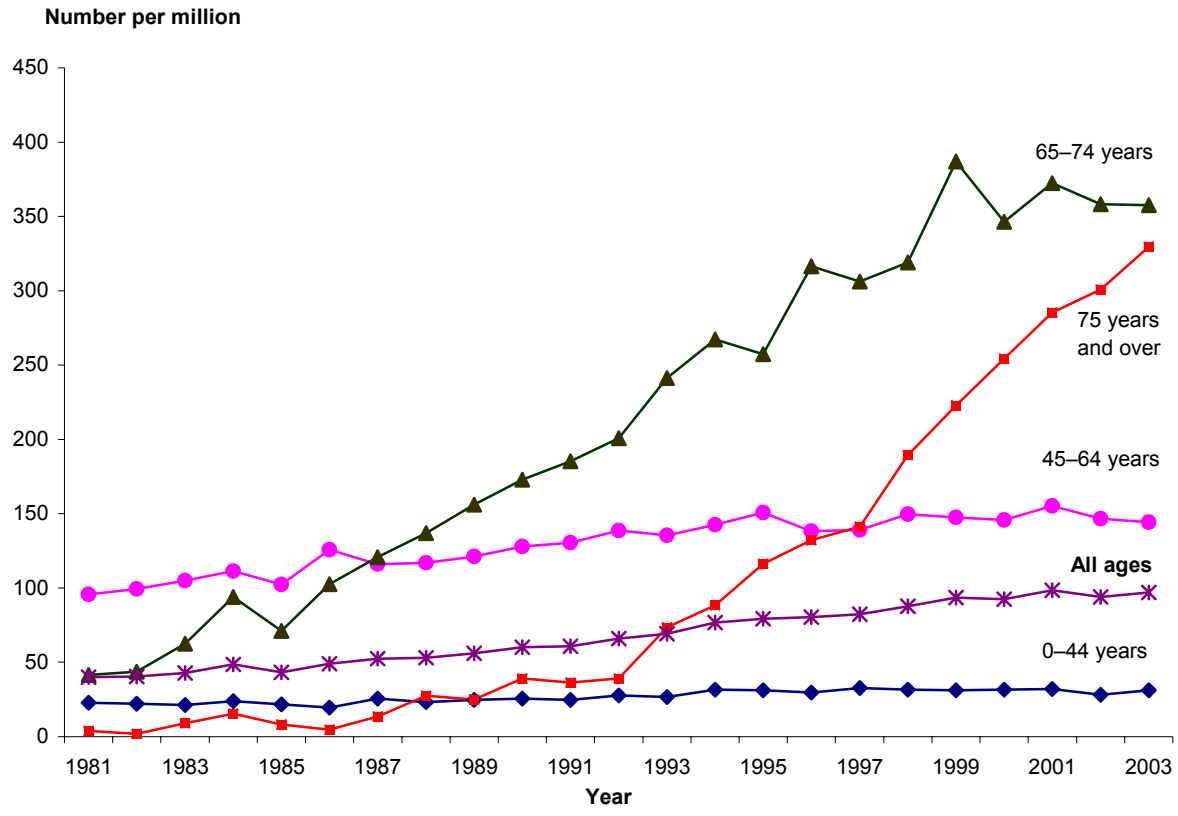
The higher incidence among males may be the result of gender differences in the causes of kidney damage and CKD. The most common causes of treated ESKD in Australia, such as glomerulonephritis, diabetes and high blood pressure, and risk factors such as smoking, are all more common among men than women.

Trends in incidence

Since the early 1980s, the age-standardised incidence rate of treated ESKD has more than doubled, from 40 per million population in 1981 to 97 per million population in 2003 (Figure 2.1). The changes in incidence rate vary between age groups. Between 1981 and 2003, the incidence of treated ESKD was stable in people below the age of 45 years, but increased among the middle and older age groups. For people aged 45–64 years the incidence increased by nearly 50%, from 96 to 144 per million population, while the incidence in those aged 65–74 years increased nearly ninefold (from 42 to 358 per million population). For the oldest age group (75 years and over), the incidence was low until 1992 but rapidly increased over the following decade to reach 330 per million population in 2003.

The reasons for the increasing incidence of treated ESKD among the middle-aged and older population are complex. The increasing prevalence of diabetes, high prevalence of high blood pressure in the past, and reduced cardiovascular mortality may all have contributed to

an increased incidence of ESKD in the community. At the same time, changes in acceptance policies for patients in the older age groups mean that more people in these age groups are being accepted into the kidney replacement therapy program. It is difficult to separate out the contribution each of these factors has made to the increasing number of people beginning kidney replacement therapy. These issues are discussed in more detail in Chapter 4 of this report.



Note: The 'all ages' rate has been age standardised to the Australian population at 30 June 2001.

Source: AIHW analysis of ANZDATA Registry data.

Figure 2.1: Incidence of treated end-stage kidney disease, by age group, 1981 to 2003.

Comorbidities and complications of chronic kidney disease

Chronic kidney disease can affect all the organs and systems in the body. The disturbances to the body's chemical balance and build-up of waste substances in the blood can have extensive functional consequences, leading to the development of complications. Most of these conditions develop early in the course of CKD and contribute substantially to its high morbidity and mortality. The exact path of development of most complications is unknown. CKD also shares a number of risk factors with other chronic diseases. For example, high blood pressure and diabetes increase the risk of cardiovascular disease, and smoking is linked to both cardiovascular and respiratory problems. For these reasons, CKD often coexists with one or more other diseases, adding to the burden of the disease on individuals and complicating their treatment.

Common problems among people with CKD in Australia include cardiovascular diseases (mainly high blood pressure, ischaemic heart disease and heart failure), respiratory diseases, infections, malnutrition, anaemia and cancers.

Cardiovascular disease

CKD is an independent and major risk factor for cardiovascular disease. High blood pressure (also called hypertension) almost invariably develops in people with CKD. In addition, reduced estimated kidney function has been found to independently increase the risk of cardiovascular disease events, including heart attack, angina, coronary artery disease, stroke and heart failure (Go et al. 2004). The risks of an event are greater in those with poorer kidney function. People with stage 5 CKD (GFR less than 15 mL/min/1.73m^2) are more than three times as likely to have a cardiovascular event as people without CKD (Go et al. 2004). In Australia, among hospitalisations that have CKD as an additional diagnosis, cardiovascular disease is the most frequent reason for overnight hospitalisation (Table 2.5). Similarly, in people who have CKD recorded as an associated cause of death, cardiovascular disease is the most common underlying cause of death (Table 2.7).

Cardiovascular disease is also the most common comorbidity and cause of death among people with treated end-stage kidney disease. Among new treated end-stage kidney disease patients in 2003, 39% had coronary artery disease, 25% had peripheral vascular disease and 14% had cerebrovascular disease when they began their kidney replacement therapy. Between 1991 and 2003, the proportion of new patients with coronary artery disease increased by 11%, peripheral vascular disease by 10% and cerebrovascular disease by 5%. In 2003, 40% of deaths among dialysis-dependent patients and 23% of deaths among kidney transplant patients in Australia were from cardiovascular disease (Excell & McDonald 2005b).

Although a history of high blood pressure and other shared risk factors may partly explain the association between CKD and cardiovascular disease, the increased risk is mostly attributed to the effects of reduced kidney function. This is associated with increased risk of inflammation and blood clotting, left ventricular hypertrophy (enlargement of the left chamber of the heart, which can lead to heart failure) and hardening of the arteries (Go et al. 2004).

Cancer

It is not known if there is an increased risk of cancer among CKD patients in the early stages of the disease, but it has been found that there is a higher risk of cancer among people who are receiving kidney replacement therapy. According to the ANZDATA Registry, the incidence rate for all types of cancer combined (excluding non-melanocytic skin cancer) was 1.7 times higher among dialysis patients and 3.1 times higher among kidney transplant patients than among the general population in 2003 (Chapman & Webster 2005). For dialysis patients the increased risk was seen for cancers of the respiratory system, bones and cartilage, urinary system, endocrine glands and central nervous system. For transplant patients, the risk was increased for most types of cancers.

The higher risk of cancer among people receiving treatment for end-stage kidney disease may be associated with the presence of chronic infections, a weakened immune system, treatment with immunosuppressive or cytotoxic drugs, nutritional deficiencies, and altered DNA repair (Maisonneuve et al. 1999).

Infections

Because reduced kidney function can impair the immune system, people with CKD have increased susceptibility to infections (Braunwald et al. 2001). The most common types of infections among people with CKD are respiratory infections (described below).

Dialysis-dependent patients are also at high risk of other types of infections. People receiving haemodialysis (filtering of the blood outside of the body by a machine) can develop serious infections, most of which are related to the access site (where the body is connected to the dialysis machine). People on peritoneal dialysis (filtering of the blood within the body) are also at high risk of developing inflammation of the lining of the abdomen (peritonitis).

Respiratory diseases

CKD shares some risk factors, such as smoking, with respiratory diseases. Further, people with CKD are prone to infection, as described above. Therefore, CKD and respiratory problems may often coexist. Respiratory diseases and infections, especially pneumonia and chronic obstructive pulmonary disease, have been found to be a common cause of overnight hospitalisation and one of the major causes of death among people with CKD. The ANZDATA Registry also reported that about 16% of new treated end-stage kidney disease patients in 2003 were found to have chronic lung disease, an increase of 5% from 1991.

Malnutrition

People with CKD have a risk of protein deficiency, inadequate caloric intake and electrolyte imbalance if their diet is not properly controlled as the kidney disease progresses. Weight loss and oedema (fluid retention causing swelling) may be signs of these problems. Malnutrition has a significant influence on patients' survival and is a strong predictor of patients' mortality and quality of life. In people receiving dialysis, malnutrition has been found to be associated with impaired pulmonary function, which may affect patient outcomes (Nascimento et al. 2004). There is no information on the nutritional status of people with CKD in Australia.

Other complications

Other common diseases and conditions associated with CKD include anaemia (too few red blood cells, leading to insufficient oxygen going to the tissues and organs), bone and muscle problems, disorders of the nervous system (neuropathy) and disorders of endocrine function (such as diabetes and thyroid problems) (Braunwald et al. 2001). There are also increased risks of sleep disorders, anxiety and depression among people with CKD, especially those on dialysis treatment. Information about the incidence and prevalence of these diseases among people with CKD in Australia is not currently available.

Disability and quality of life

CKD has a significant impact on patients' and their carers' lives, especially for those people whose life relies on dialysis treatment. People with CKD may have to take a number of different medications to control risk factors or other health problems, or to maintain the correct amounts of various vitamins, minerals and chemicals which are affected by their kidney problems. The complications of CKD may also impact on quality of life, and can cause disability. For example, heart disease and stroke are common causes of physical activity restrictions in Australians (AIHW 2004c). Problems such as disturbed sleep or insomnia can impact on the patient's physical and mental wellbeing as well as on that of their family.

Results from the Australian Diabetes, Obesity and Lifestyle study in 1999–00 showed that people with CKD reported significantly poorer physical functioning, general health and vitality than the general population, and were more likely to report difficulties performing their usual activities due to physical or emotional problems (Chow et al. 2003). Mental health in particular was a problem in younger people, while physical functioning was a greater issue for older people.

The Australian Bureau of Statistics' Disability, Ageing and Carers survey collects information on the presence and types of disability, and main disabling condition. In 2003, it was estimated that almost 8,000 Australians had a disability due to a kidney or urinary system disorder (excluding incontinence). It is not possible to determine how many of these people had chronic kidney disease.

Although CKD is usually symptomless until the later stages, people with CKD may experience a range of problems including fatigue, muscle cramps, nausea, itchy skin, urinary tract infections, headaches, and loss of appetite when nearing the end stage. These symptoms can affect the patient's mental state as well as their physical health. As kidney function worsens, physical and mental health may be increasingly affected. For people whose disease reaches end-stage, the diagnosis of ESKD is a significant event and may at first be met with denial. As with any serious health problem, people diagnosed with ESKD can feel angry, anxious, hopeless or depressed (Lew & Piraino 2005). They may 'grieve' for their lost health (Australian Kidney Foundation 2002). Depression is common among people being treated for ESKD, particularly those just beginning dialysis, and this can severely affect their quality of life and outcomes (Tossani et al. 2005). It may also affect their willingness to comply with their treatment, which can have serious consequences (Jindal et al. 2003). Family and friends, as well as dealing with their own feelings about the diagnosis, might also be affected by the patient's reactions, and relationships and friendships can become strained.

Impacts of 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. The choice may also be influenced by the availability of local resources. Starting dialysis means starting a new way of life that is beneficial yet also problematic. People's lives are prolonged by dialysis treatment, but may also be greatly altered by it. The different forms of dialysis have different effects on people's lives and quality of life.

In peritoneal dialysis, the dialysis solution is pumped into the abdomen and the blood is filtered through the peritoneal membrane. This is the lining of the abdominal cavity, which covers the 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 minutes. In between exchanges, the patient is free to continue their usual activities. Peritoneal dialysis can be performed either by the patient during the day, or automatically by a machine at night while the patient sleeps. This type of dialysis needs to be done every day, usually three or four times. 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.

In contrast, the lives of haemodialysis patients are to some extent 'fixed' by the need for the dialysis machine. Blood is diverted from the body to the machine, where it is filtered before being returned to the body. The patient is connected to the machine for around 4 hours per dialysis session, and during this time all their blood passes through the machine approximately six times. Haemodialysis is usually performed three times each week, and the patient cannot get up and move away from the machine during a session, though they can perform activities which do not require much movement such as sleeping, reading, talking, or using a computer. This type of dialysis can be done at home or in hospitals or clinics, however, the dialysis machine requires special plumbing and therefore the patient must limit their travel to places where dialysis facilities are available. In most cases the patient will need assistance connecting to the machine, and a partner, relative or friend can be trained to do this for home dialysis patients. The method and location of initial dialysis is selected based on the preference of a fully–informed patient.

People with ESKD have to constantly monitor and control their diet and fluids. ESKD reduces the appetite and so patients need to make sure to eat properly even when they don't feel like it. Complications of ESKD and the dialysis process may also bring further interruption to their lives (Polaschek 2003).

Dialysis treatment also has a profound effect on patients' families, friends and colleagues. Family members have to limit their own social life to provide support for the dialysis patient. The amount of care required also increases over time as the patient's health deteriorates. This may lead to resentment and distancing in the relationship (Polaschek 2003). However, various studies have shown that physical functioning, mental health and quality of life can be improved through appropriate intervention. Education, counselling, treatment with antidepressant medication, strong social and familial support and regular physical activity have all been found to have beneficial effects for dialysis patients (Koo et al. 2005; Tossani et al. 2005; Kouidi 2004; Levendoglu et al. 2004; Tsay & Hung 2004).

Health service usage

The treatment and care of people with CKD covers a variety of settings and types of care. Due to lack of information, many services consumed by people with CKD are impossible to identify. In this section, the focus is on the health services provided by general practitioners (GPs) and hospitals. Although it is acknowledged that specialists and allied health professionals would provide a substantial amount of services to people with CKD, particularly people receiving kidney replacement therapy, these services cannot be identified from available data sources. No data on these services are included in this section.

Visits to general practitioners

GPs are the source of first-contact care and they have a natural role in managing and monitoring CKD. Information about usage of GP services by people with CKD was drawn from the Bettering the Evaluation and Care of Health (BEACH) survey of general practice. This survey involves random samples of approximately 1,000 GPs per year, each of whom records the details of 100 consecutive patients' encounters (AIHW: Britt et al. 2005).

In 2003–04, CKD problems were managed at a rate of 3 per 1,000 GP encounters. This suggests that CKD was managed in approximately 290,000 Medicare-paid GP consultations in 2003–04. GP management of CKD problems becomes more common with age.

The most frequently managed CKD problem in 2003–04 was 'chronic kidney failure' (44% of CKD problems managed), followed by 'unspecified kidney failure' (19%) and glomerulonephritis/nephrosis (10%). Other problems such as hypertensive kidney disease and diabetic nephropathy were managed less frequently.

GPs manage these problems in a variety of ways: treating the problem without medication; prescribing/recommending medication; ordering imaging or pathology tests; and coordinating referrals. Management strategies reported by GPs in 2003–04 for CKD problems are shown in Table 2.2. Pathology tests were ordered for most problems, with electrolytes/urea/creatinine and a full blood count being the most common tests ordered. Medications were prescribed in around two-fifths of all problems managed. In 12% of cases the patient was referred to another health professional or health service provider.

Table 2.2: Management of chronic kidney disease by GPs, 2003–04

Type of management	% of CKD problems managed (n = 301)
Prescribed medications	41%
Ordered pathology tests	
Electrolytes/urea/creatinine (EUC)	17%
Full blood count	13%
Blood creatinine or albumin: creatinine ratio	3%
Urinary albumin	2%
Liver function	8%
Lipid profile or cholesterol/triglycerides	1%
Other	36%
Ordered imaging	
Ultrasound of kidney or renal tract	4%
Other	3%
Referral	
Specialist	2%
Urologist	6%
Hospital or clinic	1%
Other	2%

Note: Figures do not add to 100% as more than one form of management may be used for each problem.

Source: AIHW analysis of the BEACH GP survey.

Hospitalisation

People with CKD require a large amount of hospital services, particularly those people with end-stage kidney disease. In Australia, information about hospital services is available from the AIHW National Hospital Morbidity Database. In this database, the principal and any additional diagnoses are recorded for each hospital separation. The principal diagnosis is defined as 'the diagnosis established after study to be chiefly responsible for occasioning an episode of admitted patient care '(AIHW 2005a:333). An additional diagnosis is defined as 'a condition or complaint either coexisting with the principal diagnosis or arising during the episode of care' (AIHW 2005a:326).

The most frequent reason for using hospital services among people with CKD is day admission for dialysis. However, people with CKD also can be hospitalised for other reasons. Many of these are attributed to diseases associated with CKD, such as cardiovascular disease, and side effects of kidney replacement therapy. These cases are more likely to have CKD recorded as an additional diagnosis rather than as the principal diagnosis.

Chronic kidney disease as the principal diagnosis

In 2003–04 there were 784,925 hospital separations with a principal diagnosis of CKD (11.5% of all hospital separations). Among these, the major reason for hospitalisation was admission

for regular dialysis. There were 759,272 hospitalisations for dialysis in 2003–04 (96.7% of hospital separations with a principal diagnosis of CKD; 11% of all hospital separations). This figure represents multiple separations for a much smaller number of patients as each would have received dialysis about three times each week. It is not possible to determine the cause of end-stage kidney disease in people receiving dialysis from the hospital separations data.

Besides receiving dialysis, people with CKD also frequently use hospital services for the treatment of casual diseases, uraemia and complications of kidney replacement therapy. Common principal diagnoses in 2003–04 included kidney tubulo-interstitial diseases (6,312 separations), chronic kidney failure (4,983 separations) and diabetic nephropathy (4,075 separations) (Table 2.3).

Table 2.3: Hospital separations for chronic kidney disease, by principal diagnosis, 2003–04

Principal diagnosis	ICD-10-AM codes	Number of separations	Per cent of subtotal	Per cent of total
Diabetic nephropathy	E10.2, E11.2, E13.2, E14.2	4,075	15.9	0.5
Hypertensive kidney disease	I12, I13, I15.0, I15.1	639	2.5	0.1
Glomerular diseases	N00–N08	2,502	9.8	0.3
Kidney tubulo-interstitial diseases	N11, N12, N14–N16	6,312	24.6	0.8
Chronic kidney failure	N18	4,983	19.4	0.6
Unspecified kidney failure	N19, Z49.0	3,601	14.0	0.5
Other disorders of kidney and ureter	N25, N26, N27, N28, N39.1, N39.2	1,609	6.3	0.2
Congenital malformation of the kidney and ureter	Q60–Q63	1,132	4.4	0.1
Complications related to dialysis and kidney transplant	T82.4, T86.1	800	3.1	0.1
Subtotal		*25,653*	*100.0*	*3.3*
Dialysis	Z49.1, Z49.2	759,272		96.7
Total		**784,925**		**100.0**

Source: AIHW National Hospital Morbidity Database.

Bed days and length of stay

A total of 879,517 hospital bed days were occupied by people with a principal diagnosis of CKD in 2003–04, representing around 4% of the total bed days in that year. Of these bed days, 86% (758,611 days) were same-day separations for dialysis. After removal of same-day dialysis separations, the average length of stay in hospital for people with CKD in 2003–04 was 4.6 days, 35% longer than the average length of stay for all separations (3.4 days).

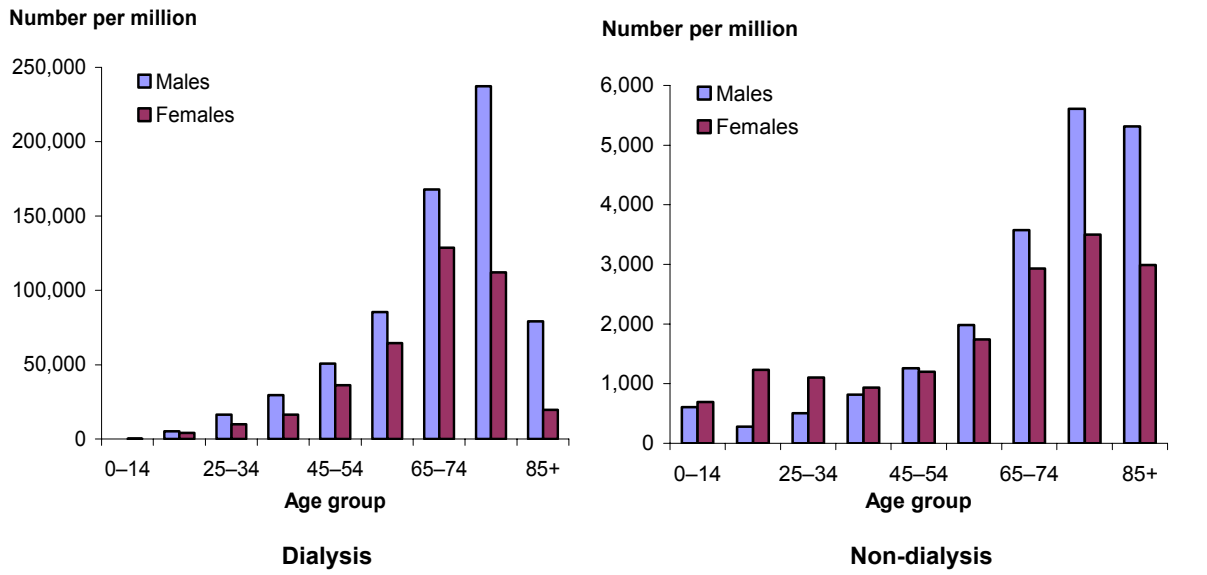
Sex and age

In 2003–04, males were more likely to be hospitalised with a principal diagnosis of CKD than females (457,655 and 327,269 separations, respectively). This pattern occurred across all age groups with the exception of those aged 5–19 years. Hospitalisation rates generally increased with age and peaked in the 75–79 years age group. Sixty-eight per cent of all CKD hospitalisations occurred in people aged 55 years and over.

The age and sex distribution of dialysis separations is quite different from that of separations for other CKD principal diagnoses (Figure 2.2). Separations for dialysis are more common in

males across all age groups, and the separation rate rises steeply with age. This reflects the prevalence of treated ESKD, and the higher proportions of transplants and peritoneal dialysis in the younger age groups (leading to less need for hospital-based dialysis).

In contrast, non-dialysis separations for CKD are more common among females than males in those aged less than 45 years, and the age-related increase in separation rates is much less steep. This is due to a much higher separation rate for tubulo-interstitial kidney diseases among females in the younger age groups.



Source: AIHW National Hospital Morbidity Database.

Figure 2.2: Hospital separations with a principal diagnosis of chronic kidney disease, 2003–04

Trends

Between 1998–99 and 2003–04, the age-standardised hospital separation rate for separations with a principal diagnosis of CKD increased by 39%, and the age-standardised number of bed days associated with these separations rose by 30% (Table 2.4). The average number of bed days per separation decreased by 6%. These changes can be mostly attributed to a substantial increase in the number of same-day separations for dialysis, from 478,658 in 1998–99 to 758,611 in 2003–04. This is a 41% increase in the same-day dialysis separation rate, from 26.3 to 37.1 per million population. When same-day separations for dialysis are excluded, the age-standardised hospital separation rate for CKD as principal diagnosis shows a 2% increase, with the age-standardised number of bed days and average bed days both showing decreases.

Table 2.4: Hospital separations with a principal diagnosis of chronic kidney disease, 1998–99 and 2003–04

	Separations with principal diagnosis of CKD			Excluding same-day dialysis		
	Separations	Bed days	Average bed days	Separations	Bed days	Average bed days
	(per 1,000 population)		(per separation)	(per 1,000 population)		(per separation)
1998–99	27.5	33.1	1.2	1.3	6.8	5.2
2003–04	38.4	43.0	1.1	1.3	5.9	4.6
% change	*39.3*	*30.0*	*–6.1*	*2.3*	*–12.8*	*–11.6*

Note: Figures for separations and bed days have been age standardised to the Australian population at 30 June 2001.

Source: AIHW National Hospital Morbidity Database.

Chronic kidney disease as an additional diagnosis

CKD is also commonly listed as an additional diagnosis. In 2003–04, CKD was listed as an additional diagnosis in 122,335 hospital separations. About 23% (28,139) of these separations were attributed to cardiovascular disease (Table 2.5). In comparison, only 6.6% of all hospital separations in 2003–04 had a principal diagnosis of cardiovascular disease. This highlights the strong association between cardiovascular disease and CKD. Other commonly recorded principal diagnoses in separations where CKD was an additional diagnosis were respiratory diseases (10,366 separations), other diseases of the genitourinary system (9,190 separations) and diabetes (6,311 separations). Each of these was also more likely to be recorded when CKD was an additional diagnosis than in general, again highlighting the complex interaction between CKD and these diseases.

Table 2.5: Hospital separations with an additional diagnosis of chronic kidney disease, by principal diagnosis, 2003–04

	Separations with CKD as an additional diagnosis		All separations	
Principal diagnosis (ICD-10-AM code)	**Number**	**Per cent**	**Number**	**Per cent**
Diseases of the circulatory system (I00–I99)[(a)]	28,139	23.0	448,220	6.6
Ischaemic heart disease (I20–I25)	9,379	7.7	164,226	2.4
Diseases of the respiratory system (J00–J99)	10,366	8.5	331,956	4.9
Pneumonia (J12–J18)	4,294	3.5	65,516	1.0
Endocrine, nutritional and metabolic diseases (E00–E89)[(b)]	9,838	8.0	107,076	1.6
Diabetes (E10–E14)[(b)]	6,311	5.2	56,207	0.8
Other diseases of the genitourinary system (N30–N99)	9,190	7.5	335,743	4.9
Diseases of the digestive system (K00–K93)	8,731	7.1	783,445	11.5
Symptoms, signs involving the circulatory and respiratory systems (R00–R09)	2,180	1.8	118,122	1.7
Complications of surgical and medical care, not elsewhere classified (T80–T88)	6,238	5.1	71,749	1.0
Neoplasms (C00–D48)	6,675	5.5	497,117	7.3
Care involving use of rehabilitation procedures (Z50.9)	5,899	4.8	130,209	1.9
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50–D89)	4,051	3.3	80,171	1.2
Infectious and parasitic diseases (A00–B99)	3,990	3.3	92,892	1.4
Diseases of the musculoskeletal system and connective tissue (M00–M99)	4,425	3.6	366,926	5.4
Other diseases and conditions	22,613	18.5	2,691,661	39.4
Total	**121,223**	**100**	**6,837,128**	**100**

(a) Excludes hypertensive kidney disease.

(b) Excludes diabetic nephropathy.

Source: AIHW National Hospital Morbidity Database.

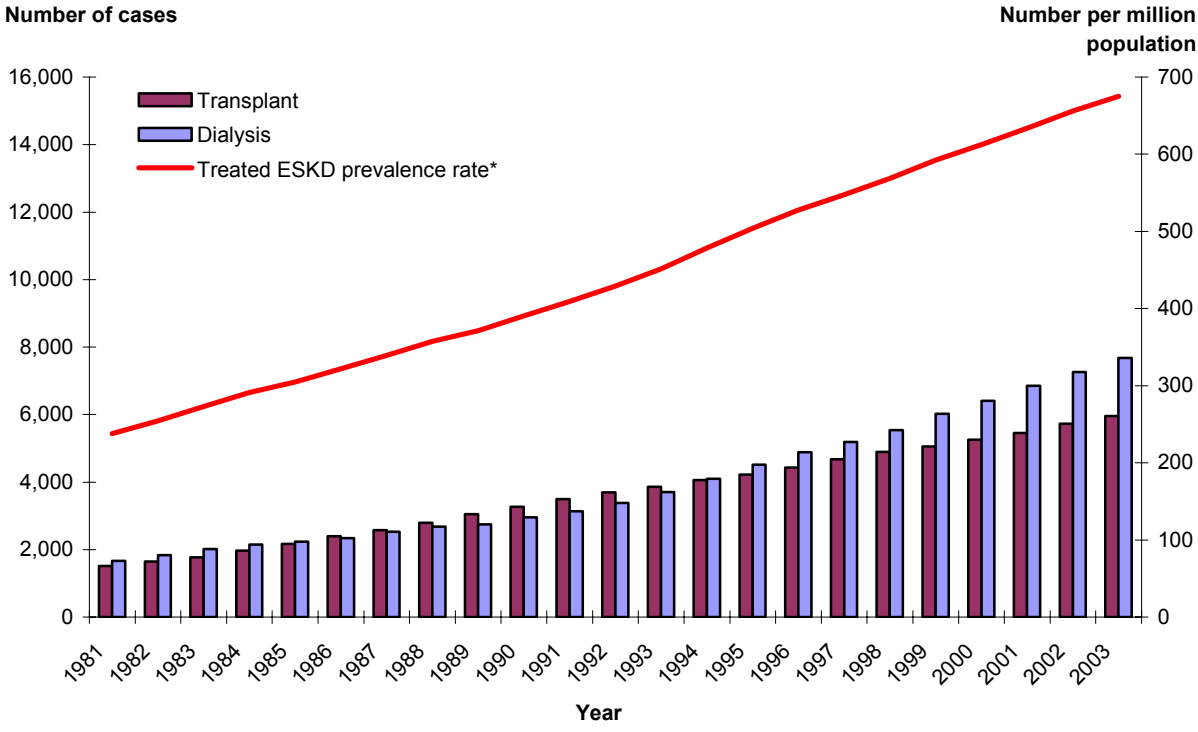
Treatment for end-stage kidney disease

People with end-stage kidney disease require kidney replacement therapy (dialysis or a kidney transplant) to sustain their life. As this treatment is very expensive and requires intensive health services, it poses a significant burden both financially and in terms of health service resources. If recent increases in the number of people receiving treatment for ESKD continue, this burden will also increase.

Using information from the ANZDATA Registry, the following section provides a profile of the kidney replacement therapy in Australia and details changes over the past 5 years.

Prevalence of kidney replacement therapy

At the end of 2003, a total of 13,625 people (675 per million population) were being treated for ESKD in Australia. This included 7,674 persons on dialysis and 5,951 persons with a functioning kidney transplant. Before 1994, about half of those receiving kidney replacement therapy were undergoing dialysis and the rest were living with a kidney transplant. Since then, the proportion of those on dialysis has increased rapidly (Figure 2.3). By 2003, 56% of patients registered with ANZDATA were undergoing dialysis and 44% had transplants. The higher average age of patients on kidney replacement therapy is one factor contributing to this shift, as older patients are less likely to opt for or be accepted for transplantation. Another factor is the low growth in the availability of donor organs (AIHW 2004a).



* Age-standardised to the Australian population at 30 June 2001.

Source: AIHW analysis of ANZDATA Registry data.

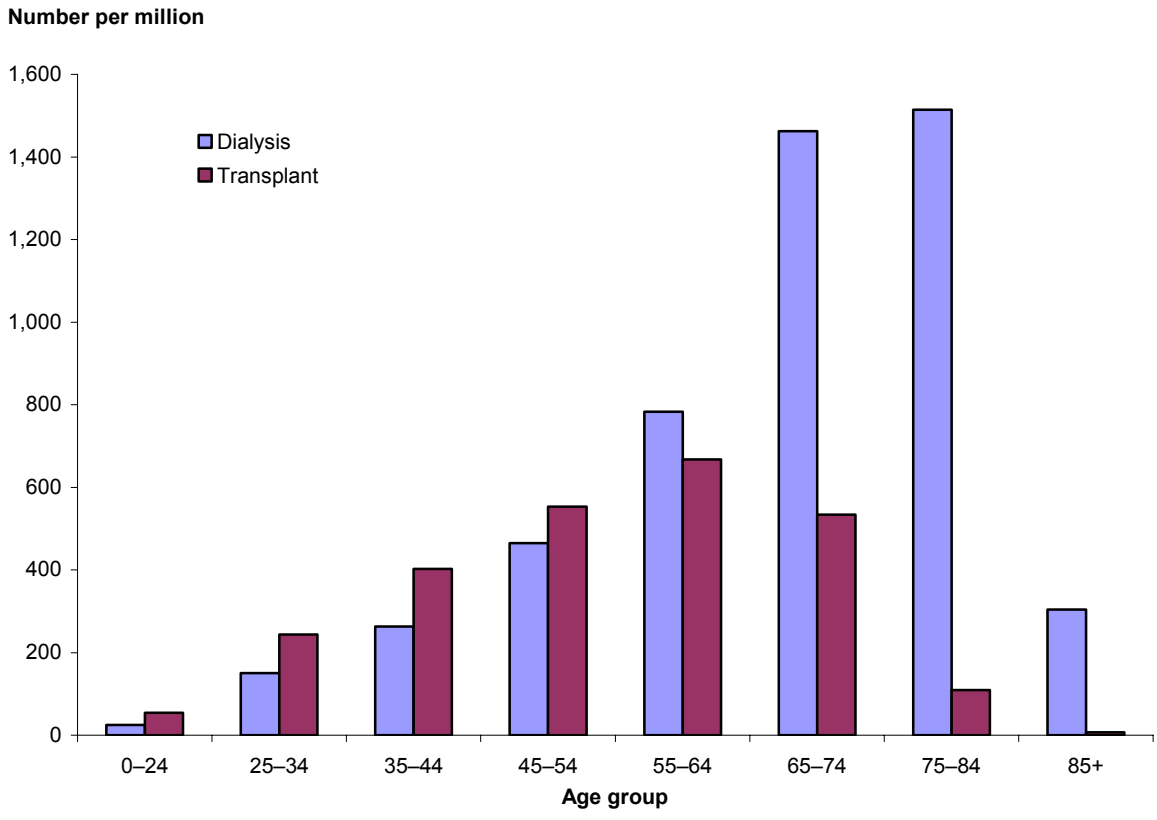
Figure 2.3: Number of treated end-stage kidney disease patients and age-standardised prevalence rate, 1981 to 2003

Dialysis

There were 7,674 people (386 per million population) receiving dialysis treatment at the end of 2003. The prevalence rate increased progressively with age, the highest rate being among people aged 75–84 years (1,514 per million population) (Figure 2.4).

The prevalence of dialysis in 2003 was an increase of 5% (409 more patients) from 2002, and 27% (1,653 more patients) from 1999. This increase occurred across all age groups among people aged 25 years and over. The annual rate of increase was higher among those aged 65–84 years (8%) and 85 years and over (14%).

The prevalence of dialysis varied between the states and territories. The highest prevalence rate in 2003 was 1,225 per million population in the Northern Territory, followed by Victoria (403 per million population), New South Wales (390 per million population), Western Australia (387 per million population), the Australian Capital Territory (358 per million population), South Australia (331 per million population) and Tasmania (312 per million population).



Source: AIHW analysis of ANZDATA Registry data.

Figure 2.4: Prevalence of functioning kidney transplants and dialysis, by age group, 2003

The demand for dialysis has been increasing consistently in Australia over the last 5 years. The growth rate of the dialysis pool is dependent on the entry of new patients and exits through death or transplantation. The incidence rate of end-stage kidney disease has increased steadily over the last 40 years. At the same time, dialysis-dependent patients are surviving longer as the technology and management improves. It also appears that the transplantation rate is unlikely to increase quickly to ease the pressure on demands for dialysis. All these factors suggest that the demand for dialysis treatment will continue to grow (Mathew 2005).

Methods and locations of dialysis

In 2003, about 76% (5,851) of dialysis-dependent patients were on haemodialysis, including 39% in satellite centres, 27% in hospital and 10% at home. About 24% (1,823) were on peritoneal dialysis, including 14% receiving continuous ambulatory peritoneal dialysis (CAPD) at home, 9% automated peritoneal dialysis (APD) at home and 0.4% CAPD or APD in hospital. Altogether, about 28% of dialysis patients received treatment in hospital, 33% at home and 39% in satellite centres.

Over the last 5 years, the number of patients increased for most methods of dialysis in all locations, except continuous ambulatory peritoneal dialysis (Table 2.6). However, the proportion of patients receiving peritoneal dialysis has been gradually decreasing, from 28% in 1999 to 24% in 2003. Although the proportion of patients receiving home haemodialysis is decreasing, the total proportion of patients receiving haemodialysis has been increasing, from 72% in 1999 to 76% in 2003. This increase was mainly due to increased haemodialysis in satellite centres (Excell & McDonald 2005c).

Table 2.6: Method and location of dialysis, 1999–2003

	1999	2000	2001	2002	2003
			(number)		
APD	264	390	501	612	726
CAPD	1,414	1,346	1,306	1,173	1,097
Total PD	*1,678*	*1,736*	*1,807*	*1,785*	*1,823*
Hospital HD	1,636	1,721	1,808	2,001	2,091
Home HD	706	742	773	777	772
Satellite HD	2,001	2,211	2,462	2,702	2,988
Total HD	*4,343*	*4,674*	*5,043*	*5,480*	*5,851*
Total	**6,021**	**6,410**	**6,850**	**7,265**	**7,674**
			(per cent)		
APD	4	6	7	8	9
CAPD	23	21	19	16	14
Total PD	*28*	*27*	*26*	*25*	*24*
Hospital HD	27	27	26	28	27
Home HD	12	12	11	11	10
Satellite HD	33	34	36	37	39
Total HD	*72*	*73*	*74*	*75*	*76*

APD automated peritoneal dialysis

CAPD continuous ambulatory peritoneal dialysis

HD haemodialysis

PD peritoneal dialysis

Source: AIHW analysis of ANZDATA Registry data.

Transplant

Transplantation of the human kidney is the most effective treatment for ESKD. Compared with dialysis, transplant has a significantly lower risk of comorbidities and mortality (McDonald & Russ 2002).

Number of functioning kidney transplants

Since 1963, there have been 14,068 transplant operations performed in Australia on 12,028 patients. If the first kidney transplanted fails, secondary or more transplants are possible, if suitable donors can be found. Of all kidney transplant operations performed, 85% were for primary transplant, and 15% were for secondary or further transplants. Of the total transplanted kidneys, 5,951 (300 per million population) were functioning at the end of 2003. The prevalence of functioning kidney transplants increased with age to 55–64 years, then decreased with age (Figure 2.4).

Young patients are more likely than older patients to have a kidney transplant. At the end of 2003, 83% of treated end-stage kidney disease patients aged 5–14 years had functioning kidney transplants. The proportion of patients with transplants decreased with age, to just 2% among patients aged 85 years and over.

The prevalence of functioning kidney transplants varied among the states and territories, being highest in South Australia and the Northern Territory (425 per million population), followed by Queensland (302 per million population), Victoria and Tasmania (291 per million population), New South Wales and the Australian Capital Territory (282 per million population) and Western Australia (267 per million population) (Excell et al. 2005).

Kidney transplantations in 2003

There were 543 kidney transplant operations in Australia in 2003, an age-standardised rate of 27 per million population. The annual transplant rate has increased by 13% since 1995 (when there were 455 operations, 24 per million population). While the operations were performed on patients with a wide age range (from 2.3 years to 77.6 years), the majority of recipients (93%) were aged under 65 years, with a median age of 44.8 years.

The transplantation rate in 2003 varied between the states and territories, from 38 per million population in South Australia and the Northern Territory to 18 per million population in Western Australia (Excell et al. 2005).

International comparison of treated end-stage kidney disease

Information on treated ESKD worldwide is only available for a small number of countries. International comparisons in this report are based on data published by the United States Renal Data System (USRDS 2004). This system has collected data on incidence, prevalence, modality of dialysis and kidney transplant from 31 countries.

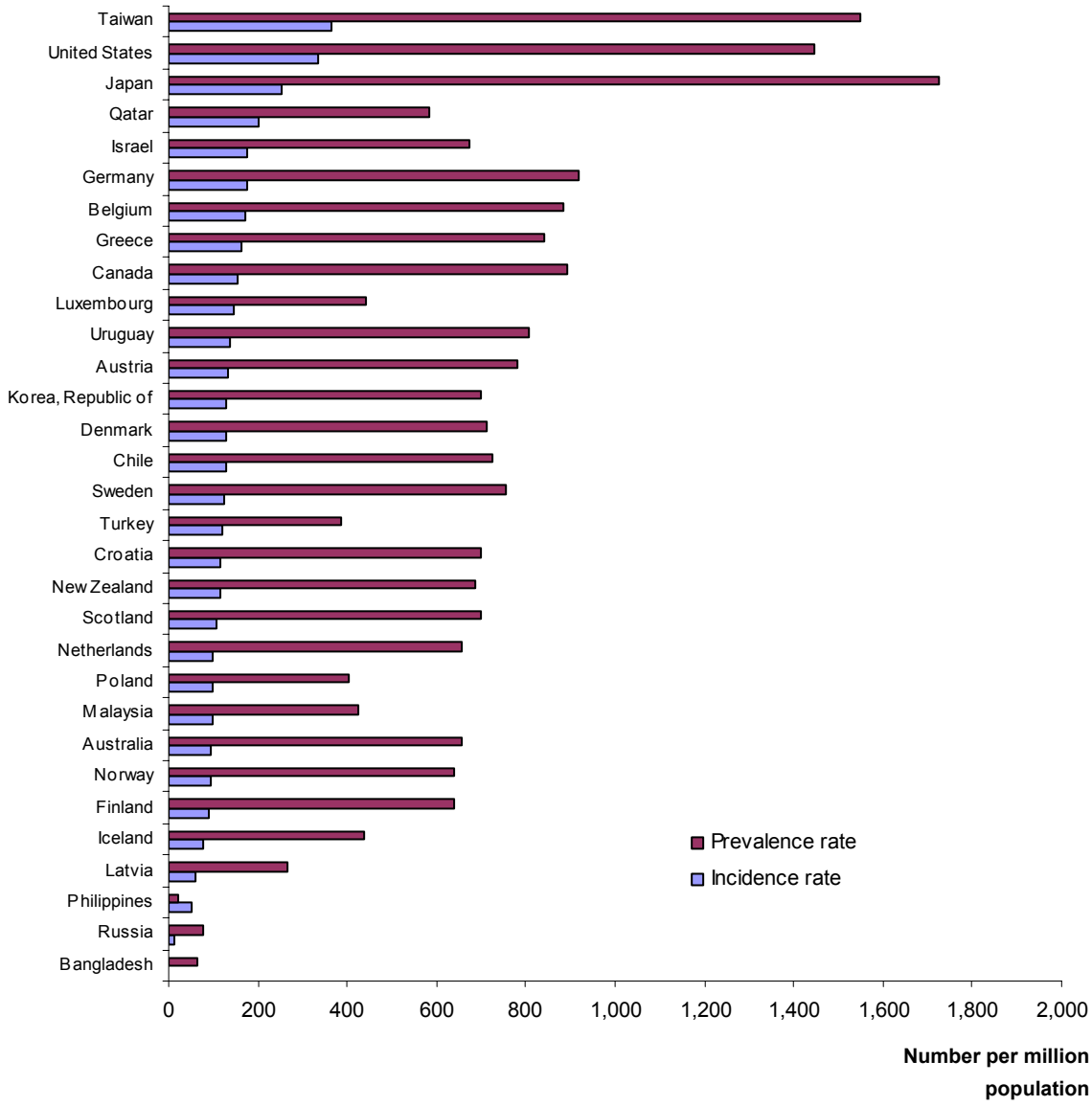
According to the data published by USRDS in 2004, the incidence and prevalence of treated end-stage kidney disease increased for most countries from 1998 to 2002, with the exception of Finland, Hungary, Russia and Sweden. In 2002, the highest incidence and prevalence rates occurred in the United States, Taiwan and Japan, and ranged from 1,446 to 1,726 per million population. The lowest rates were in the Philippines, Bangladesh and Russia, and ranged from 22 to 79 per million population (Figure 2.5).

Another marked change was the gradually increased percentage of new patients with diabetes, which happened in most of these countries.

Although treatment modalities for end-stage kidney disease varied widely from country to country, haemodialysis was the most common choice of treatment for most countries. There were significantly different functioning kidney rates and transplant rates among the countries compared. Both rates were highest in Norway and the US and lowest in Bangladesh.

In comparison, Australian incidence and prevalence rates of treated end-stage kidney disease ranked towards the lower end of these countries. Although haemodialysis was the major modality for dialysis, Australia had the second highest proportion of patients on peritoneal dialysis in the world. Both the functioning kidney rate and the transplant rate in Australia were ranked high middle of all countries, but were at the lower end when compared with those countries with similar economic conditions to Australia.

The incidence and prevalence of treated end-stage kidney disease can be affected by many factors. The differences in these rates not only reflect the true incidence and prevalence of end-stage kidney disease in these countries, but also can be much influenced by the availability and accessibility of kidney replacement therapy services provided by these countries. These are highly dependent on government infrastructure and economic conditions (USRDS 2003). Varying economic conditions may play a major role in the differences in incidence and prevalence of treated ESKD among these countries.



Source: USRDS 2004.

Figure 2.5: International comparison of incidence and prevalence of treated end-stage kidney disease, 2002

Mortality

CKD contributes significantly to mortality in Australia. It contributes to death in two ways: as the underlying cause of death (the condition that initiated the train of morbid events leading directly to death) or as an associated cause of death (a condition that gave rise to the underlying cause, or that contributed to the death but was not related to the disease or condition causing it) (ABS 2000).

In 2003, there were a total of 11,648 deaths in Australia where CKD was recorded as the underlying or an additional cause of death, with 6,272 deaths among males and 5,376 among females.

The contribution of CKD to deaths in Australia is described below through examining these underlying and additional causes. Note that there will be some overlap between the deaths presented here and deaths from other diseases published elsewhere. This is due to the inclusion of causes of death such as diabetic nephropathy and hypertensive renal disease, which are classified in other AIHW reports as deaths due to diabetes or cardiovascular disease, respectively.

Information from the ANZDATA Registry on deaths in people receiving treatment for ESKD is also presented.

Chronic kidney disease as the underlying cause of death

There were 2,431 deaths in 2003 where CKD was listed as the underlying cause of death (117 per million population, 2% of all deaths). CKD mortality rates were higher among males than among females across all age groups. The majority of deaths (87%) occurred among people aged 70 years and over.

Table 2.7: Chronic kidney disease as the underlying or an associated cause of death, by disease type, 2003

Type of chronic kidney disease	ICD-10 codes	Number as the underlying cause of death	Number as an associated cause of death	Ratio underlying: associated
Diabetic nephropathy	E10.2, E11.2, E12.2, E13.2, E14.2	91	61	1.4
Hypertensive kidney disease	I12, I13, I15.0, I15.1	477	214	2.2
Glomerular diseases	N00–N07	79	116	0.7
Kidney tubulo-interstitial diseases	N11, N12, N14, N15	93	82	1.1
Chronic kidney failure	N18	940	4,640	0.2
Unspecified kidney failure	N19	675	4,046	0.2
Congenital malformation of the kidney and ureter	Q60–Q63	41	50	0.8
Other disorders of the kidney and ureter	N25–N28, N39.1, N39.2, T82.4, T86.1	35	157	0.2
Total		**2,431**	**9,217**[(a)]	**0.3**

(a) Column will not add to total as more than one type of kidney disease may have been recorded.

Source: AIHW National Mortality Database.

Of these 2,431 deaths, 940 (39%) resulted from chronic kidney failure, with a further 675 (28%) attributed to unspecified kidney failure. Hypertensive kidney disease (477 deaths, 20%), kidney tubulo-interstitial diseases (93 deaths, 4%) and diabetic nephropathy (91 deaths, 4%) were also commonly recorded (Table 2.7).

Multiple cause of death data revealed that for most deaths with an underlying cause of CKD, one or more associated causes of death are recorded. Cardiovascular diseases are the most prominent associated causes and were listed in 58% of cases in 2003 (1,413 deaths). Other common associated causes include respiratory diseases (659 cases in 2003, 27%), acute kidney failure (341 cases, 14%), diabetes (214 cases, 9%), septicaemia (206 cases, 8%) and cancers (147 cases, 6%).

From 1997 to 2003, the mortality rate for CKD as the underlying cause of death decreased from 133 to 117 deaths per million population.

Chronic kidney disease as an associated cause of death

In 2003, CKD was listed on death certificates as an associated cause of death in 9,217 cases. As with the underlying cause of death, CKD is more commonly recorded as an associated cause of death among males, and mainly appears among people in the older age groups. Chronic and unspecified kidney failure are by far the most common CKD codes recorded as an associated cause of death (4,640 and 4,046 cases in 2003, respectively).

In cases where CKD is recorded as an associated cause of death, cardiovascular diseases are the most common underlying cause of death, with 4,045* such deaths in 2003 (44%). Other commonly recorded underlying causes of death include respiratory disease, cancers and diabetes (Table 2.8).

Between 1997 and 2003, the rate of deaths where CKD was recorded as an associated cause of death increased slightly from 449 to 456 deaths per million population.

CKD is nearly four times as likely to be recorded as an associated cause of death than as an underlying cause of death. There are several reasons that may contribute to this. In cases where uraemia (see Box 1.1) is the direct cause of death, CKD is likely to be recorded as the underlying cause of death. However, uraemia is not often directly responsible for death. From its early stages, CKD increases the risks of morbidity and mortality from a range of other diseases, such as cardiovascular disease and infections. Therefore, a substantial proportion of people with CKD may die from cardiovascular disease or other non-kidney causes before CKD reaches its end-stage (when uraemia occurs). When CKD does reach end-stage, kidney function is partly replaced through kidney replacement therapy. Treated ESKD patients do not generally die from uraemia, but die from complications of CKD or side effects of its treatment, unless they withdraw from kidney replacement therapy. These factors, along with the significant increase in the number of people receiving kidney replacement therapy, may have contributed to the different directions in the trends for CKD as an underlying or associated cause of death.

No causal relationship between the underlying and associated causes of death can be established from the AIHW National Mortality Database. However, some diseases, such as cardiovascular disease and diabetes, were much more likely to be recorded as the underlying cause of death in cases where CKD was recorded as an associated cause than in general (Table 2.8). These data highlight the associations between CKD and these diseases.

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* This figure excludes deaths with an underlying cause of hypertensive kidney disease.

Table 2.8: Conditions for which chronic kidney disease was recorded as an associated cause of death, 2003

Underlying cause of death (ICD-10-AM code)	Deaths with CKD as an associated cause		All deaths	
	Number	Per cent	Number	Per cent
Cardiovascular diseases (I00–I99)[a]	4,045	44%	48,358	37%
Heart failure (I50)	*395*	*4%*	*2,432*	*2%*
Ischaemic heart diseases (I20–I25)	*2,445*	*27%*	*25,439*	*19%*
Cerebrovascular diseases (I60–I69)	*456*	*5%*	*12,240*	*9%*
Respiratory diseases (J00–J99)	822	9%	11,892	9%
COPD[b] (J41–J44)	*374*	*4%*	*5,434*	*4%*
Pneumonia (J12–J18)	*254*	*3%*	*3,501*	*3%*
Neoplasms (C00–D48)	1,695	18%	38,392	29%
Prostate cancer (C61)	*280*	*3%*	*2,842*	*2%*
Urinary tract cancers (C64–C68)	*211*	*2%*	*1,745*	*1%*
Diabetes[c] (E10–E14)	793	9%	3,298	2%
Septicaemia (A40–A41)	192	2%	1,079	1%
Other diseases	1,670	18%	26,842	20%
Total	**9,217**	**100%**	**132,292**	**100%**

(a) Excludes deaths with an underlying cause of hypertensive kidney disease.

(b) Chronic obstructive pulmonary disease.

(c) Excludes deaths with an underlying cause of diabetic nephropathy.

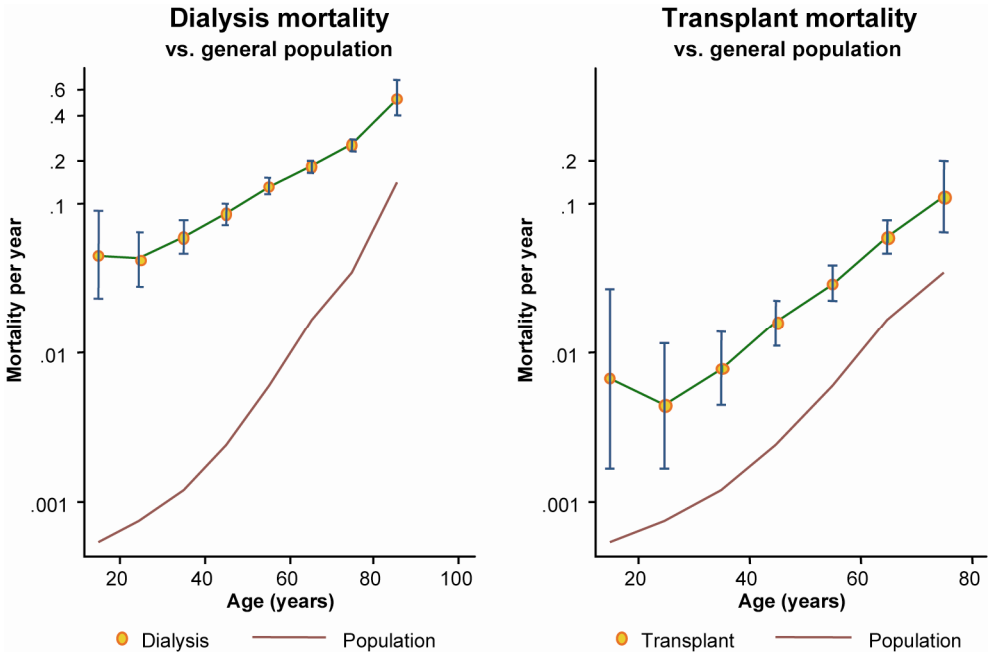
Source: AIHW National Mortality Database.

Deaths among people with treated end-stage kidney disease

According to the ANZDATA report, there were 1,260 deaths among people receiving treatment for end-stage kidney disease in 2003 (1,121 people who were dialysis dependent and 139 people who had received kidney transplants). The total number of deaths among these people in 2003 was more than five times higher than in 1981, when 230 deaths were recorded. This increase is in line with the higher prevalence of treated end-stage kidney disease and the increasing age of the patient population in recent years.

In 2003, the major causes of deaths among dialysis-dependent patients were cardiovascular diseases (40%), withdrawal from treatment (22%), infection (13%) and cancer (7%). Among kidney transplant patients, around 30% of deaths were due to cancers, followed by cardiovascular diseases (23%) and infections (17%) (Excell & McDonald 2005b).

Mortality rates among people with a functioning kidney transplant were much lower than those receiving dialysis treatment. However, the mortality rates in both groups were higher than in the general population (Figure 2.6).



Source: Excell & McDonald 2005b, p17. Reproduced with permission of the ANZDATA Registry.

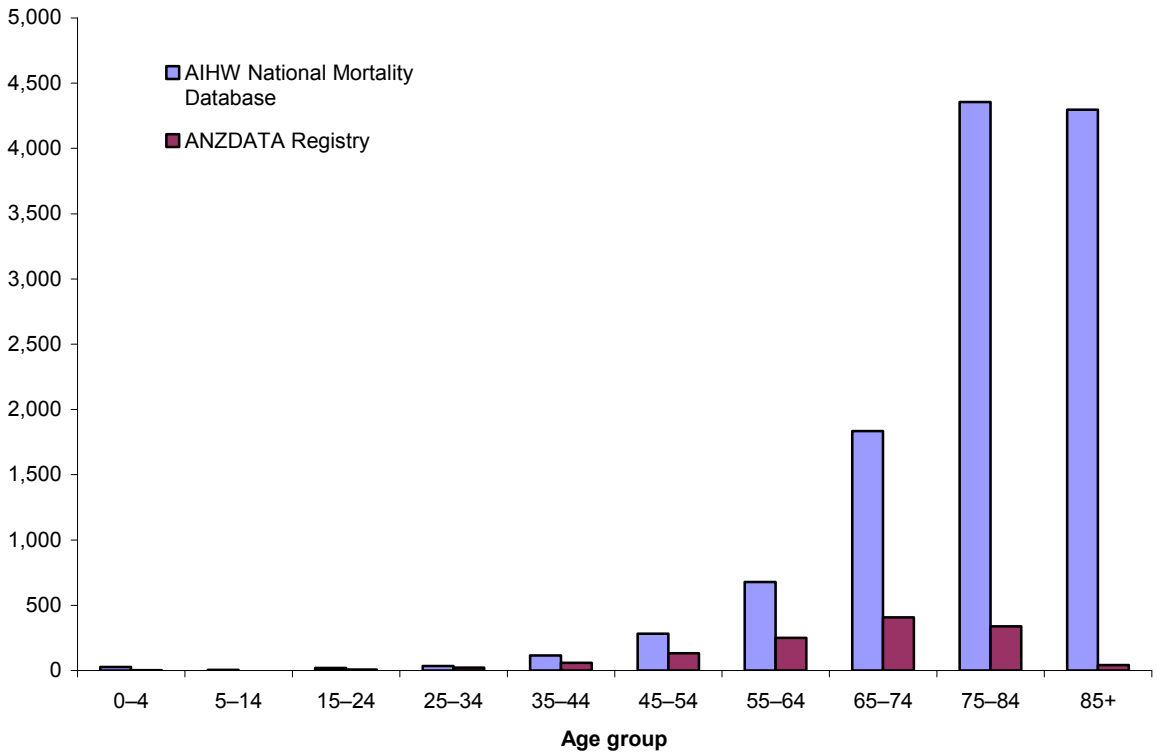
Figure 2.6: Mortality in people with treated end-stage kidney disease compared with the general population, 1998–2003

A comparison of chronic kidney disease mortality between the AIHW National Mortality Database and the ANZDATA Registry

The number of deaths where CKD was recorded as an underlying or associated cause in the AIHW National Mortality Database in 2003 was nearly 10 times the number of deaths recorded by the ANZDATA Registry among people with treated end-stage kidney disease (Figure 2.7). This implies that nine in ten people who died with CKD were not receiving kidney replacement therapy, although this does not necessarily mean that they required it.

Some of the excess deaths recorded in the AIHW National Mortality Database compared with ANZDATA may be attributed to deaths occurring in the early stages of CKD. These people therefore did not require kidney replacement therapy and were not recorded in the ANZDATA Registry. However a proportion may also be attributed to deaths of people who did not accept kidney replacement therapy, especially for people in the older age groups. The reasons for the lower acceptance of kidney replacement therapy among older Australians are not clear. It is thought that the serious comorbidity and significant disability that are highly prevalent in older people may influence decisions about suitability for treatment (Stewart et al. 2004).

The AIHW National Mortality Database does not distinguish between people who were or were not receiving kidney replacement therapy. Therefore, it is not possible to identify which people died during the early stages of CKD and determine what caused their death. Examination of the causes of death among people who died during the earlier stages of CKD is important in terms of developing strategies for prevention and management of the disease, and requires further investigation.



Notes

1. Data from AIHW National Mortality Database are deaths with an underlying or associated cause of CKD.
2. Data from ANZDATA Registry are deaths among people with treated end-stage kidney disease.

Sources: AIHW National Mortality Database; ANZDATA Registry.

Figure 2.7: Comparison of mortality, AIHW National Mortality Database and ANZDATA Registry, 2003

Health expenditure on chronic kidney disease

People with CKD use health services intensively to manage their disease. In particular, kidney replacement treatment by dialysis in its various forms is very expensive and needs to be repeated frequently to sustain patients' lives. Besides the direct expenditure on medical care and treatment, the indirect costs associated with other aspects of living with CKD are also numerous, such as the costs of travelling for treatment, the social and economic burden on carers and family, and lost wages and lost productivity due to illness.

This report provides data on direct health care expenditure for CKD—that is, money spent by governments, private health insurers, companies, households and individuals to prevent, diagnose and treat CKD. Due to lack of information, costs such as the time costs for carers or patients and work time lost due to CKD are not covered by this report. It should be noted that the data presented here are an estimate of direct expenditure on CKD itself. No attempt has been made to estimate expenditure due to the complications of CKD, or treatment for comorbid conditions in people with CKD. Complications and comorbidities may contribute substantially to overall expenditure and other costs for people with CKD. A detailed investigation of the economic burden of CKD has been commissioned by Kidney Health Australia.

The data on direct health expenditure in this report were drawn from the AIHW Disease Expenditure Database and additional analyses (AIHW 2005b). This database was compiled by allocating total recurrent health expenditure for 2000–01 to over 200 disease and injury categories, based on those used in the Australian burden of disease study (AIHW: Mathers et al. 1999). A detailed description of the methodology for the allocation of expenditure to disease is available in *Health system expenditure on disease and injury in Australia, 2000–01 (second edition)* (AIHW 2005b).

The disease categories used in the AIHW Disease Expenditure Database were based on burden of disease groupings. Since CKD is spread across several burden of disease groups it did not directly relate to a category in this database. Expenditure on CKD was estimated according to the diseases on the CKD coding list (Appendix 1) which involved taking various portions of the burden of disease groupings. Therefore parts of the expenditure on CKD overlap with burden of disease categories such as diabetes and so the results presented here are not directly comparable with those presented in the AIHW disease expenditure publications.

Total expenditure on chronic kidney disease

It is estimated that total recurrent health expenditure on CKD in 2000–01 was $647 million. This included:

- $397.2 million (61.4%) on admitted and non-admitted patient hospital services for dialysis
- $126.2 million (19.5%) on admitted and non-admitted patient hospital services for reasons other than dialysis
- $24.5 million (3.8%) on out-of-hospital medical services
- $83.1 million (12.8%) on pharmaceuticals (prescription, over-the-counter medications and highly specialised drugs)

- $5.7 million (0.9%) on research
- $2.8 million (0.4%) on services provided by other professionals
- $7.7 million (1.2%) on high-level residential aged care.

This expenditure of $647 million in 2000–01 is 1.3% of the total recurrent health expenditure of $50.2 billion that was able to be allocated by disease (AIHW 2005b).

Expenditure on dialysis services

The cost of haemodialysis in hospital or satellite centres was estimated to be $427 per separation (National Hospital Cost Data Collection). Dialysis is usually performed three times per week, therefore the total cost of dialysis in hospital was estimated to be $66,000 per person per year.

Estimation of the cost of home dialysis is difficult as there are no national data on dialysis performed outside of hospitals or satellite centres. A Victorian study estimated that home-based haemodialysis cost $9,891 less per person per year than hospital dialysis (Victorian Department of Human Services 2004). Applying this difference to the national data gives an estimated cost for home-based haemodialysis of over $56,000 per person per year. This study also estimated that both forms of peritoneal dialysis cost around $44,000 per person per year (Table 2.9). Total expenditure for home and peritoneal dialysis was estimated to be $116 million.

Table 2.9: Cost per year for different types of dialysis, 2000–01

Type of dialysis	Cost per patient per year ($)
Haemodialysis in hospital or satellite centre	66,072
Haemodialysis at home	56,181
Continuous ambulatory peritoneal dialysis	43,996
Automated peritoneal dialysis	43,996

Note: The estimate of expenditures on haemodialysis in hospital or satellite centre is an average of the hospital and satellite centre costs.

Sources: Victorian Department of Human Services 2004; National Hospital Cost Data Collection Cost Report Round 5 (2000–01).

Hospital services other than for dialysis

After dialysis services, other hospital services accounted for the largest portion of expenditure on CKD in 2000–01, around one-fifth of the total ($126 million). Of this, $99 million (79%) was for admitted patient services. A further $27 million was estimated to be spent on non-dialysis non-admitted patient services, but an unknown portion of this is also counted in out-of-hospital specialist expenditure.

Other expenditure relating to chronic kidney disease

Expenditure on CKD-related community pharmaceuticals in 2000–01 was estimated to be $9.9 million. This included $6.8 million on prescription medications and $3.1 million on over-the-counter medications.

Expenditure on highly specialised drugs for people with kidney transplants was estimated to be $73.1 million: $24.3 for immunosuppressive drugs and $48.8 million for haemopoietics.

(All highly specialised drugs are prescribed through hospitals, but are not included as part of hospital costs in Table 2.10. Pharmaceuticals used in hospitals for admitted patients with CKD are included with hospital costs in Table 2.10 as they cannot be identified separately.)

Out-of-hospital medical services for CKD include medical imaging (such as X-rays and ultrasound), pathology, visits to GPs and consultations with specialists outside of hospital. In 2000–01, direct health expenditure on out-of-hospital medical services relating to CKD was $24.5 million (Table 2.10). This included $5.4 million for GP consultations, $9.4 million for imaging and pathology and $9.7 million for specialist consultations. This $9.7 million includes the total expenditure through Medicare by nephrologists for out-of-hospital medical services ($8.3 million).

CKD-related expenditure on other professional services in 2000–01 (including those provided by allied health professionals, such as dietitians and psychologists in private practice) amounted to $2.8 million.

Table 2.10: Expenditure on chronic kidney disease, 2000–01, $million

		Type of expenditure			
Area of expenditure		**Dialysis[a]**	**Kidney transplant**	**Other CKD expenditure[b]**	**Total CKD**
Hospitals	Total	397.2	11.5	114.7	523.4
	Admitted patient[c]	*287.4*	*11.5*	*87.7*	*386.6*
	Non-admitted patients	*109.8*	*n.a.*	*27.0*	*136.8*
Aged care homes (high care component)		n.a.	n.a.	n.a.	7.7
Medical services (out-of-hospital)	Total	n.a.	n.a.	n.a.	24.5
	Unreferred attendances (GP)	*0.03*	*0.1*	*5.2*	*5.4*
	Imaging and pathology	*n.a.*	*n.a.*	*n.a.*	*9.4*
	Specialist	*n.a.*	*n.a.*	*n.a.*	*9.7*
Pharmaceuticals	Total	0.3	0.0	9.0	83.1
	Pharmaceuticals requiring a prescription	*0.3*	*0.6*	*5.9*	*6.8*
	Highly specialised drugs	*0.0*	*73.1*	*0.0*	*73.1*
	Over-the-counter	*0.0*	*0.0*	*3.1*	*3.1*
Other health professionals		0.0	0.0	2.8	2.8
Research		n.a.	n.a.	n.a.	5.7
Total expenditure		**n.a.**	**n.a.**	**n.a.**	**647.1**

(a) Includes haemodialysis in hospitals and satellite centres, peritoneal dialysis and expenditure on treatment of infection and inflammatory reactions due to peritoneal dialysis catheters.

(b) Includes an estimated CKD portion of expenditure on the burden of disease categories of diabetic nephropathy, hypertensive renal disease, genitourinary system disease and genitourinary system congenital malformations.

(c) Includes cost of private medical services delivered to admitted patients who are private.

n.a. Not available.

Note: Columns may not add to totals due to rounding.

Expenditure on high-level residential aged care services for people with CKD was estimated as $7.7 million for 2000–01. This estimate was based on Australian Bureau of Statistics data from 1998 which indicated that 0.29% of residents in residential aged care had as their main condition ICD-10 disorders N00 to N39. This proportion (with some adjustment for the relative costliness of different disorders) was applied to total expenditure for high-level

residential aged care. This is likely to be an overestimate of actual residential aged care expenditure for people with CKD as N00 to N39 includes disorders such as stress incontinence.

Direct health expenditure on CKD-related research in 2000–01 was estimated to be $6 million. (This was 43% of the research estimated to be for the genitourinary system. Genitourinary system research was estimated to be 1.1% of total health research based on data from the ABS 2000–01 survey of research and experimental development.)

The research expenditure is for research which supports the understanding of the causes, extent and impact of CKD, the development and evaluation of new and existing treatment methods, public health interventions, and a portion of general health services and epidemiological research.

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