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

The National Centre for Monitoring Chronic Kidney Disease

Australian Institute of Health and Welfare

GPO Box 570

Canberra ACT 2601

Phone: (02) 6244 1000

Email: ckd@aihw.gov.au

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Summary

Chronic kidney disease (CKD) is a common and serious problem in Australia and its management can be resource intensive. Those with CKD's most severe form, end-stage kidney disease, usually require dialysis or a kidney transplant to survive. Some forms of dialysis require regular and frequent hospital admissions and dialysis is the most common reason for hospitalisation in Australia.

Health care expenditure on chronic kidney disease 2004–05 is the first full report on health care expenditure for CKD in Australia, and revises estimates reported in *Chronic kidney disease in Australia 2005*. Expenditure estimates in this report were derived from the Australian Institute of Health and Welfare (AIHW) Disease Expenditure Database and include only the direct health care costs that were able to be allocated by disease.

Key findings

- CKD is a substantial contributor to health care expenditure in Australia, accounting for 1.7% of total expenditure.
- Expenditure on CKD is increasing much faster than total health care expenditure.

The figures

Substantial contributor

- Health care expenditure on CKD in Australia in 2004–05 was $898.7 million.
- Nearly 85% ($760 million) of CKD expenditure was due to dialysis and transplant, with dialysis alone accounting for around two-thirds (over $593 million).

Expenditure increasing

- Between 2000–01 and 2004–05 expenditure on CKD increased from 1.3% to 1.7% of the total allocated health care expenditure.
- After adjusting for inflation, this was a 33% increase, whereas total health care expenditure increased by 19%.
- Expenditure on CKD per person in Australia increased by 27%, more than double the increase in per person total health care expenditure.

1 Introduction

Purpose

This report estimates the total allocated health system expenditure associated with chronic kidney disease in Australia for the period 2004–05. The term 'expenditure' in this report refers to allocated expenditure (explained in *Chapter 2*) unless otherwise specified. Estimates are presented by area of expenditure: hospital admitted patients, out-of-hospital medical services, and prescription pharmaceuticals.

Background

Chronic kidney disease (CKD) is defined as all conditions of the kidney where a person has had evidence of kidney damage and/or reduced kidney function for at least three months. It is a common chronic disease in Australia. In 1999–2000, as many as one in seven Australians aged over 25 years had some degree of CKD (Chadban et al. 2003).

CKD comprises a continuum of disease ranging from mild kidney damage, most often without symptoms (stage 1), through to end-stage kidney disease (ESKD or stage 5) where kidney function is no longer sufficient to sustain life. The stages of CKD are based predominantly on the level of kidney function. However, in the earlier stages other clinical evidence of kidney damage, such as proteinuria, are required for a diagnosis (Lamb et al. 2005).

Kidney function is measured by the amount of blood the kidneys clear of waste products in one minute (glomerular filtration rate or GFR). As this cannot be measured directly, the GFR is estimated (eGFR) by applying a formula based on measured creatinine levels in the blood, age and gender. Patients in Stage 5 usually require kidney replacement therapy in the form of dialysis or transplant to survive, and it is on these resource-intensive and technologically advanced treatments where much of the health costs for CKD are incurred (Cass et al. 2006). Regular dialysis is the most common reason for hospitalisation in Australia, accounting for just fewer than 12% (811,493) of all hospitalisations in 2004–05. In total, CKD was the primary reason for 838,625 hospitalisations.

As for many other chronic diseases, the rates of CKD are higher among Aboriginal and Torres Strait Islander peoples than for other Australians. In 2004, around 10% of new cases of treated ESKD, and 6.7% of all cases of treated ESKD, were among Indigenous Australians (McDonald et al. 2008). This is despite Indigenous Australians making up only 2.4% of the population. In some Indigenous communities the rates of treated ESKD are up to 30 times the rates among other Australians (Spencer et al. 1998). Although there is no measured information on the overall incidence or prevalence of CKD (i.e. including both treated and untreated cases of CKD) in Indigenous Australians at the national level, several studies have discovered high rates of CKD and indicators of kidney damage among Indigenous communities. McDonald et al. (2003) found that 12% of adults in a remote Aboriginal community in the Northern Territory had stage 3, 4 or 5 CKD and a further 36% had evidence of reduced kidney function.

What is health expenditure?

Health expenditure comprises recurrent and capital expenditure on hospitals, medical, dental, patient transport services, other health practitioner, community and public health services, medications, aids and appliances, health research and the administrative systems that support these services. The health expenditure reported here is funded mostly by the Australian Government and state and territory governments, with some funding by private health insurance, households, and other non-government sources (AIHW 2007).

The scope of this report covers direct health care expenditure—that is, money spent by governments, private health insurers, companies, households and individuals to prevent, diagnose and treat CKD. Some direct health care costs that are unable to be allocated by disease—such as capital expenditure (see *Methods*) and indirect costs associated with living with CKD—are not included in the estimates. At an individual and community level these indirect costs outside the health system are numerous and include: lost earnings and productivity, loss of tax revenue, the need to provide unemployment or disability benefits, the cost of travelling for treatment, and the social and economic burden on carers and family. Therefore this report does not represent the total economic impact of CKD in the Australian community, rather it concentrates on the expenditure directly related to the health system.

The method used here allocates expenditure where CKD is the *primary* reason for medical care. Other costs where CKD is not the primary reason for medical care (ie. comorbidity, see *Methods*) are allocated to the primary disease. This implies that a proportion of the cost for CKD is not included here; but there will also be a proportion of costs for other diseases included in the CKD expenditure estimate.

2 Methods and limitations

The method for estimating disease expenditure is a 'top–down' approach, where total expenditure across the health system is estimated and then allocated to the various diseases. Although this method yields consistency and good coverage and ensures that components add up to known expenditures, it may not yield the same estimate for any specific disease as a detailed 'bottom–up' analysis of actual costs incurred by patients with that disease.

Not all recurrent health expenditure can be allocated by disease. Items such as capital expenditure, expenditure on community and public health programs, health administration, and health aids and appliances provide support for the treatment and prevention of many conditions but cannot be allocated to one specific disease.

Direct health expenditure on CKD in this report was drawn from the AIHW Disease Expenditure Database and additional analyses. All disease totals in the AIHW Disease Expenditure Database were extracted from the AIHW Health Expenditure Database. The major data providers include:

- Australian Bureau of Statistics
- Department of Health and Ageing
- state and territory health authorities
- Department of Veterans Affairs
- Private Health Insurance Administration Council
- Comcare
- major workers' compensation and compulsory third-party motor vehicle insurers in each state and territory.

The AIHW Disease Expenditure Database apportions total recurrent health expenditure to 19 broad disease groups which largely correspond to a chapter level heading in the International Classification of Diseases (ICD-10) (AIHW: Begg et al. 2007).

Whilst CKD has long been recognised as a health problem, and is the subject of research and policy discussion, it has not been used as a medical term in the ICD-10 nor generally used as a diagnosis in clinical settings (AIHW 2005a). To overcome this problem a coding list for CKD was developed by AIHW researchers in conjunction with nephrologists and experts on disease classification (see *Appendix 2*).

The codes used to identify CKD are spread across several disease groups and therefore do not directly relate to a specific category in the AIHW Disease Expenditure Database. Expenditure on CKD was estimated according to the CKD coding lists, which involve various disease groupings. Parts of the expenditure on CKD overlap with disease categories such as diabetes, therefore the results presented here are a complex combination of those presented in other AIHW disease expenditure publications. For this reason comparison with other diseases or disease groupings is not possible.

In addition, there are some other diseases or conditions not listed on the coding list that can, but do not generally, result in CKD. In these cases CKD cannot be identified without medical evidence to indicate that there is kidney damage and/or reduced kidney function. Administrative databases, from which the AIHW Disease Expenditure Database is compiled, do not contain pathology information. As such, these cases cannot be identified and this may

lead to some underestimation of health service usage due to CKD in Australia (AIHW 2005a).

In the case of hospitalisations and other health services usage, the disease that is considered the primary reason behind the episode of care is recorded as the principal diagnosis. Where a disease coexists with a principal diagnosis, either by being present prior to admission or arising during an episode of care, and affecting the management of the patient by requiring therapeutic treatment, diagnostic procedures, or increased nursing care, it is recorded as an additional diagnosis. This report presents estimated health expenditure only where CKD is the principal diagnosis. CKD shares many risk factors with cardiovascular disease (CVD) and diabetes, and these diseases often appear together due to a complex causal relationship where each may be caused by, or be a complication of one, or both of the other diseases. This is known as *comorbidity*, and the clinical management for people with comorbid conditions is much more complex and time consuming than for those with single diseases (AIHW: Tong & Stevenson 2007).

As is the case with estimates of expenditure for other diseases based on data in the AIHW Disease Expenditure Database, no attempt has been made to estimate expenditure due to the complications of CKD, or treatment for CKD where it coexists with other diseases. Complications and comorbidities may contribute substantially to overall expenditure and other costs for people with CKD. However, as the method used here is to estimate the direct health expenditure where CKD was the *primary* cause, these other costs have not been included. It is also important to note that while there is a proportion of cost for CKD not included here, there will also be a proportion of costs for other diseases included in the CKD expenditure estimate.

Data used to provide estimates

- **Admitted patients hospital services:** in public hospitals were derived from those published in *Australian Hospital Statistics 2004–05* (AIHW 2006). Private hospital expenditure data was derived from the Australian Bureau of Statistics Private Health Establishments Survey.
- **Out-of-hospital medical services:** were estimated using data from the general practitioners survey, Bettering the Evaluation and Care of Health (BEACH).
- **Prescription pharmaceuticals and highly specialised drugs:** the Pharmacy Guild survey and costing data for the Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceuticals Benefits Scheme (RPBS) were used to estimate expenditure on prescription drugs. Expenditure on highly specialised drugs was estimated based on the number of people living with a kidney transplant.
- **Dialysis:** as for admitted patient hospital services for hospital dialysis. Out-of-hospital dialysis expenditure was estimated using the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA) and costs estimated by a Victorian Government study into renal dialysis.

Appendix 1 provides detailed information on data sources and methods.

Changes in methods between 2000–01 and 2004–05

The methodology used for estimating health system expenditure on CKD in 2004–05 largely followed the methods and data sources used in the 2000–01 study, reported in *Chronic kidney disease in Australia 2005*. Since 2000–01, however, there have been some changes to the *International Classification of Primary Care*, second edition (ICPC-2) CKD coding list used in primary care and general practice. For comparisons sake, the 2000–01 coding list has been used for 2004–05 estimates in *Chapter 5*. There are also several areas of expenditure included in the 2000–01 report that were not included in the estimates provided in this report. These areas are: expenditure on non-admitted patient hospital services, over-the-counter pharmaceuticals, other health practitioner services, aged care and research.

Expenditure on these areas has been deducted from the total health care expenditure for 2000–01, resulting in a 24% reduction in the estimate.

3 How much is spent on chronic kidney disease?

In 2004–05, total allocated recurrent health care expenditure for CKD in Australia was estimated to be $898.7 million (Table 3.1), equating to 1.7% of the total allocated expenditure on health goods and services in Australia for this period (estimated at $52,660 million). Almost two-thirds (65%) of CKD expenditure ($584.6 million) was on admitted patient hospital services (Table 3.1, Figure 3.1), with the majority of that cost reflecting the high numbers of patients admitted for regular dialysis. Highly specialised drugs and non-admitted patient hospital services for dialysis each accounted for 15% of CKD expenditure, whilst out-of-hospital medical services and pharmaceuticals requiring a prescription made up only 4% and 1% respectively.

As CKD is more common in older age it is likely that the majority of the cost is incurred for the older age groups.

Table 3.1: Total allocated health care expenditure on chronic kidney disease, 2004–05, $million

	Type of expenditure			
Area of expenditure	**Dialysis[a]**	**Kidney transplant**	**Other CKD expenditure[b]**	**Total allocated CKD**
Total hospital services	593.22	20.05	106.96	720.23
Admitted patient hospital services[c]	*457.55*	*20.05*	*106.96*	*584.55*
Non-admitted patient hospital services[d]	*135.68*	*n.a.*	*n.a.*	*135.68*
Out-of-hospital medical services	n.a.	n.a.	n.a.	36.73
Unreferred attendances (GP)	*0.02*	*0.22*	*10.09*	*10.33*
Imaging and pathology	*n.a.*	*0.07*	*n.a.*	*11.70*
Specialist	*n.a.*	*n.a.*	*n.a.*	*14.70*
Pharmaceuticals requiring a prescription	0.25	1.37	7.76	9.38
Highly specialised drugs for kidney transplantees	—	132.37	—	132.37
Total allocated expenditure	**n.a.**	**n.a.**	**n.a.**	**898.70**

(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.

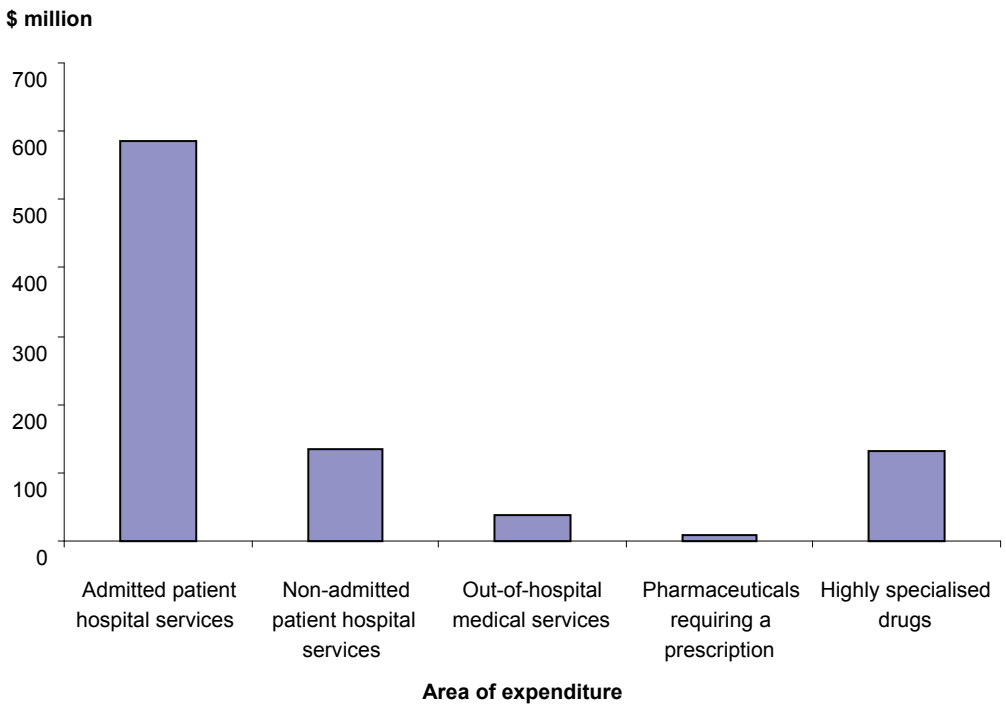
(c) Includes the cost of private medical services delivered to admitted patients who are private.

(d) Expenditure on non-admitted patient hospital services has been estimated for dialysis only. It is not possible to allocate other expenditure in this area by disease.

n.a. Not available.

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

Source: AIHW Disease Expenditure Database.



Note: Estimate for non-admitted patient hospital services relates to dialysis patients only.

Source: AIHW Disease Expenditure Database

Figure 3.1: Allocated health care expenditure on CKD by area of expenditure, 2004–05 ($ million)

4 Treatment of end-stage kidney disease

In 2004–05, expenditure on treatment of end-stage kidney disease was over $760 million, or nearly 85% of total CKD expenditure. As at 31 December 2004, there were 8,008 people on dialysis and 6,267 people living with a functioning transplant (McDonald et al. 2008). Excluding nephrologists' costs, which were unable to be apportioned between dialysis and transplant patients, the total cost of dialysis treatment accounted for over $593 million (Table 4.1). Nearly all of this was spent on hospital services for admitted and non-admitted patients. Three-quarters of the expenditure was on haemodialysis in hospital and satellite centres with the other quarter being on home haemodialysis and peritoneal dialysis.

Excluding nephrologists costs of $12.5 million, the total hospital, out-of-hospital and general pharmaceutical cost for all patients who received a kidney transplant in 2004–05 was $21.7 million. The majority of this ($20.1 million) was on admitted patient hospital services. In addition, $132.4 million was spent on highly specialised drugs for people who had a kidney transplant in 2004–05 and for people with a functioning kidney transplant done in a previous year.

Table 4.1: Health care expenditure for dialysis and transplant, 2004–05 ($ millions)

	Total hospital services[(a)]	Out-of-hospital medical services	Prescription pharmaceuticals	Highly specialised drugs for kidney transplantees	Total allocated expenditure
Kidney transplant	20.05	0.29	1.37	—	21.71
Highly specialised drugs for kidney transplantees	—	—	—	132.37	132.37
Haemodialysis[(b)]	447.68	0.02	0.25	—	447.96
Home dialysis and peritoneal dialysis[(c)]	145.54	—	—	—	145.54
Total allocated expenditure	**613.27**	**12.82[(d)]**	**1.62**	**132.37**	**760.08[(e)]**

(a) Includes admitted and non-admitted patient hospital services.

(b) Haemodialysis in hospitals and satellite centres.

(c) Includes home based haemodialysis, peritoneal dialysis and expenditure due to infection and inflammatory reaction due to peritoneal dialysis catheter.

(d) Out-of-hospital medical includes an estimated $12.5 million expenditure in nephrologists' fees which were unable to be apportioned between dialysis and transplant patients.

(e) Column does not add to total due to included nephrologists' fees which were unable to be apportioned.

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

Sources: AIHW Disease Expenditure Database.

Hospital or satellite haemodialysis was the most expensive type of dialysis (Table 4.2), costing on average over $75,500 per patient per year. Haemodialysis at home was the next most expensive type of dialysis, with peritoneal dialysis costing the least.

As nearly three-quarters (74%) of patients receiving dialysis or transplant treatment for ESKD in 2004 were 45 years and over, the majority of these costs were incurred in this age group. In addition, those aged 65 years and over accounted for nearly one-third (32%) of dialysis and transplant patients, highlighting the greater burden of CKD among older age groups (AIHW analysis of ANZDATA registry data).

Table 4.2: Health care expenditure for different types of dialysis, 2004–05

Type of dialysis	Average expenditure per patient per year ($)
Haemodialysis in hospital or satellite centre	75,660
Haemodialysis at home	64,330
Continuous ambulatory peritoneal dialysis	50,362
Automated peritoneal dialysis	50,362

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 9 (2004–05) and ANZDATA Registry data.

ANZDATA reports on the number of kidney transplants performed in each calendar year. In 2004, there were 650 transplant operations performed in Australia; and 623 in 2005. If the average of these is used to estimate the average cost per transplant operation, it equates to just over $34,000 per operation for hospital services, out-of-hospital medical services and prescription pharmaceutical costs.

ANZDATA also reports the number of people living with a functioning kidney transplant. The average over the years 2004 and 2005 was 6,395. If this is used to estimate the average cost of highly specialised drugs per patient with a functioning kidney transplant, the average cost per person for 2004–05 was approximately $21,000, or $1,750 per month. It must be noted, however, that costs are much higher in the first year after transplant, which will inflate the average. Cass et al. (2006) estimate the cost of the actual transplant to be nearly $31,500 and drug therapy for kidney transplant patients in their first year to be $31,500, dropping to just under $10,000 from year two onwards. Hence over time, transplant is the cheaper alternative to dialysis.

5 Changes in health care expenditure, 2000–01 to 2004–05

Areas of expenditure included in the 2000–01 estimates that were not included in this report have been excluded from this section to enable accurate comparison. This includes expenditure on non-admitted patient hospital services, over-the-counter drugs, other health practitioner services, research, and high-level residential aged care.

Allocated expenditure on health services for CKD in 2000–01 have been converted to 2004–05 prices using the total health price index deflator to allow for reliable comparison (AIHW 2007). After adjusting for health price inflation, overall expenditure on CKD increased by one-third (33%) between 2000–01 and 2004–05 (Table 5.1), from 1.3% to 1.7% of total allocated expenditure. In monetary terms this represents an increase of $191 million expressed in 2004–05 prices. During the same period, total health care expenditure in Australia increased by 19% (AIHW 2007).

Expenditure on admitted patient hospital services accounted for the majority (70% or $133 million) of the growth, increasing by 29% between 2000–01 and 2004–05. The greatest proportional increase in spending for the main areas of expenditure was on highly specialised drugs for kidney transplantees, increasing by 55%.
Out-of-hospital medical services expenditure increased by nearly one third, whilst pharmaceuticals requiring a prescription increased by 25%.

Table 5.1: Change in inflation-adjusted spending, 2000–01 to 2004–05 ($ millions)

Area of expenditure	2000–01	2004–05	$ million change	Per cent change
Admitted patient hospital services	451.6	584.6	133.0	29.4
Total out-of hospital medical services	28.6	38.0	9.4	32.7
Unreferred attendances (GP)	*6.3*	*10.1*	*3.8*	*60.0*
Imaging and pathology	*11.0*	*13.4*	*2.4*	*21.6*
Specialist	*11.3*	*14.5*	*3.2*	*28.3*
Pharmaceuticals requiring a prescription	8.0	10.0	2.0	25.3
Highly specialised drugs for kidney transplantees	85.4	132.4	47.0	55.0
Total allocated expenditure	**573.6**	**764.9**	**191.3**	**33.4**

Notes

1. To enable accurate comparison between years areas of expenditure from 2000–01 not included in 2004–05 estimates have been excluded.
2. 2004–05 date are estimated using the 2000–01 ICPC-2 coding list for comparison's sake and differ from data presented elsewhere in this report.
3. Columns may not add to totals due to rounding.
4. 2000–01 expenditures have been expressed in 2004–05 prices by applying the total health price deflator.

Source: AIHW Disease Expenditure Database.

Since expenditure figures for 2000–01 were published in the *Chronic kidney disease in Australia 2005* report (AIHW 2005a) there have been some changes to the ICPC-2 coding list for CKD. For comparison's sake, Table 5.1 was prepared using the same codes that were used for the 2000–01 figures. Using the current coding list makes little difference to the overall increase in

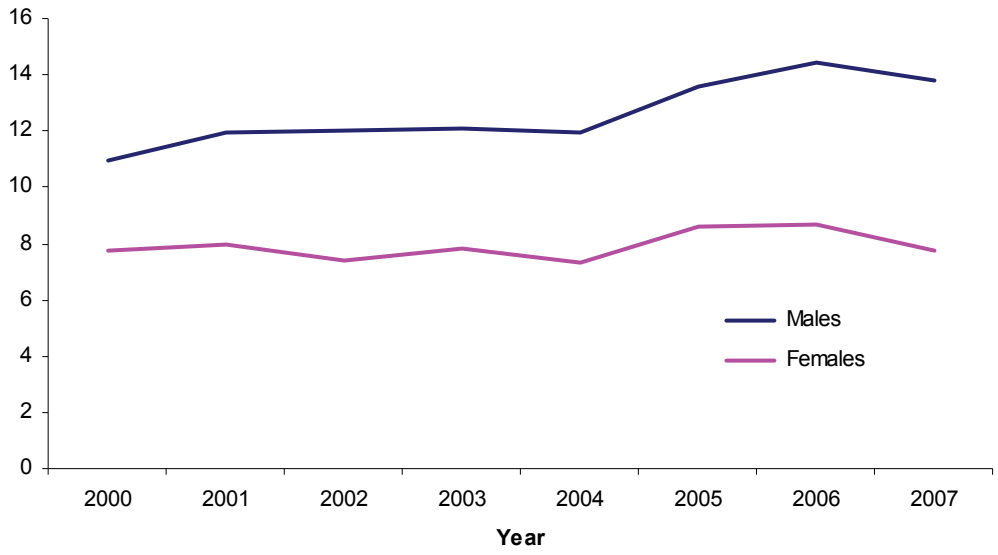
CKD expenditure (33.0% compared to 33.4%). However, there are some differences when expenditure is broken down by area. The most notable of these is for imaging and pathology which increased by only 6.1%, using the current ICPC-2 codes, rather than 21.6%. This is most likely due to the removal of certain codes for kidney diseases, which may require diagnostic screening but are not necessarily considered 'chronic'.

As the population grows, it could be anticipated that health expenditure will also increase to maintain the average level of health goods and services available to each person in the community. By examining expenditure on a per person basis, the influence of changes in the overall size of the population is removed from the analysis. Using constant (inflation adjusted) figures, per person expenditure on CKD increased by 27% between 2000–01 and 2004–05, from $30 to $38. Over the same period, national per person health expenditure on admitted patient hospital services, out-of-hospital medical services, and pharmaceuticals increased by only 13%. After allowing for population growth and inflation, a real increase in expenditure per person is indicative of increases in service use (AIHW 2007).

A large part of the increase in service usage, and hence expenditure, over this period reflects a 25% increase in the number of dialysis patients in Australia (from 6,409 in 2000 to 8,008 in 2004). Over the same period, the number of people living with a functioning kidney transplant increased by nearly 19% (from 5,283 to 6,267) (McDonald et al. 2008). After adjusting for age, the prevalence of treated ESKD increased by 13% between 2000 and 2004 (AIHW analysis of ANZDATA registry data).

It is likely that this increase in health service usage and expenditure will continue in the future, with 9,642 people receiving dialysis treatment and 7,109 living with a kidney transplant at the end of 2007 (McDonald et al. 2008). The number of people commencing treatment for ESKD each year is also increasing significantly: the age-standardised rate of new cases of ESKD rose by 19% between 2000 and 2007 (Figure 5.1), with the majority of the increase between 2004 and 2007 (AIHW 2009).

Cass et al. (2006) predicted the cost of treating all cases of ESKD will increase by 24% between 2004 and 2010 using a linear growth model. They estimated the cost of dialysis and transplant treatment, using a different methodology to the one used here. Although the methods are not directly comparable, the estimates of dialysis and transplant costs are similar to those in this report.



Note: Age-standardised to the 2001 Australian population.

Source: AIHW analysis of ANZDATA Registry Data

Figure 5.1: Trends in incidence of treated end-stage kidney disease, 2000–2007

6 Discussion and conclusion

Chronic kidney disease contributes considerably to health service usage and expenditure in Australia and is on the increase. Allocated expenditure on CKD in 2004–05 was $898.7 million, increasing by one-third from 2000–01, whilst per person expenditure increased by 27%. After allowing for inflation and population growth, the increase is double that of comparable total health expenditure. This rise can largely be explained by the increase in the incidence of treated ESKD and service use of people with the disease. Using the AIHW Disease Expenditure Database, this report has shown that CKD is a significant contributor to direct health care costs in Australia, particularly in hospital services and use of highly specialised drugs. Although not in scope of this report, indirect health care expenditure is also likely to be significant, given the large dependency on health services for people with the later stages of the disease.

The 'top–down' approach for estimating disease expenditure uses the total health system expenditure and allocates it to the principal condition requiring health care. This approach yields consistency, good coverage, and totals that add up to known expenditures, however it may not be as sensitive for any specific disease as a 'bottom–up' analysis of actual costs incurred by patients. However, studies using a bottom–up approach risk overestimating expenditure, as they tend to also include costs associated with other diseases. Adding the results of a series of individual, bottom–up studies of related diseases is likely to produce a total greater than theoretically possible.

There are some difficulties with estimating the true cost of diagnosing, treating and preventing CKD in Australia. As noted earlier, 'chronic kidney disease' was not as a specific category in the ICD-10 in 2004–05, nor was it a burden of disease group in the AIHW Disease Expenditure Database. Thus the estimated allocated expenditure for CKD presented in this report represents portions of various other burden of disease groupings. It is therefore not possible to compare CKD expenditure with health care expenditure on other diseases or disease groupings presented in other AIHW publications.

New coding introduced in Australia from July 2008 may go some way to identifying further the prevalence and economic impact of chronic kidney disease. For hospital data, a new subcategory has been added to the Genitourinary System chapter of the sixth edition of the *International Statistical Classification of Diseases and Related Health Problems, tenth revision, Australian modification* (ICD-10-AM) which enables a diagnosis, and stage, of CKD to be recorded. The assignment of a CKD stage is based on:

- documentation of a stage by clinician, or
- documentation of GFR (or eGFR) by clinician, or
- GFR (eGFR) from pathology result.

New codes for CKD stages 1 to 5 were also added to the *International Classification of Primary Care, second edition* (ICPC-2), used for primary care and general practice, in October 2008. It is expected that it will be some time before it becomes regular practice to record the CKD stage, however, and be accurately reflected in the BEACH data.

Similar diagnosis codes introduced in the United States in October 2005 contributed to a 20% increase in recognised CKD expenditure in 2006 among Medicare patients (aged 65 years and older) (USRDS 2008). It is unclear, however, how much of this increase is attributable to the coding change. Between 1996 and 2006 the recognised CKD population within Medicare

nearly tripled, from 3.1% to 8.6%. Expenditure on CKD in the United States also appears to have grown enormously. Over the 13 year period to 2006, costs for Medicare patients with CKD increased fivefold whilst overall Medicare expenditures increased by only 91%(USRDS 2008).

The approach taken here is to calculate expenditure where CKD was the principal reason for requiring health care. Of nearly 840,000 hospitalisations in 2004–05 where a code from the CKD coding list was the principal diagnosis, 97% were for regular dialysis treatment. Where CKD has progressed to the point that it requires kidney replacement therapy it is far more likely to be coded as the principal diagnosis in health care settings. Further, once treatment commences, the type and location of treatment is recorded with ANZDATA. This registry was used to inform expenditure estimates for home based treatment in this report and therefore the majority of health care expenditure on ESKD will be captured. Where CKD is in the earlier stages and coexists with, or was caused by, another disease it is more likely to be an additional diagnosis and costs associated with its prevention, identification and treatment are not allocated to CKD.

CKD is a highly interactive disease, having direct and indirect causal relationships with both CVD and diabetes. In 2004–05, nearly 76% of hospitalisations involving CKD, but excluding dialysis, also had a diagnosis of diabetes and/or CVD (AIHW: Tong & Stevenson 2007). Comorbidity is associated with greater health care use, including more hospital admissions, longer stays in hospital, and greater frequency of visits to GPs and specialists. Where CKD is an additional diagnosis (around 142,000 hospitalisations in 2004–05), expenditure will be allocated to the principal diagnosis. It is important to note, however, that the estimated expenditure on CKD, where it is the principal diagnosis, will also include expenditure on treating other comorbid conditions such as diabetes and CVD.

The hospital expenditure method estimates hospital admitted patient costs using the Australian Refined Diagnostic Related Groups (AR-DRGs) with an adjustment for length of stay. This is an Australian admitted patient classification system, which provides a clinically meaningful way of relating the number and type of patients treated in a hospital (that is, its casemix) to the resources expected to be used by the hospital. This classification system categorises acute admitted patient episodes of care into groups with similar conditions and similar expected use of hospital resources, based on information in the hospital record such as the diagnoses, procedures and demographic characteristics of the patient (AIHW 2006). As can be seen from the methodology section, some attempt is made to allow for the additional resource use associated with comorbidities when assigning the AR-DRG, although this method may not allow for adequate sensitivity.

A number of international studies have reported on the increased costs associated with treating patients with a comorbidity of CKD. A study of 765 patients undergoing a procedure for coronary heart disease (CHD) in Germany found that a comorbidity of CKD was a significant and independent predictor of markedly higher in-hospital costs, even after adjustment for other comorbidities such as age, diabetes and left ventricular function (Meyer et al. 2008). Patients were grouped into stages of CKD and it was found that costs increased with CKD stage. In addition, after adjusting for confounders, costs were higher for patients with CKD stages 2 to 5 than non-CKD patients.

A large American study analysed the incremental health care costs associated with the development of CKD in patients with diabetes only, hypertension only, and both diabetes and hypertension (Laliberte et al. 2009). The database used included complete medical and pharmacy claims for more than 30 million managed care members, about 10% of whom had laboratory results available. Using primary and secondary diagnoses commonly associated

with CKD, as well as estimating GRF from laboratory results to identify patients who developed CKD, they found all-cause medical service costs in patients with diabetes and/or hypertension increased by between 37% and 67% post-CKD diagnosis. For patients who developed CKD, approximately 9%–19% of all-care health care costs were directly attributable to treatment of CKD.

Other studies in the United States have also shown that patients with treated ESKD are more likely to develop and be hospitalised for a number of other conditions, adding to the overall cost associated with, but not necessarily allocated to, CKD. Dialysis patients were found to have nearly ten times the annual rate of hospitalisation for fungal infections compared to the general population (Abbott et al. 2001), and be at increased risk of hospitalisation for bacterial endocarditis (Abbott & Agodoa 2002). The use of immunosuppressants following kidney transplant has a number of side effects, including an increase in the risk of infection, cancers and bone disease (Magee & Pascual 2004).

The examples listed above indicate that using principal diagnosis to estimate direct health care expenditure on CKD could result in an underestimate of the actual costs incurred by the health system. Instances where CKD was an additional diagnosis, or affected the management of a patient with an alternative principal diagnosis, are not included in the estimates in this report; however, the estimates do include expenditure on other comorbid diseases where CKD was a principal diagnosis. To accurately allocate the costs of comorbidity across disease groups would be extremely complicated and would require a detailed microanalysis of available administrative data.

Despite the limitations on estimating health expenditure on CKD, it is clear that CKD is a substantial contributor to direct health care expenditure in Australia. Changes to better identify CKD in the ICD-10-AM and ICPC-2 have occurred, which are expected to improve the estimate of CKD expenditure in the future. With ESKD rates expected to rise, it is likely that the amount of direct health care expenditure allocated to CKD will also continue to increase in the future.

Appendix 1: Data and methods used to provide estimates

Admitted patient hospital services

The proportions of total public acute hospital expenditure which relate to admitted patients was estimated using the admitted patient proportions estimated by each state and territory and published in *Australian hospital statistics 2004–05* (AIHW 2006). Private hospital expenditure data was derived from the Australian Bureau of Statistics' *Private Health Establishments Survey*.

To estimate admitted patient hospital costs, total admitted patient expenditure was apportioned to individual episodes of hospitalisation. The calculation included an adjustment for the resource intensity of treatment for the specific episode (using the Australian Refined Diagnostic Related Groups, or AR-DRGs—see *Glossary*) and the length of stay. The length of stay adjustment is made in such a way as to reflect the fact that some costs are proportional to length of stay (e.g. ward costs and meals); whereas others are independent of length of stay (e.g. theatre costs). The subdivision of episode costs into these cost 'buckets' was made using National Hospital Costs Data Collection data.

An adjustment was also made for the hospital where the treatment was provided. The standard DRG method for estimating costs uses state and territory DRG weights, and so assumes that each hospital has the same cost as the average for the state or territory. The Public Hospitals Establishments database contains the actual cost of treating admitted patients at each hospital, so these data were used to scale up or down the estimate from state and territory DRG weights.

Diagnostic related groups are assigned on the basis of procedure codes (in the surgical partition) and diagnosis codes in the medical partition. Additional variables including the patient's age, complicating diagnoses/procedures and/ or patient clinical complexity level, the length of stay and the mode of separation are also used for AR-DRG assignment.

Studies have shown that Aboriginal and Torres Strait Islander patients have greater comorbidities and average costs of treatment than non-Indigenous patients (AIHW 2005b; You et al. 2002). A 5% cost loading has been applied to admitted patient costs for Aboriginal and Torres Strait Islander separations, to take into account these known differences (AIHW 2005b). Adjustment factors were also applied to data from most jurisdictions to correct for under-identification of Aboriginal and Torres Strait Islander people.

Where there are no DRG weights, as is the case with some subacute and non-acute patients, the most recent data on costs came from the July to December 1996 subacute and non-acute patient (SNAP) study (Eagar et al. 1997). Per diem costs were applied and inflated to 2004–05 estimates using the implicit price deflator for final government consumption expenditure on hospital care (AIHW 2006).

Estimates of expenditure on private medical services for private patients in hospitals were included in admitted patient hospital costs.

Out-of-hospital medical services

Data from the general practitioners (GPs) survey, Bettering the Evaluation and Care of Health (BEACH), was used to allocate private medical services provided by both GPs and specialists. The ICPC-2 codes used in BEACH have been mapped to the disease costing groups (which are based on ICD-10) to enable out-of-hospital medical services expenditure to be allocated by disease.

Three years of BEACH data—2003–04, 2004–05 and 2005–06—were used in the analysis, which included 297,000 encounters overall. The proportion of problems by disease was used to allocate out-of-hospital medical services expenditure, based on the total medical expenditure available from Medicare data and the AIHW Health Expenditure Database.

Expenditures for 'unreferred attendances', 'imaging' and 'pathology' were allocated to diseases on the basis of GP encounters, while expenditure for 'other medical services' (mostly specialist services) was allocated to disease on the basis of the referral pattern in BEACH. Allocation of GP costs where there were multiple presenting conditions in the GP encounter were done on a pro-rata basis.

Out-of-hospital medical services for CKD included medical imaging (such as X-rays and ultrasound), pathology, visits to GPs and consultations with private specialists providing services to non-admitted patients.

Prescription pharmaceuticals and highly specialised drugs

The Australian Government Department of Health and Ageing has provided detailed costing data for pharmaceuticals issued under the Pharmaceutical Benefits Scheme and the Department of Veterans' Affairs Repatriation Pharmaceutical Benefits Scheme. It also provided volume data for private prescriptions and under-copayment drugs. These data originally came from a Pharmacy Guild survey and were adjusted by the Department to represent volume figures for all of Australia. Costing figures were applied to these prescription drugs to obtain a total expenditure figure for each one. Prescription drugs are coded by the fifth edition of the Anatomical Therapeutic Chemical (ATC) classification—a system developed by the World Health Organization for classifying therapeutic drugs (WHO Collaborating Centre for Drug Statistics Methodology 2002). The ATC codes were mapped to the 'in-house' codes for prescription drugs used in the BEACH survey. As a result, data from BEACH was used to allocate expenditure on prescription drugs to each disease group, based on the medical problem in the GP encounter that related to the prescribing of the particular drug. An assumption was made that the pattern of diseases relating to each type of prescription drug is the same when prescribed by a GP and by a specialist. This assumption was applied because there are no data that permit allocation of specialist-written prescriptions to diseases.

Pharmaceuticals dispensed in hospitals were included in the estimates of hospital costs rather than the 'prescriptions pharmaceutical' category.

Highly specialised drugs for CKD include anti-rejection drugs for kidney transplant recipients, and expenditure on these is estimated separately. The proportion of anti-rejection drugs for CKD are derived using data from ANZDATA on the number of people living with kidney transplants. All highly specialised drugs are prescribed through hospitals to non-admitted patients or to admitted patients on discharge, but are not included as part of admitted patient costs as they are not part of the admitted patient episode. Other

pharmaceuticals used in hospitals for admitted patients with CKD are included with admitted patient costs.

Expenditure on dialysis services

The estimate for haemodialysis in hospital or satellite centres is based on the national average cost of $485 for AR-DRG *L61Z Admit for renal dialysis* (Commonwealth Department of Health and Ageing 2006). The cost per dialysis separation varied between the jurisdictions, ranging from $423 to $565, and the majority of patients attend three times per week or 156 times per year. Estimates for other types of dialysis come from a Victorian study into renal dialysis (Victorian Government Department of Human Services 2004). Whilst a number of other costing studies have been undertaken in various states and territories, almost none of these have been published in peer-reviewed manuscripts or government reports (Cass et al. 2006).

Changes in methods between 2000–01 and 2004–05

Non-admitted patient hospital services (with the exception of dialysis), over-the-counter pharmaceuticals and other health practitioner services were all estimated in 2000–01 by adjusting the 1993–94 expenditure for demographic changes using the 1998–99 NHS survey data. This approximation, based on 1998–99 data, was considered to be no longer tenable for 2004–05 data, so expenditure on these areas in 2004–05 has not been allocated to disease groupings.

In addition, high-level residential aged care was classified as part of health expenditure for the 2000–01 report. This expenditure is now classified as welfare expenditure and is not included in this report.

Appendix 2: Defining CKD

These coding lists identify the primary kidney diseases that are known to cause CKD, and patients with a diagnosis of these diseases are assumed to have CKD. Australian general practice data are classified according to the International Classification of Primary Care, second edition (ICPC-2). A separate coding list for CKD for general practice data was developed by the AIHW by mapping the ICD-10 codes to the ICPC-2.

International Classification of Diseases (ICD)

The *International Classification of Diseases* (ICD) is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and hospital records. In addition to enabling the storage and retrieval of diagnostic information for clinical and epidemiological purposes, these records also provide the basis for the compilation of national mortality and morbidity statistics by World Heath Organization member states.

ICD was created in the 1850s. The first edition, known as the *International List of Causes of Death*, was adopted by the International Statistical Institute in 1893. WHO took over the responsibility for the ICD at its creation in 1948 when the sixth revision, which included causes of morbidity for the first time, was published. ICD-10 was endorsed by the forty-third World Health Assembly in May 1990 and came into use in WHO member states from 1994. It has been in use in Australia since the late 1990s and is the latest version in the ICD series.

The ICD has become the international standard diagnostic classification for all general epidemiological and many health management purposes. These include the analysis of the general health situation of population groups, and monitoring of the incidence and prevalence of diseases and other health problems in relation to other variables such as the characteristics and circumstances of the individuals affected.

The *International Statistical Classification of Diseases and Related Health Problems, tenth Revision, Australian modification* (ICD-10-AM) was developed by the National Centre for Classification in Health (NCCH) with assistance from clinicians and clinical coders to ensure that the classification is current and appropriate for Australian clinical practice.

Table A2.1 shows the ICD codes used to identify CKD in this report.

Table A2.1: 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	Z94.0*, Z99.2*
Transplant procedures[(a)]	36503-00

(a) The kidney transplantation code (36503-00) is an ICD-10-AM health intervention code, not an ICD-10-AM disease code.

^ These codes are used for identification in mortality data only.

* These codes are used for identification in hospital morbidity data only.

International Classification of Primary Care, second edition (ICPC-2)

The *International Classification of Primary Care*, second edition (ICPC-2), is used as a classification for primary care or general practice wherever applicable.

ICPC-2 classifies patient data and clinical activity in the domains of general/family practice and primary care, taking into account the frequency distribution of problems seen in these domains. It allows classification of the patient's reason for encounter, the problems/diagnoses managed, interventions, and the ordering of these data in an episode of care structure.

It has a biaxial structure and consists of 17 chapters, each divided into seven components dealing with: symptoms and complaints (comp. 1), diagnostic, screening and preventive procedures (comp. 2), medication, treatment and procedures (comp. 3), test results (comp. 4), administrative (comp. 5), referrals and other reasons for encounter (comp. 6) and diseases (comp. 7). Table A2.2 shows the codes used in this report to identify CKD in general practice data.

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

ICPC-2 PLUS code	ICPC-2 PLUS label	2004–05	2000–01
K87002	Hypertension; renal disease	√	√
K87003	Hypertension; nephropathy	√	√
K87006	Hypertension; cardiorenal	√	x
U14001	Problem, kidney	x	√
U28001	Kidney transplant	√	√
U59001	Dialysis; kidney (renal)	√	√
U59007	Dialysis; peritoneal	√	x
U59008	Haemodialysis	√	x
U59009	Dialysis; CAPD	√	x
U70001	Infection, kidney	x	√
U70002	Pyelitis	x	√
U70006	Pyelonephritis	x	√
U85001	Polycystic kidney	√	√
U85003	Duplex kidney	√	√
U85004	Congenital anomaly; urological	√	x
U85005	Congenital anomaly; kidney	√	√
U88001	Nephropathy	√	√
U88002	Nephrosis	√	√
U88003	Nephrotic syndrome	√	√
U88005	Glomerulonephritis	√	√
U88007	Glomerulonephritis, acute	√	√
U88008	Glomerulonephritis, chronic	√	√
U88010	Nephropathy, analgesic	√	√
U88011	Nephropathy, diabetic	√	√
U88012	Nephrosclerosis	√	√
U90007	Proteinuria, orthostatic	x	√
U98002	Proteinuria	x	√
U98006	Microalbuminuria	x	√
U99002	Cyst; renal	√	√
U99016	Uraemia	√	√
U99020	Hypertrophic; kidney	√	√
U99021	Hydronephrosis	√	√
U99022	Insufficiency; renal	√	x
U99023	Failure; renal; chronic	√	√
U99024	Necrosis; renal; papillary	√	x
U99028	Stenosis; artery; renal	√	√
U99030	Failure; renal; not otherwise stated	√	x

Glossary

Bettering the Evaluation and Care of Health (BEACH)

BEACH is an ongoing national survey of general practitioners in Australia, conducted by the Australian General Practice Statistics and Classification Centre, situated at the University of Sydney. It involves a random sample of approximately 1,000 general practitioners per year, each of whom records the details of 100 consecutive patient encounters.

Complication and comorbidity level (CCL)

CCLs are severity weights given to all diagnoses as part of the AR-DRG classification. They range in value from 0 to 4 for surgical and neonate episodes, and from 0 to 3 for medical episodes. They have been developed through a combination of medical judgment and statistical analysis. That is:
0 = not a complication or comorbidity
1 = a minor complication or comorbidity
2 = a moderate complication or comorbidity
3 = a severe complication or comorbidity
4 = a catastrophic complication or comorbidity.

Diagnostic Related Groups (DRGs) and Australian Refined Diagnosis Related Groups (AR-DRGs)

DRGs are a patient classification system that provides a clinically meaningful way of relating the types of patients treated in a hospital to the resources required by the hospital. An Australian version, the AR-DRG, was developed for the classification of episodes of acute inpatient care in Australian public and private hospitals. The AR-DRG Classification is based on hierarchies of diagnoses and procedures distributed between surgical, medical and other partitions.

Highly specialised drugs

The Australian Government provides funding for certain specialised medications under the Highly Specialised Drugs Program. Highly specialised drugs are medicines for the treatment of chronic conditions which, because of their clinical use or other special features, are restricted to supply through public and private hospitals having access to appropriate specialist facilities. To prescribe these drugs as pharmaceutical benefit items, medical practitioners are required to be affiliated with these specialist hospital units. A general practitioner or non-specialist hospital doctor may only prescribe highly specialised drugs to provide maintenance therapy under the guidance of the treating specialist. To gain access to a Commonwealth funded drug under this program, a patient must attend a participating hospital and be a day admitted patient, a non-admitted patient or a patient on discharge, be under appropriate specialist medical care, meet the specific medical criteria and be an Australian resident in Australia (or other eligible person). A patient will be required to pay a contribution for each supply of a highly specialised drug at a similar rate to the Pharmaceutical Benefits Scheme. Commonwealth subsidy is not available for hospital inpatients.

Patient clinical complexity level (PCCL)

This is a measure of the cumulative effect of a patient's complications and comorbidities, and is calculated for each episode as part of the AR-DRG classification. The calculation is complex and has been designed to prevent similar conditions from being counted more than once.

Proteinuria

Also called albuminuria or urine albumin—proteinuria is a condition in which urine contains an abnormal amount of protein. Most proteins are too big to pass through the kidneys' filters into the urine; however, proteins from the blood can leak into the urine when the filters of the kidney (glomeruli) are damaged.

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