

# The organization and funding of the treatment of end-stage renal disease in Australia

Anthony Harris

Monash University, Melbourne, Australia

## Abstract

Treatment rates for end-stage renal disease have risen over the last 25 years in Australia, from 3,181 patients in 1981 to 14,221 patients (707 per million) in 2004. Access to dialysis services is largely through the national public insurance system, with more than 85% of services provided by public hospitals for outpatient (68%) or home-based (32%) care. Annual payment rates per patient are around AU\$53,500 for hemodialysis (78% of patients). Total recurrent health expenditure on all chronic kidney disease was AU\$647 million, or 1.3% of the total recurrent health expenditure that could be allocated by disease.



This paper is part of the International Study of Health Care Organization and Financing, which examines how the treatment of renal failure is paid for around the world. This study comprises 13 related papers published in a two-part special issue of the *International Journal of Health Care Finance and Economics*. The original published version of this paper (© Springer Science+ Business Media, LLC 2007) is available at [www.springerlink.com](http://www.springerlink.com).

The ISHCOF is a substudy of the Dialysis Outcomes and Practice Patterns Study (DOPPS). The ISHCOF is supported by the Arbor Research Collaborative for Health; the DOPPS is supported by research grants from Amgen and Kirin Pharma without restrictions on publications. Arbor Research thanks Springer for permission to reproduce this article.

Reference: Harris A. The organization and funding of the treatment of end-stage renal disease in Australia. *Int J Health Care Finance Econ* 7(2-3):113-132, 2007.

## Introduction

While the prevalence of treated end-stage renal failure (ESRF) in Australia has quadrupled in the past 25 years, and while there is little hard evidence of major problems of access to treatment, anecdotal evidence suggests that in some areas a shortage of places has reduced the quality of services and delayed treatment. In some rural and remote areas, including those where the prevalence of ESRF in indigenous Australians is high, there may be difficulties in providing the same level of services as in urban areas. The treatment system is dominated by publicly funded dialysis. Treatments are provided in major hospitals as an inpatient or outpatient service (27%), in satellite facilities associated with that hospital (36%), or by home dialysis supported by and with phone support from hospital-based staff (37%). Hemodialysis is the major modality, but 27% of patients use peritoneal dialysis. Little dialysis occurs at private facilities because the population is already covered by low-cost public insurance and private insurance premium regulations discourage coverage for chronic disease. As a consequence, private insurance coverage is variable and, in some parts of Australia, can leave patients with substantial out-of-pocket expenses. There is no single model of service provision for public maintenance dialysis in Australia, but units are generally organized around area services, often based around a major hospital. One example is the hub and spoke model where the hubs act as fund holders for their satellite hospitals or 'spokes'. In Victoria, for example, there are seven tertiary centers or 'hubs' that have full-time consultant nephrology staff and renal nurses. The seven major health services have intra-hub responsibilities, including: patient demand management within the various sub-regions for which they are responsible; overall quality of patient care (e.g. 24 h telephone support for satellites and regular case review); acute dialysis services and support (e.g., unblocking fistulas); and equipment maintenance, which includes dialyzers (VDHS, 2004). Concern has been expressed about the potential for a marked increase in total expenditure on kidney disease in the next 20 years and specifically about the cost of renal maintenance treatment (Cass et al., 2006). It is against that background that we consider the current organization and funding of renal replacement therapy in Australia.

## Methods

The International Study of Health Care Organization and Financing (ISHCOF) is a sub-study of the Dialysis Outcomes and Practice Patterns Study (DOPPS) that seeks to characterize economic structures and their impact on the delivery of dialysis care. The ISHCOF is based primarily on one-time commissioned surveys (2004–2005) and subsequent papers by authors from each of the 12 DOPPS countries: Australia, Belgium, Canada, France, Germany, Italy, Japan, New Zealand, Spain, Sweden, the United Kingdom, and the United States. Details of the methods are described in Dor, Pauly, Eichleay, and Held (2007).

In general, the reported statistics and data are based on the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA) and the Australian Institute for Health and Welfare (AIHW) database. All monetary estimates were provided in Australian dollars and converted to US dollars with OECD purchasing power parities (PPP) from the year of each figure (OECD, 2006). Due to the small number of economic investigators and countries in this study, all international comparisons reported here are informal and qualitative, unless otherwise noted.

## Financing health care in Australia

The Australian health care system is financed by a mixture of universal public insurance for primary and hospital care, Medicare, and a parallel private insurance system that covers a portion of inpatient private hospital charges and a portion of inpatient medical fees. The Australian Medicare system provides free treatment in a public hospital anywhere in Australia. It also subsidizes out-of-hospital general practitioner (GP) and specialist consultations, medical services provided to private inpatients and prescription drugs listed on the Pharmaceutical Benefits Scheme. Except for salaried doctors in public hospitals, doctors set their own fees and patients may face out-of-pocket costs from differences between the fee charged and the Medicare reimbursement, as well as from hospital charges for private treatment, and prescription out-of-pocket charges (Hall & Savage, 2005).

Public patients treated in public hospitals forgo the choice of medical provider and are treated free of charge by hospital-paid specialists. These specialists may be private practitioners, paid on a sessional basis, or salaried staff specialists who are hospital employees, with rights to private practice. Waiting times for treatment vary considerably depending on procedure. Although, there are no appreciable waiting times for renal dialysis, there may be delays in surgical procedures necessary for dialysis.

Private health insurance in Australia is limited to a portion of private in-hospital treatment fees, prostheses and devices provided to private inpatients, and to ancillary services such as dental and optical care, physiotherapy, and chiropractic treatment. Hospital insurance may be purchased separately from ancillary service insurance; however, most who are insured have both. Annual premiums vary depending upon the extent of coverage, the front-end deductible, and the state of residence. All applicants for a policy must be accepted by the fund. Prior to 2000, the premium charged could not vary by age, health status, or any other personal characteristic, but now some risk rating by age for new enrollees may occur. Most funds provide full coverage for dialysis in private clinics, however, they are not required to do so and there is some evidence that they may limit the number of patients with full coverage (Smith, 2004). Private health insurance coverage of the population fell steadily after the introduction of Medicare in 1984 and reached its lowest level (30%) in 1998. This led to a number of government initiatives designed to increase private coverage and relieve pressure on the public system. As a result of the insurance incentives, private coverage increased from 30.1% in 1998 to 43% in 2000, a jump of over 40% before stabilizing at that rate through 2005.

Table 1 shows the comparative contribution of the public and private hospital sectors from 1999–2000 to 2003–2004 (AIHW, 2005a). While activity increased in both sectors, private hospital separations grew more than three times faster than public ones. This continues the trend of increasingly private provision, but private-sector growth has been accelerated in this period by health insurance reforms. The long term decline in length of hospital stay in both sectors continued in this period with the growth in patient days lagging behind the growth in separations.

**Table 1. Hospital activity by sector 1990–2000 to 2003–2004**

Activity	Year					Change from 1999–2000 to 2003–2004
	1999– 2000	2000– 2001	2001– 2002	2002– 2003	2003– 2004	
<i>Number of hospitals</i>						
Public hospitals	748	749	746	748	761	2%
Private hospitals	509	516	560	549	525	3%
Total	1,257	1,265	1,306	1,297	1,286	2%
<i>Separations '000</i>						
Public hospitals	3,873	3,882	3,966	4,091	4,201	8%
Private hospitals	2,026	2,272	2,433	2,554	2,641	30%
Total	5,899	6,154	6,398	6,645	6,841	16%
<i>Patient days '000</i>						
Public hospitals	16,243	15,726	16,237	16,425	16,419	1%
Private hospitals	6,361	6,743	6,964	7,115	7,165	13%
Total	22,604	22,469	23,201	23,541	23,583	4%

Source: AIHW, 2005b

### Public hospitals

Public hospitals provide the majority of acute care beds and dialysis treatments. They are largely funded by the State and Territory Governments and receive additional revenue from services to private patients. Large urban public hospitals provide most of the more complex types of hospital care such as intensive care, major surgery, organ transplants and dialysis, as well as outpatient care. Public hospitals have their own pharmacies, which provide medicines to admitted patients free of charge. In 1999–2000 there were 748 public hospitals nationally (including 24 psychiatric hospitals) compared with 756 in 1995–1996. These public hospitals represent 68% of all beds in the hospital sector. Public hospital beds have declined from 3.3 beds per 1,000 population in 1995–1996 to 2.8 beds in 1999–2000 and 2.7 in 2003–2004 (AIHW, 2005a).

Under the Australian Health Care Agreements between the Commonwealth Government and the State/Territory Governments, people are entitled to free accommodation, medical, nursing and other care as public patients in public hospitals. Alternatively, patients may choose to be private patients in public hospitals, enabling them to choose their doctors. Those who elect to be private patients in public hospitals are charged separate fees for medical and hospital care. If patients have private insurance, this will usually cover all or part of the charges by a public hospital. Medicare payments subsidize part of the cost of doctors' charges, while private insurance pays an additional amount towards these charges and other costs (e.g., surgically implanted prostheses) incurred during the hospital stay. Public hospital funding systems are similar in most states, organized by diagnostic related group (DRG) based case payments with a prospective, individual hospital cap on total throughput. The system in New South Wales (the largest state), while informed by DRG case mix costs, is a regionally based capitation system with prospective budgets for individual hospitals determined at the regional level.

### Private hospitals

In 2001–2002, the private hospital sector was responsible for 30% of all hospital bed-days and 38% of separations. There were 543 private hospitals in operation in 2003–2004, with 296 acute

and psychiatric hospitals and 247 day hospital facilities that provide for only short post-operative recovery periods. The number of acute and psychiatric hospitals has continued to decline since 1995–1996 when 323 of these hospitals were in operation. In contrast, day hospital facilities that perform less complex elective surgery have shown strong growth for several years, from 140 in operation in 1995–1996 to 247 in 2003–2004. The average number of beds at private day hospital facilities increased from 1995–1996 by 55% to 1,581 in 1999–2000 and again by 8% to 1,715 in 2003–2004. The number of private hospital beds available per 1,000 population increased from 1.2 in 1999–2000 to 1.3 in 2003–2004. The continued growth in the use of private day surgery facilities is reflected in the 30% increase in private hospital separations between 1999–2000 and 2003–2004. These hospitals have traditionally been non-profit institutions, but group for-profit facilities have increased their market share in recent years with a fifth of the market in private day hospital separations and almost half of the market in acute and psychiatric private hospital separations in 1999–2000 (Australian Bureau of Statistics, unpublished Private Health Establishments Collection data).

Costs incurred by patients receiving private doctors' services in or out-of-hospital, and some optometrists' services, are generally reimbursed, either fully or in part, by the federal government through Medicare benefits. These benefits are administered by Medicare Australia. Medical Benefits Schedule (MBS) fees are used to calculate Medicare benefit entitlements, but doctors are able to determine their own fees, provided the service is not 'bulk-billed'. If the service is bulk-billed by agreement between the doctor and patient, the doctor must accept the Medicare benefit, paid directly to the doctor, as payment in full. However, while over two thirds of GP services are bulk-billed, more than two thirds of specialist services attract out-of-pocket costs. The rate of benefit for non-hospital medical services, such as consultations, is 85% of the MBS fee. Once the difference between the schedule fee and benefit is more than AU\$52.50 (indexed annually) the benefit is the schedule fee less AU\$52.50 (US\$38; PPP 2004). In any year, if the sum of the out pocket 'gap' payments (payments above the benefit level and up to the level of the schedule fee) for non-hospital services for an individual or registered family exceeds AU\$302.30 (US\$227; PPP 2001), all further benefits for the remainder of that year are paid at 100% of the schedule fee. Private insurers are prohibited from insuring all or part of the gap between Medicare payments for a service and the fee charged by the doctor, e.g. a consultation with a nephrologist in their private rooms may involve a gap payment if the specialist does not accept Medicare benefit as full payment. In 2004, the government introduced a maximum family out-of-pocket cost threshold of AU\$716 (US\$523; PPP 2004) above which Medicare will pay 80%. The threshold is less for low income people and for those who already receive concessions. Table 2 illustrates how the system operates. It demonstrates the case of a person or family who has reached the annual threshold and then a nephrologist charges for the monthly supervision of home dialysis. The Medicare schedule fee for the supervision of home dialysis is AU\$128.05 (US\$93; PPP 2004) and the rebate is AU\$108.85 (US\$79; PPP 2004). If the renal specialist charges an additional AU\$30 in excess of the schedule fee, the person will also receive 80% of their out-of-pocket costs (AU\$49.20) over and above the rebate. This means that for the doctor's charge of AU\$158.05, the patient will receive a total of AU\$148.21 (US\$108; PPP 2004) in Medicare rebate.

Payments for private, non-doctor hospital services are insurable. Where the insurance company has reached an agreement with the hospital there may not be any out-of-pocket charges, but otherwise, patients may pay for a share of both hospital and medical costs above the MBS fee.

**Table 2. Medicare reimbursement**

Patient Pays (AU\$)		Patient Receives (AU\$)	
Medicare schedule fee	128.05	Medicare rebate	108.85
Additional physician charge (hypothetical)	30.00	Safety net (80% of out-of-pocket costs)	39.36
Total cost	158.05	Total received	148.21

Overall, the Australian health care system provides universal public insurance coverage for high quality primary care and public acute care with low or zero out-of-pocket costs. Private insurance allows access to private acute care, particularly elective surgery, without the waiting period that is common in some specialties. The complexity of the system and the overlapping public funding responsibilities across levels of government does inhibit coordination of care particularly for those with long term chronic conditions such as renal failure and end-stage management.

#### Medical workforce

In 1998, Australia had 20,852 primary care physicians and 18,891 specialists, including 199 renal medicine specialists. 197,700 nurses were employed in 1998 (104,000 of them in acute hospitals in 1996), but 44% choose to work only part time (an average of 23 h per week). By 2001, the Australian Institute of Health and Welfare (AIHW) reported 19,125 specialist medical practitioners in Australia, of whom 180 (20.1% female) were renal specialists (AIHW, 2004). The survey also reveals that renal specialists worked on average 52.9 h per week.

At a recent Senate committee enquiry, the current, net (post-expenses, but pre-income tax), FTE general practitioner income was estimated at AU\$91,000 (US\$65,942; PPP 2005) for a metropolitan doctor, and AU\$111,000 (US\$80,435; PPP 2005) for a rural doctor. A small number of doctors and paramedical professionals are salaried employees of the various tiers of government. Many salaried specialist doctors in public hospitals are able to treat some private patients in public hospitals and usually contribute a portion of the income earned from fees back to the hospital. This may give less incentive to treat private patients in public hospitals and more incentive to treat wholly within the private sector. Other doctors may contract with public hospitals to provide medical services. These contracts are usually in the form of a fixed sessional payment.

Table 3 shows the average salary of staff employed in the public sector hospitals by state (AIHW, 2006). Note that since doctors retain the right to private practice and often negotiate their salary package, the annual incomes of senior clinicians are difficult to estimate. For these reasons the precise income of the average renal specialist is unknown. Since many specialists work both in the private fee-for-service environment and in the salaried or sessional public sector, their income will be considerably greater than those reported in Table 3.

**Table 3. Average salary (AU\$) of full-time equivalent staff, a public acute and psychiatric hospitals, states and territories, 2003–04**

Staffing category	NSW <sup>(b)</sup>	Vic <sup>(b,c)</sup>	Qld	WA	SA <sup>(b)</sup>	Tas <sup>(d)</sup>	ACT	NT	Total <sup>(e)</sup>
Salaried medical officers	116,880	133,707	105,388	138,997	108,598	102,624	133,990	130,376	120,435
Nurses	65,284	62,722	57,422	61,407	57,098	56,202	61,661	64,828	61,575
Other personal care staff	n.a.	n.a.	38,273	39,944	n.a.	n.a.	42,712	52,350	38,933
Diagnostic & allied health professionals	53,769	43,431	59,419	54,823	50,253	59,505	51,805	62,147	50,413
Administrative & clerical staff	50,366	44,593	42,084	45,361	42,279	40,708	50,640	54,642	46,142
Domestic & other staff	36,914	42,715	38,665	39,348	34,785	47,853	40,034	41,831	38,799
<b>Total staff</b>	<b>61,481</b>	<b>60,756</b>	<b>56,719</b>	<b>61,417</b>	<b>56,480</b>	<b>56,742</b>	<b>64,075</b>	<b>65,003</b>	<b>60,098</b>

Source: AIHW, 2006

a Where average full-time equivalent (FTE) staff numbers were not available, staff numbers at 30 June 2004 were used

b Data for one *psychiatric hospital* in SA and Vic not included at staffing category level but included in total. *Other personal care staff* are included in *Diagnostic and allied health professionals* and *Domestic and other staff*

c FTEs may be slightly under-enumerated with a corresponding overstatement of average salaries

d Data for two small hospitals not included. *Other personal care staff* are included in *Domestic and other staff*

e The totals for *Other personal care staff*, *Diagnostic and allied health professionals* and *Domestic & other*

*staff* are affected by reporting arrangements noted above

n.a Not available

## Paying for prescription drugs

Prescription drugs are free for public patients in public hospitals but otherwise the Commonwealth Government provides affordable access to a wide range of what it judges to be necessary and cost effective prescription medicines through the Pharmaceutical Benefits Scheme (PBS). Prescriptions that are dispensed in the community or in private hospitals are eligible for subsidy under the scheme. The following details relate to charges and safety net levels applying on January 1, 2006. Medicare-eligible patients who do not hold a Health Care Card, Pensioner Concession Card, or Commonwealth Seniors Health Card are required to pay the first AU\$29.50 (US\$21; PPP 2005) for each medication listed on the Pharmaceutical Benefits Schedule. Concessional patients must pay AU\$4.70 (US\$3.41; PPP 2005) per prescription. Individuals and families are protected from large overall expenses for PBS listed medicines by safety nets. For general patients, once the eligible expenditure of a person and/or their immediate family exceeds AU\$960.10 (US\$696; PPP 2005) within a calendar year, the additional payment the patient has to make per item decreases from AU\$29.50 to the concessional out-of-pocket rate of AU\$4.70. For cardholder patients, once their total eligible expenditure exceeds AU\$253.80 (US\$184; PPP 2005) within a calendar year, any further prescriptions are free for the remainder of that year. Patients may pay more than the relevant copayment where there is more than one brand of the same drug or alternative product that produces similar results. The government subsidizes on the basis of the lowest priced drug, and any difference in price due to brand or product preferences must be met by the patient. The additional price cannot be counted towards the patient's safety net. The majority of renal dialysis patients are health care card holders and qualify for the safety net. However, some do not qualify for the card and therefore must pay AU\$960.10 (US\$696; PPP 2005) before qualifying for the reduced copayment rate of AU\$4.70 per prescription.

In 2000–2001 the PBS dealt with over 148 million benefit prescriptions, representing a cost to the government of AU\$3.82 billion (US\$2.87b; PPP 2001) and a total cost, including copayments, of AU\$4.56 billion (US\$3.43b; PPP 2001). By 2004/2005 this had increased to 170 million benefit prescriptions at a cost to Government of AU\$5.3 billion and a total cost of AU\$6.3 billion (US\$4.6b; PPP 2005). The number of PBS prescriptions for all patients was 8.4 per capita in 2005–2006, and was 7.7 per capita in 2000–2001. The total recurrent expenditure on benefit paid prescription pharmaceuticals, measured at constant 2003–2004 prices, increased at an average annual rate of 10.5% between 1994–1995 and 2004–2005 (AIHW, 2006). The rate of growth in prescription numbers and their cost reflects the ongoing trend towards newer and more costly medicines. The average dispensed price for PBS medicine in 2000–2001 was AU\$30.83 (US\$23; PPP 2001) or about 3.5% of average weekly earnings. However, drugs provided during inpatient episodes in public hospitals are dispensed free of charge to patients. As most dialysis treatments are provided as part of public hospital care, all medications received during dialysis would be free to patients.

A comparison of the growth in health expenditure from 1993 to 2003 by sector is shown in Table 4. The rapid rise in drug expenditure in the last 10 years (10% average growth per annum between 1993–2003) contrasts with more moderate growth in other areas of health expenditure (less than 4% average growth per annum).

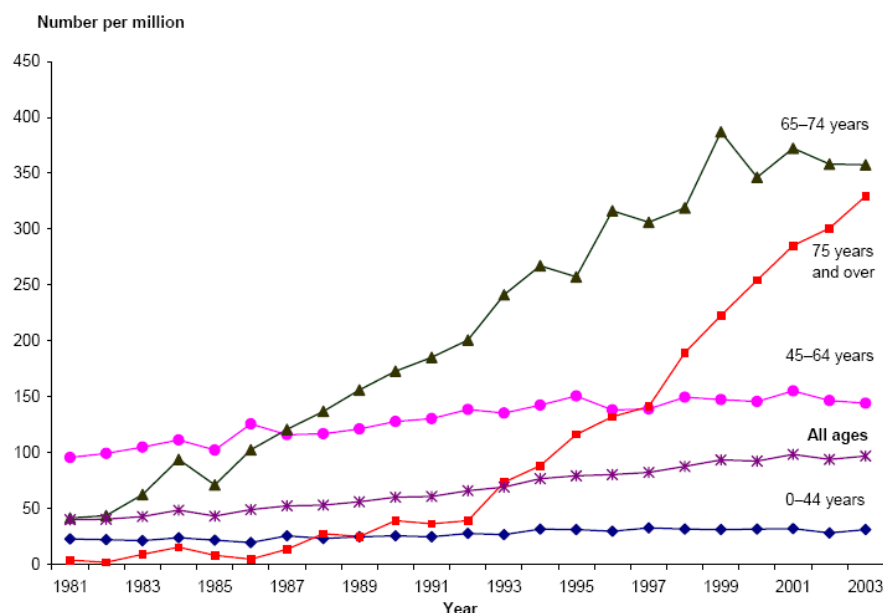
## The provision of end-stage renal care in Australia

The ANZDATA registry annual reports provide high quality data on end-stage renal disease (ESRD) treatment for Australia. On December 31, 2004, Australia had 14,221 patients (707 per million) receiving renal replacement therapy. Forty four percent of those patients (312 per million) had a functioning kidney transplant and 56% (395 per million) received dialysis treatment. There were 1,912 patients who commenced renal replacement therapy in Australia in 2004 (95 per million), and 649 (32 per million) new kidney transplants (ANZDATA, 2005).

The number of people being treated for ESRD has more than quadrupled over the last 25 years, from 3,181 patients in 1981 to 14,221 patients (707 per million) in 2004 (ANZDATA, 2005). Over this period, the prevalence rate of treated ESRD increased by 5.6% each year on average. However, the annual rate of growth has gradually decreased from 7% (1981–1982) to 4% (2003–2004). Figure 1 shows the age-specific incidence of treated ESRD per million population from 1981–2003 (AIHW, 2005b). The incidence of treated ESRD has grown particularly rapidly in those over 64 years old, with a more than six fold increase in the past twenty years. This could reflect not only an increased disease incidence, but also increased community expectations for treatment. There is, for example, a higher likelihood of acceptance onto dialysis for those over 65 with ESRD now than had been the case in the 1980s.

In 1990, about half of those receiving renal replacement therapy were undergoing dialysis while the rest were living with a kidney transplant. Since then the proportion of those with ESRD who are living with a kidney transplant has been falling steadily from over 52% in 1990 to less than 44% in 2003 (ANZDATA, 2003, 2004). Of the patients hemodialyzing three times per week, 29% were dialyzing for 5 h or longer per session; only 7% received less than four hours per session. Forty-seven percent of patients dialyzed for 4–4.4 h. The median weekly dialysis treatment period of all hemodialysis patients was 12 h; range 2–52 h.

**Figure 1.** Incidence of treated end-stage renal disease, by age group, 1981–2003



Note: The "all ages" rate has been age standardised to the Australian population at 30 June 2001.  
Source: AIHW, 2005 analysis of ANZDATA

**Table 4. Total funding of recurrent health expenditure, constant prices<sup>a</sup>, by area of expenditure, and annual growth rates, 1993–94 to 2003–04**

Year	High-level residential care		Drugs		Medical		Other professional services <sup>(c)</sup>		Private hospitals		Public hospitals		Other <sup>(c)</sup>		Total recurrent expenditure	
	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)	Amount (AU\$ m)	Growth (%)
1993–94	3,326	..	4,128	..	9,025	..	2,266	..	4,594	..	12,979	..	9,331	..	45,649	..
1994–95	3,361	1.1	4,532	9.8	9,512	5.4	2,178	-3.9	5,035	9.6	13,359	2.9	9,549	2.3	47,525	4.1
1995–96	3,550	5.6	4,891	7.9	9,956	4.7	2,093	-3.9	5,167	2.6	13,941	4.4	10,026	5.0	49,625	4.4
1996–97	3,764	6.0	5,342	9.2	10,198	2.4	2,351	12.3	5,156	-0.2	14,757	5.9	10,371	3.4	51,938	4.7
1997–98	4,054	7.7	5,769	8.0	10,294	0.9	2,079	-11.6	4,961	-3.8	15,587	5.6	10,678	3.0	53,422	2.9
1998–99	4,179	3.1	6,284	8.9	10,635	3.3	2,019	-2.8	5,247	5.8	16,170	3.7	11,135	4.3	55,670	4.2
1999–2000	4,116	-1.5	7,024	11.8	11,264	5.9	1,971	-2.4	5,308	1.2	16,454	1.8	12,159	9.2	58,297	4.7
2000–01	4,151	0.9	8,214	16.9	11,347	0.7	2,600	31.9	5,410	1.9	16,918	2.8	14,277	17.4	62,917	7.9
2001–02	4,279	3.1	9,200	12.0	11,788	3.9	2,737	5.3	5,540	2.4	17,756	5.0	15,057	5.5	66,357	5.5
2002–03	4,545	6.2	10,011	8.8	11,980	1.6	2,818	3.0	5,593	1.0	18,718	5.4	15,963	6.0	69,628	4.9
2003–04 <sup>(b)</sup>	4,809	5.8	10,792	7.8	12,591	5.1	3,038	7.8	5,636	0.8	19,412	3.7	16,425	2.9	72,702	4.4
<i>Average annual growth rate</i>																
1993–94 to																
1997–98	5.1		8.7		3.3		-2.1		1.9		4.7		3.4		4.0	
1997–98 to																
2002–03	2.3		11.7		3.1		6.3		2.4		3.7		8.4		5.4	
1993–94 to																
2003–04	3.8		10.1		3.4		3.0		2.1		4.1		5.8		4.8	

a Constant price health expenditure for 1993–94 to 2003–04 is expressed in terms of 2002–03 prices. Not adjusted for general tax expenditures

b Based on preliminary AIHW and ABS estimates

c From 2000–01, it includes DVA funding and DoHA hearing services (audiology component) which was previously included in 'other'

In 2004, 208 facilities providing dialysis treatment in Australia (ANZDATA, 2005). The data do not specify the type of facility or ownership, but almost all ANZDATA facilities appear to be in hospitals. Many are satellites of large parent public hospitals. Parent hospitals provide specialist services for the satellites, which are often located in a smaller local hospital or a community facility. There has been a trend away from home dialysis towards hospital- and satellite-based dialysis. In 2001, 19% of the 6,852 prevalent dialysis patients were using continuous ambulatory peritoneal dialysis (CAPD), 7% automated peritoneal dialysis, 26% hospital-based hemodialysis, 36% satellite hemodialysis, and 11% home hemodialysis (ANZDATA, 2005). Automated peritoneal dialysis increased each year with a corresponding decline in CAPD (ANZDATA, 2005). In 2004, 13% of the 7,952 dialysis patients were using continuous ambulatory peritoneal dialysis, 9% automated peritoneal dialysis, 26% hospital based hemodialysis, 42% satellite hemodialysis and 10% home hemodialysis (ANZDATA, 2005).

Inpatient hemodialysis was the principal diagnosis for 585,046 separations in 2001/2002 (299.5 per 10,000 population), of which 500,102 (85%) were in public hospitals (AIHW, 2005). In 2003/2004, of the 814,828 inpatient hemodialysis hospital separations (330.9 per 10,000 population), 82% were in public hospitals. The growth rate of the private sector over this period was 70% compared to an overall rate of increase of 39%. The share of private dialysis has been increasing along with the number of private facilities. This in part, reflects changes in the numbers of privately insured individuals, and an increase in the supply of private hospital services particularly in areas outside of main metropolitan centers.

In 2004, 649 renal transplants were performed in 23 services. One hospital performed 108 of these transplants in 2004 (Princess Alexandra in Brisbane), while three other single hospitals each performed over 50, and the statewide renal service in NSW performed 70. Living donor transplants have increased in the 10 years leading up to 2004 from 103 (23%) to 243 (37%). The proportion of patients receiving dialysis who received a transplant in 2004 was 6.6%. For primary deceased grafts performed in 2003/2004 the 12 month patient and graft survival rates were 96% and 90%. The respective five-year survival rates for operations performed in 1995/1996 were 86% and 77%. Australia had 6,269 functioning kidney transplant patients on December 31, 2004, a prevalence of 312 patients per million (a steady annual 3.3% increase from 211 per million in 1992) (ANZDATA, 2002, 2005).

The death rate per 100 patient years among dialysis dependent patients in 2004 was 15.4 (hemodialysis 15.2; peritoneal dialysis 16.0), and 2.0 for those with a functioning kidney transplant. Kidney disease contributes significantly to mortality. In 2000, there were 1,715 deaths for which kidney failure was recorded as the underlying cause of death (803 males and 913 females). Death rates rise with age in both sexes, and are highest among those aged 75 and over. Deaths following kidney failure have risen over the past 20 years. In 2000, age-adjusted death rates were 8.8 and 6.0 per 100,000 for males and females respectively, up from 7.0 and 3.7 two decades earlier (AIHW, 2003). The recorded deaths due to kidney failure understate the number of deaths due to kidney disease to a considerable, but unknown, extent. Perhaps most patients who die from an underlying kidney disease have cardiovascular disease recorded as the underlying cause of death.

## Costs and payments for the treatment of ESRD

Despite the considerable variation in costs and payment structures across Australia, this study has estimated a total annual expenditure per ESRD patient of AU\$50,576 (US\$36,917; PPP 2004). Estimation methods for this figure are shown in Appendix B; the differences in data across organizational structures and geographic areas are described below.

### Public sector funding

All states fund dialysis with an annual grant to public facilities often based on the annual number of dialysis patients. There has been a move towards a two part payment system with a capitation payment designed to pay for fixed costs and a case payment to pay for variable costs. For example, in Victoria, dialysis payments in public hospitals have both a case payment calculated on the number of attendances and a capitation (block) grant to hospitals that varies with the size of the hospital. Payment rates for Victoria are shown in Table 5 (VDHS, 2006).

**Table 5. Victorian maintenance dialysis program public payment rates, 2006–07**

Treatment modality	Annual capitation grant per patient (AU\$) <sup>a</sup>	Case payment (AU\$) <sup>b</sup>	Total payment (AU\$)
Home hemodialysis	37,533		37,533
Hospital hemodialysis	28,394	25,183	53,578
Satellite hemodialysis	28,401	25,183	53,584
Continuous ambulatory peritoneal dialysis	47,447		45,715
Automated peritoneal dialysis A	57,410		55,314
Nocturnal home hemodialysis	42,723		36,163

Source: VDHS, 2006

a The capitation payment reported here is for a major hospital but the rate varies slightly within bands of the patient load of the hospital

b Annual case payment based on a payment of AU\$3,153 per case weighted separation where the weight for hemodialysis is 0.0512 and assumes three sessions per week for 52 weeks (AU\$161.43 per session)

The six dialysis modalities each incur a specific annual capitation grant in Victoria that is payable to the parent providers (for example a satellite hospital would not receive this money directly) to cover the following costs: hemodialysis consumables; medical care, review and 24 h call service (including emergencies); acute dialysis treatments; nurse training; provision of 24 h support for nurses; provision of allied health services (dietitians and social workers); pharmaceuticals, both expensive non-PBS and PBS; provision and maintenance of hemodialysis and water treatment equipment, ancillary fittings and plumbing; on-call equipment service; water quality testing; recovery of a machine usage fee from other parent units that use the satellite service. A separate price for nocturnal home hemodialysis was introduced in 2006 and its cost and payment are currently under review.

The case payment per dialysis episode is made directly to providers of in-center and satellite services. The case payment rate is based on a detailed clinical costing study and has been designed to cover the following costs: nurse care; waste management; power, water, and domestic/cleaning services; linens and catering; supply department services (receiving goods); provision of some equipment like chairs and dressing trolleys; telecommunications; medical reports; and patient transport.

In 2006/2007 the annual case payment per patient for in-patient dialysis in Victoria was AU\$25,183 (US\$18,249; PPP 2005). When combined with the annual capitation grant (AU\$28,394) the total annual payment for in-center hemodialysis was AU\$53,578 (US\$38,825; PPP 2005). Using a typical number of three visits per week, the average payment per in-center maintenance dialysis treatment in Victoria is AU\$343 (US\$249; PPP 2005). Although payment rates vary across the states, most are similar to those in Victoria. In Australia's largest state, New South Wales, the annual payment per patient for dialysis in 2002/2003 was AU\$44,105 (US\$32,914; PPP 2002) compared to AU\$43,992 (US\$32,830; PPP 2002) in Victoria for hospital hemodialysis in that year.

### *Private sector funding*

Over the last twenty years, there has been growth in the capacity of the private sector, both in offering dedicated day procedure facilities and a more complex range of services. With the exception of some super specialty services (such as transplantation), some large metropolitan private hospitals now offer comparable services to the major public teaching hospitals. Dialysis units were available in 22 private hospitals in 1999–2000 compared with only three hospitals in 1991–1992.

In private insurance policies with only basic hospital coverage dialysis is a restricted service. Restricted services only attract a default benefit, which is determined by the federal government. This benefit is equivalent to the cost of shared public hospital accommodation charges, with no benefit for hospital medical facility charges. This is much less than the normal private hospital benefit and will not cover most of the costs of dialysis. Patients face significant out-of-pocket expenses if treated for these services in a private hospital or private day facility. However, for patients with full private hospital insurance coverage, where the insurance company has negotiated an agreement with the facility, there may be no out-of-pocket costs. It is not known how many patients would be covered by such arrangements but there appear to be limits applied by some insurers on the number of fully reimbursed places. Perhaps the three main reasons why patients might use private facilities are: (a) public facilities may not be as easily accessible (particularly in non-metropolitan areas); (b) some public hospitals with insufficient capacity have contracted private hospitals to provide services to public patients; (c) patients can choose their specialist in a private facility; and (d) a patient has insurance with a company who has a contract with a hospital used by the patient's chosen specialist and therefore, has no out of pocket costs.

### *Estimates of the cost of dialysis*

The cost of providing end-stage renal disease treatment services varies across settings, location and sector. There is no comprehensive data on the cost of dialysis or kidney transplant services.

The closest to a nationally-consistent cost dataset is the National Hospital Cost Data Collection (NHCDC, 2003), which is taken from a sample of hospitals with computerized costing systems. The national hospital cost data reported 536,706 public separations for inpatient dialysis at an average cost per episode of AU\$451 (US\$339; PPP 2001) in 2001–2002.

The national hospital cost data also reported 41,670 private separations for renal dialysis in 2001–2002, at a cost of AU\$413 per separation (US\$311; PPP 2001).

There is a considerable difference between the NHCDC estimate of cost for public hospital inpatient hemodialysis of AU\$485 per episode in 2004–2005 (approximately AU\$75,660 or US\$54,826 per annum, assuming dialysis three times a week on average) (NHCDC, 2007), and the annual payment rate for any of the six modalities of dialysis in Victoria shown in Table 5 (VDHS, 2006). The payment rates in Victoria were established following a detailed costing study (ACIL, 1998) and further cost analysis in later years. Similar studies in other states produced comparable cost estimates. A recent study comparing satellite dialysis and nocturnal home dialysis in large regional hospital service in Victoria suggested that the average cost of a satellite dialysis treatment was AU\$232.58 (AU\$36,284 per patient per year; US\$26,286; PPP 2005). There are a number of reasons to be cautious about accepting the higher cost estimates from the NHCDC. First these are produced from a non-representative sample of hospitals that have computerized costing systems. Second, the methods used to calculate costs are not consistent across the sample with some hospitals using “bottom up” clinical costing systems and others modeling the costs from the “top down”. In addition the cost of an admission for dialysis could include the costs of diagnostic tests and treatment for secondary conditions and may even include multiple days in the hospital. Lastly, the quality of the information systems that feed into NHCDC vary, particularly for medical and pharmacy costs, and even for consumables (Jackson, 2001).

The remoteness of some locations in Australia affects the average cost of dialysis. Some populous states have rural areas where costs are relatively similar to metropolitan areas, but extremely remote states, such as the Northern Territory, may have substantial differences in urban and rural dialysis costs. The NSW Renal Services Network, for example, estimated annual operating costs for a rural satellite dialysis service with less than six chairs, per patient, based on 2003 figures (Table 6). This rural renal maintenance dialysis service cost AU\$46,847 (US\$34,701; PPP 2003) per patient per annum, which is very similar to the payment level of AU\$46,166 (US\$34,197; PPP 2003) for hemodialysis in a smaller satellite facility in Victoria in 2002–2003 (VDHS, 2004). On the other hand, the average cost per routine dialysis treatment in a more dispersed population in the Northern Territory reported in You, Hoy, Zhao, Beaver, and Eagar (2002) is about AU\$527 (US\$393; PPP 2002), almost twice the equivalent average payment of AU\$282 (US\$210; PPP 2002) per episode of in-center hemodialysis in Victoria (VDHS, 2004).

**Table 6. Cost of a rural dialysis service in NSW in 2003**

<b>Cost</b>	<b>Annual cost (AU\$)<sup>a</sup></b>	<b>Annual cost per patient (AU\$)</b>
<i>Salaries and wages</i>		
Management and nursing	339,946	28,329
Social work and dietetics	22,042	1,837
Technician and stores person	60,084	5,007
Sub-total	422,072	35,172
<i>Consumables</i>		
Dialysis disposables	110,448	9,204
Non-PBS pharmacy	7,862	655
Compute / IT / records	2,340	195
Phone/office expenses	1,722	144
Food services	9,360	780
Linen	2,059	172
Waste	1,310	109
RMR	5,000	417
Sub-total	140,102	11,675
<b>Total</b>	<b>562,173</b>	<b>46,847</b>

Source: Nucleus Group, 2005

a Based on 12 patients per year

### *Cost of comorbidities and complications of ESRD*

It is not possible to provide an accurate estimate treatment costs for ESRD patients' comorbidities or complications associated with dialysis. The AIHW, in its analysis of national health expenditure by disease, estimated that total recurrent health expenditure on all chronic kidney disease (up to 7.5% of the population) in 2000–2001 was AU\$647 million (US\$494m; PPP 2000) (AIHW, 2005c). This included AU\$397.2 million (61.4%) on admitted and non-admitted patient hospital services for dialysis; AU\$126.2 million (19.5%) on admitted and non-admitted patient hospital services for reasons other than dialysis; AU\$24.5 million (3.8%) on out-of-hospital medical services; AU\$83.1 million (12.8%) on pharmaceuticals (prescription, over-the-counter medications and highly specialized drugs); AU\$5.7 million (0.9%) on research; AU\$2.8 million (0.4%) on services provided by other professionals; and AU\$7.7 million (1.2%) on high-level residential aged care. The total CKD expenditure is 1.3% of Australia's total recurrent health expenditure of AU\$50.2 billion (US\$38b; PPP 2000) (AIHW, 2005c).

### *Prescription drugs*

As discussed above, the public insurance system for out of hospital prescription drugs is administered under the PBS. All treatment in public hospitals is free of charge with some hospitals charging the relevant patient contribution for outpatient drugs. The distribution of dialysis patients among the categories of patients is unknown, but it seems reasonable to assume that almost all dialysis patients would reach the PBS safety net threshold, and many (because of age or employment status) would be concessionary card holders receiving all medical treatment

in a public hospital free of charge and paying a maximum of AU\$182 for their annual total pharmaceutical use in 2001.

Some specialized drugs in public hospitals are funded by the PBS but administered by the states. Epoetin alfa (Eprex) and Darbepoetin (Aranesp) and now Epoetin beta (Neorecormin) are examples. In this case the usual PBS arrangements for subsidy described above apply for all patients albeit with stricter prescribing controls. The listed price for 4,000 units in a 0.4 ml syringe of Epoetin alfa was AU\$74.50 (US\$55; PPP 2003) (April 2003). In 2004, over 87% of dialysis patients were receiving erythropoietic agents (ANZDATA, 2005). The total public expenditure on Epoetin alfa and Darbepoetin in 2003–2004 was AU\$80.4 million in the public sector and AU\$14.97 million in the private sector (PBS, 2003). Private insurance does not cover pharmaceuticals on the PBS schedule. Concession card holding patients with this level of consumption would reach the PBS safety net described above and pay only AU\$182 in 2003 (less than 2.7% of the cost). Calcitriol, another important drug for these patients, was listed on the PBS for hypocalcaemia due to renal disease at a dispensed price in 2003 of AU\$60.65 (US\$45; PPP 2003) for a maximum quantity of one hundred 0.25 mg capsules. Results from ANZDATA (2005) demonstrate that only 5% of patients in Australia had a hemoglobin level  $\leq 90$  gm/l.

## Trends and outcomes

The number of people being treated for ESRD has more than tripled over the last 20 years (AIHW, 2005b). This rapid growth, considered an epidemic by some, is probably associated with lifestyle changes, an ageing population and greater ascertainment of cases.

In the past 10 years, the proportion of kidney disease patients receiving dialysis has increased from 50% to 56% in 2004, with a corresponding decrease in the proportion of transplant patients. The precise reasons for this are unknown, but the number of donors has not kept pace with the increase in the ESRD cases, while the increasing age and comorbidity of patients has reduced the proportion suitable for transplantation. Organizational changes over the same 10 years, include an increasing proportion of private dialysis facilities, some of which contract to take publicly-funded as well as privately-funded patients. In part, this reflects an increase in private insurance coverage in recent years as a consequence of public subsidy arrangements. In addition, the supply of private hospital services has also increased, particularly in areas outside of the main metropolitan centers. This is probably the result of changing population patterns and the greater flexibility of the private sector to respond to an increased demand. Lastly, there appears to have been a shift from home dialysis to in-center dialysis, but the reasons for this trend are not clear. It may reflect a change in the type of patients (age and independence) but also reflect funding arrangements. The Victorian government funded nocturnal home dialysis as a separate category in 2005–2006, and depending on the success and viability of this program it may have some impact on the trend. In addition, the federal government has recognized the decreasing home dialysis patient numbers, and in November 2005 introduced a monthly Medicare benefit for the planning and management of dialysis (either hemodialysis or peritoneal dialysis) and the supervision of a patient on home dialysis by a renal specialist physician. Given that supervision can be done by telephone, this may help reverse the trend away from home dialysis.

In general, the rate of increase in ESRD prevalence has slowed in recent years, but it seems likely that treatment numbers will continue to increase in the near future. Additionally, the costs of management are likely to rise, particularly given the expectations of new, more expensive drugs for patients with ESRD, such as those for the prevention of cardiovascular disease. A higher incidence of ESRD is a major factor in the numbers in treatment, but there are other factors. These include an ageing population as well as improved management and new technologies that have led to earlier ascertainment, earlier treatment, and increased survival for ESRD patients.

## Conclusion

There is no doubt that the economic burden of treated ESRD has increased rapidly in Australia in the past 20 years, although the exact cause of that increase is not known. At least part of the reason for the increase has been the increased accessibility and acceptability of dialysis for patients. Cass et al. (2006) forecast that the annual discounted cost of renal replacement therapy will rise from their estimate of AU\$559.9 million in 2004 to AU\$605.4 million in 2010 as the age-related prevalence of ESRD increases. The dilemma is how current services can maintain access to treatment at a reasonable cost. The use of home hemodialysis has declined, perhaps because of the change in the age structure of the renal replacement therapy population. Nevertheless, there remains a desire to develop services closer to the homes of patients, with a funding system that follows patients as they move across dialysis modalities, and allows an integrated service delivery. There is a view that home-based dialysis offers both improved quality of life at similar or lower cost for suitable patients (Agar et al., 2005; Cass et al., 2006). With recent changes in health insurance, the use of private dialysis services is expected to grow, at least in the non-indigenous population. However, the public sector is likely to remain the dominant provider of ESRD treatment in Australia for the foreseeable future.

## Acknowledgments

The International Study of Health Care Organization and Financing is supported by the Arbor Research Collaborative for Health. The Dialysis Outcomes and Practice Patterns Study is supported by research grants from Amgen and Kirin without restrictions on publications.

## Appendix A—ESRD treatment for indigenous populations in Australia

Approximately AU\$1,789 billion (US\$1.3b; PPP 2002) was spent on health services provided to Aboriginal and Torres Strait Islander peoples in 2001–2002. This figure represented 2.8% of total health expenditure for that year, and included both government and private expenditure. In 2001–2002, the estimated expenditure per person was AU\$3,900 for indigenous people, compared with AU\$3,308 for non-indigenous people. (AIHW, 2005d).

Briganti, McNeil, and Atkins (2000) have estimated the incidence of dialysis and transplantation in indigenous Australians. In 1997, the ESRD acceptance rate in the indigenous population was 383 per million, 5.2 [95% CI: 4.4, 6.2] times more common than in the rest of the population (9.5 times after standardization for age), and accounting for 11.3% of all new ESRD cases. They estimated that Aboriginal Australians received 4.6% of all kidney transplants. During this same year, the incidence of kidney transplants was 55.8 per million people in the indigenous population, which was 2.1 [95% CI: 1.37, 3.10] times greater than for the rest of the population (3.7 times after standardizing for age). In the indigenous population the incidence of deceased donor transplants was 53.3 per million and that of living donor transplants 2.5 per million, compared to 18.6 per million and 7.9 per million respectively in the rest of the population (Briganti et al., 2000).

Kidney failure among indigenous Australians is high and has been described as an epidemic (Spencer, Silva, Snelling, & Hoy, 1998). According to ANZDATA, new cases of ESRD in indigenous Australians rose from 42 cases to 170 between 1991 and 2001 (ANZDATA, 2002), representing an average annual growth rate of nearly 17%. The rise was most dramatic in the Northern Territory, where more than 80% of new cases in 2000 were in indigenous Australians. The increase in the incidence of kidney failure in indigenous people has been attributed to a number of factors, including high levels of glomerulonephritis following streptococcal infections and increasing prevalence of metabolic syndromes (e.g., high blood pressure, Type 2 diabetes, obesity, and heart disease). Better ascertainment and greater acceptance of ESRD therapy by the indigenous communities may also have contributed to the increase in reported numbers. Though the rate of increase in ESRD incidence has slowed in recent years (207 new patients in 2005 demonstrates a 5% increase per year since 2001) (ANZDATA, 2006), indigenous Australians still represent a disproportionate fraction of ESRD cases. In 2005, indigenous Australians accounted for about 7% of ESRD registrants with ANZDATA (ANZDATA, 2006), yet they account for just 2% of the total population (AIHW, 2006). In 2005, 1,041 indigenous people were receiving dialysis or living with kidney transplants.

A significant difference between the indigenous and other Australian populations is in the age of ESRD development. Indigenous people typically need treatment for ESRD at an earlier age than other Australians. More than 85% of new indigenous patients are aged 64 or under. This contrasts with 55% of new patients in this age group among the rest of the Australian population (ANZDATA, 2006).

You, Hoy, Zhao, Beaver, and Eagar (2002) compared treatments costs of all Aboriginal (101) and non-Aboriginal (64) hemodialysis patients in the Northern Territory from 1996–1998. They found that after adjusting for patient years in treatment, Aboriginals had fewer routine dialysis

treatments than non-Aboriginals (137 vs. 146 per patient)—but twice the rate of hospitalizations for reasons other than routine dialysis, and almost twice the average length of stay. The study population represented 0.6% of inpatients in the three public hospitals in the Top End of Australia, but accounted for 8.8% of the total inpatient cost.

Of the AU\$12.4 million spent on the study population, AU\$9.5 million (77%) was for routine dialysis and AU\$2.9 million (23%) was spent on hospitalizations. Of the AU\$2.9 million spent on hospitalizations, 83% was spent on Aboriginal patients. After adjusting for person years in treatment, the average annual cost per Aboriginal patient was AU\$71,000 (US\$54,198; PPP 1998) compared to AU\$76,000 (US\$58,015; PPP 1998) for non-Aboriginal patients. The data seem to suggest that the indigenous population with ESRD in the Top End of Australia were receiving care at a lower annual cost per patient than the non-indigenous population, after adjusting for the lower number of treatments but higher rate and cost of hospitalizations in that population.

Aboriginal patients had almost three times the cost of hospitalization than non-Aboriginal patients. This can in part be explained by the lower rates of both renal transplant and peritoneal dialysis in indigenous patients, but they were in the program for longer and had more opportunity to incur the cost of both dialysis and hospitalization. However, even after adjusting for the number of patient days in treatment, the average annual cost of hospitalization for reasons other than routine hemodialysis was AU\$41,648 (US\$31,792; PPP 1998) for Aboriginals and AU\$21,295 (US\$16,256; PPP 1998) for non-Aboriginals. The authors speculate that the twofold difference may result from the well-documented poorer health status of Aboriginal people, in combination with the social reasons for prolonged hospital length of stay.

## Appendix B—Estimating the Annual Expenditure per ESRD Patient in Australia, 2002

To estimate the total annual expenditure per ESRD patient in Australia, modality costs were estimated separately and then weighted by the proportion of the ESRD population receiving that modality in 2004 (ANZDATA, 2005). Details for each modality estimation are described below.

### Estimating dialysis expenditures

Payment rates for dialysis in Australia may be an accurate measure of maintenance dialysis costs; however, they do not cover costs for hospitalizations unrelated to dialysis treatment or visits to physicians for reasons other than dialysis. Below is an attempt to include these other costs and obtain a total annual expenditure per dialysis patient.

#### *Dialysis payments*

Table 4 lists dialysis payment rates in the state of Victoria for each dialysis modality in 2006. In Table A.1, these rates have been deflated 3% per year to estimate rates in 2002.

### *Hospitalization costs*

You et al. (2002) estimated the cost of hospitalizations for reasons other than maintenance hemodialysis for Australians. Inflating their 1998 data by 3% per year to obtain estimates for 2004 yielded an average annual hospitalization cost of AU\$49,730 (US\$31,792; PPP 2004) for Aboriginals and AU\$25,427 (US\$18,696; PPP 2004) for non-Aboriginals. Weighting these cost data by race (6.9% Aboriginal, 93.1% non-Aboriginal), the average annual cost of hospitalizations for all Australians was AU\$27,102 (US\$19,928; PPP 2004) in 2004.

### *Non-dialysis physician services*

According to the USRDS, ESRD patient visits to physicians for reasons other than dialysis account for 8.8% of the total per HD expenditure (USRDS, 2005). In Table A.1, we have assumed this percentage also applies in Australia.

Using USRDS data may overestimate these expenditures since dialysis patients regularly receive physical reviews from hospital based clinicians as part of routine dialysis care. It is worth noting that the Australian Institute for Health and Welfare database estimates nondialysis physician costs at 3.8% of the total expenditure for all CKD patients (AIHW, 2005e). The difference between the USRDS and AIHW percentages may be explained by: (1) the routine reviews of dialysis patients by physicians during treatment; (2) the different health status between patients in CKD Stages 1–4 as compared to those in CKD Stage 5 (ESRD); and (3) the possible exclusion of drugs, both prescription and over-the-counter, in the AIHW estimate. For these reasons, as well as to maintain consistency across estimates for other ISHCOF countries, we have used the higher USRDS estimate rather than that from AIHW.

### *Estimating transplant expenditures*

Kidney transplantation costs were estimated separately for the first year of transplantation and subsequent years. First-year costs were further separated by donor status. The payment rates for these transplant categories were obtained from Cass et al. (2006).

The mean cost per patient in the first year of transplant (AU\$67,317) weighted live donor transplants by 37.5% and deceased donor transplants by 62.5%. Then, to calculate the cost over the year of transplantation (rather than the first year after transplantation), we assume the transplant occurred in the middle of the year and that each patient received dialysis for the first six months of the year. The dialysis component to the year of transplant is AU\$41,439 ( $0.5 \times 82,877$ ). Because the majority of the cost of transplantation occurs in the first few months following transplantation (Lee et al., 2002), 65% of the total first year cost is assumed to occur in the first six months, yielding a six-month incident transplant expenditure of AU\$43,756. Summing these two six-month components yields a total expenditure in the year of transplantation of AU\$85,195 (US\$62,643; PPP 2002).

For transplant recipients in the year following their transplantation year, a similar six-month method was used. The cost in the first six months is 35% of the cost of the first year of transplant (AU\$23,561). For the rest of the year, the patient is assumed to have stabilized and will have a

six-month expenditure of AU\$5,375 ( $0.5 \times 10,749$ ). The total cost in the calendar year following transplant sums to AU\$28,936 (US\$21,276; PPP 2004).

All other years after transplantation cost a total of AU\$11,786 (US\$8,796; PPP 2002) per year. This assumes no extra costs for hospitalizations, but adds 8.8% of the total for physician services to the Cass et al. (2006) estimate.

**Table A.1. Annual expenditure estimations for ESRD in Australia, by modality, 2004**

Modality	Weight <sup>a</sup>	Payment (AU\$)	Hospital (AU\$)	MD Office Visits (AU\$)	Expenditure (AU\$)	Weighted Expenditure	
						AU\$	US\$ <sup>b</sup>
<i>Dialysis</i>					74,906		
Hospital HD	0.15	47,432	22,697	6,767	76,896	11,196	8,172
Home HD	0.06	33,228	22,697	5,396	61,321	3,434	2,507
Satellite HD	0.24	47,438	22,697	6,767	76,902	18,087	13,202
CAPD	0.07	42,031	22,697	6,246	70,974	5,167	3,771
APD	0.05	50,825	22,697	7,094	80,616	4,063	2,966
<i>Transplant (TX)</i>							
Year of TX	0.05	81,209	-	-	81,209	3,716	2,712
First full year as TX	0.05	28,936	-	-	28,935	1,324	966
Other years	0.35	10,749	-	1,037	11,786	3,589	2,319
Total						50,576	36,917

a Weights derived from ANZDATA (2005)

b PPP for 2004 (OECD, 2006)

## References

ACIL. (1998). Study of renal dialysis service provision and cost: Report to the Department of Human Services. Victoria: ACIL Consulting.

Agar, J., Knight, R. J., Simmonds, R. E., Boddington, J. M., Waldron, C. M., & Somerville, C. A. (2005). Nocturnal haemodialysis: An Australian cost comparison with conventional satellite haemodialysis. *Nephrology*, 10(6), 557–570.

Australian Institute for Health and Welfare (AIHW). (2003). *Australia's health 2002*. Canberra: Australian Institute for Health and Welfare.

AIHW. (2004). *Medical labour force*. Canberra: Australian Institute for Health and Welfare.

AIHW. (2005a). *Australian hospital statistics 2003/2004*. Canberra: Australian Institute for Health and Welfare.

AIHW. (2005b). *Chronic kidney disease*. Canberra: Australian Institute for Health and Welfare.

AIHW. (2005c). *Health system expenditure on disease and injury in Australia 2000–01* (2nd ed.). Canberra: Australian Institute for Health and Welfare.

- AIHW. (2005d). *Expenditures on health for Aboriginal and Torres Strait Islander peoples, 2001–02*. Canberra: Australian Institute for Health and Welfare. Retrieved February 15, 2007 at <http://www.aihw.gov.au/publications/index.cfm/title/10147>
- AIHW. (2005e). *Chronic kidney disease in Australia, 2005*. AIHW Cat. No. PHE 68. Canberra: Australian Institute for Health and Welfare.
- AIHW. (2006). *Health expenditure Australia 2004–05*. Canberra: Australian Institute for Health and Welfare.
- ANZDATA. (2002). *Australia and New Zealand dialysis and transplant registry: 2002*. Adelaide: Australia and New Zealand Dialysis and Transplant Registry.
- ANZDATA. (2003). *Australia and New Zealand dialysis and transplant registry: 2003*. Adelaide: Australia and New Zealand Dialysis and Transplant Registry.
- ANZDATA. (2004). *Australia and New Zealand dialysis and transplant registry: 2004*. Adelaide: Australia and New Zealand Dialysis and Transplant Registry.
- ANZDATA. (2005). *Australia and New Zealand dialysis and transplant registry: 2005*. Adelaide: Australia and New Zealand Dialysis and Transplant Registry.
- ANZDATA. (2006). *Australia and New Zealand dialysis and transplant registry: 2006*. Adelaide: Australia and New Zealand Dialysis and Transplant Registry.
- Briganti, E., McNeil, J., & Atkins, R. (2000). The epidemiology of diseases of the kidney and urinary tract: An Australian perspective: A report to the Board of the Australian Kidney Foundation. Melbourne: Monash University & Monash Medical Centre.
- Cass, A., Chadban, S., Craig, J., Howard, K., McDonald, S., Salkeld, G., & White, S. (2006). *The economic impact of end-stage kidney disease in Australia*. Sydney: The George Institute for International Health.
- Dor, A., Pauly, M.V., Eichleay M.A., & Held, P.J. (2007). End stage renal disease and economic incentives: The International Study of Health Care Organization and Financing (ISHCOF). *International Journal of Health Care Finance and Economics*, DOI: 10.1007/s10754-007-9024-9
- Hall, J., & Savage, E. (2005). The role of the private sector in the Australian healthcare system. In A. Maynard (Ed.), *The public-private mix for health*. London, UK: The Nuffield Trust.
- Jackson, T. (2001). Using computerised patient-level costing data for setting DRG weights: The Victorian (Australia) cost weight studies. *Health Policy*, 56, 149–163.
- Lee, H., Manns, B. J., Taub, K., Ghali, W., Dean, S., Johnson, D., & Donaldson, C. (2002). Cost analysis of ongoing care of patients with end-stage renal disease: The impact of dialysis modality and dialysis access. *American Journal of Kidney Diseases*, 40, 611–622.
- National Hospital Cost Data Collection (NHCDC). (2007). National Hospital Cost Data Collection: Cost Report Round 9 (2004–05). Retrieved March, 2007, from [http://www.health.gov.au/internet/wcms/publishing.nsf/Content/+Round\\_9-cost-reports](http://www.health.gov.au/internet/wcms/publishing.nsf/Content/+Round_9-cost-reports)
- NHCDC. (2003). *National Hospital Cost Data Collection: Cost Report Round 6 (2001–02)*. Canberra: Department of health and ageing. Retrieved March, 2007, from [http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-casemix-costing-fc\\_r6.htm](http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-casemix-costing-fc_r6.htm)
- Nucleus Group. (2005). *Review of renal service needs: Lower western sector – South: Greater western area health service*. Retrieved October 11, 2006 from <http://www.nucleusgroup.com.au/downloads/renaldialysis-final-report.pdf>

- OECD. (2006). *Purchasing Power Parities (PPPs) for OECD countries 1980–2005*. Paris: Organization for economic cooperation and development. Retrieved February, 2007, at [http://www.oecd.org/statisticsdata/0,2643,en\\_2649\\_34357\\_1\\_119656\\_1\\_1\\_1,00.html](http://www.oecd.org/statisticsdata/0,2643,en_2649_34357_1_119656_1_1_1,00.html)
- Pharmaceutical Benefits Scheme (PBS). (2003). *Pharmaceutical benefits scheme national expenditure report 2002–03*. Retrieved December 9, 2005, from <http://www.health.gov.au/internet/wcms/publishing.nsf/Content/health-pbs-general-stats-natexprpt.htm>.
- Smith, A. (2004). Insurer cuts cover for dialysis treatment. *Sydney Morning Herald*, 20 February 2004.
- Spencer, J. L., Silva, D. T., Snelling, P., & Hoy, W. E. (1998). An epidemic of renal failure among Australian Aboriginals. *Medical Journal of Australia*, 168, 537–541.
- USRDS. (2005). *Annual data report: Atlas of end stage renal disease in the United States*. Bethesda, MD: National Institutes of Health, Nations Institute of Diabetes, Digestive and Kidney Diseases.
- Victorian Department of Human Services (VDHS). (2006). *Policy and funding guidelines 2006–07*. Melbourne: Victorian Department of Human Services.
- VDHS. (2004). *Improving and integrating care for patients on renal dialysis: Situation analysis*. Melbourne: Healthcare Management Advisors report to the Victorian Department of Human Services.
- You, J., Hoy, W., Zhao, Y., Beaver, C., & Eagar, K. (2002). End-stage renal disease in the Northern Territory: Current and future treatment costs. *Medical Journal of Australia*, 176, 461–465.