

# International Study of Health Care Organization and Financing of renal services in England and Wales

Tricia Nicholson, Paul Roderick

Public Health Sciences & Medical Statistics, University of Southampton, Southampton, England, UK

## Abstract

In England and Wales, the quantity and quality of renal services have improved significantly in the last decade. While acceptance rates for renal replacement therapy appear low by international standards, they are now commensurate with many other northern European countries. The major growth in renal services has been in hemodialysis, especially at satellite units. Health care is predominantly publicly funded through a tax-based National Health Service, and such funding has increased in the last 10 years. Improvements in health outcomes in England and Wales are expected to continue due to the recent implementation of standards, initiatives, and monitoring mechanisms for renal transplantation, vascular access, and patient transport.



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: Nicholson T, Roderick P. International Study of Health Care Organization and Financing of Renal Services in England and Wales. *Int J Health Care Finance Econ*. E-published ahead of print, 26 July 2007. DOI: 10.1007/s10754-007-9015-x.

## Introduction

In England and Wales, patients receiving renal replacement therapy (RRT) in general are not treated differently from patients with other chronic conditions. Funding for renal services is drawn from public taxation, and services are free at the point of delivery. Provision of renal services has, therefore, depended on the variable public resources assigned to health care and, consequently, has been subject to implicit rationing due to competing demands and limited public resources. However, health care funding has significantly expanded in the last decade or so. In England, funding is now organized by contracts between providers (renal teams based in public hospitals) and, typically, local specialized commissioning consortia made up of groups of primary care trusts (PCTs). Health Commission Wales (Specialist Services) commissions renal services throughout Wales.

In England and Wales, hemodialysis (HD) is provided primarily at main or satellite renal units; few patients receive HD at home. Main renal units provide the full range of renal services, including inpatient beds and treatment of acute renal failure, with some units also providing transplantation. Satellite units provide outpatient HD and are typically run by nurses with limited or no on-site nephrologists. Most satellite units are based in public hospitals or at National Health Service (NHS) sites, but some are not on NHS-owned land. Some satellites are owned and/or run by private companies under contract with the NHS, but all are linked to a main renal unit and medical care is coordinated from there.

The strategic importance of renal services has been recognized with the establishment of a National Service Framework (NSF) for Renal Services, which follows similar initiatives for Coronary Heart Disease, Children's Services, Mental Health, Older People's Services, and Diabetes. In England, the Department of Health has produced the Renal Services framework documents with advice from expert groups, including patients. A similar process has been completed in Wales. The English NSF documents comprise two parts (Department of Health Renal Team, 2004, 2005). Part 1, released in 2004, sets standards and markers of good practice for dialysis, transplantation, and pre-end stage renal disease (ESRD) care. Part 2, released in 2005, covers chronic kidney disease (CKD), alternatives to dialysis (specialist palliative care), and acute renal failure. However, there is no central NHS funding specifically earmarked to ensure that the markers are achieved. There is inevitably tension between providers, who try to develop services to meet such markers of good practice, and commissioners, who have a long list of competing priorities and limited resources.

The UK Renal Registry is an important source of information on renal services and care for patients on RRT that can be used to monitor achievement of practice goals. Other methods to assess quality of service provision include clinical governance frameworks and the Quality and Outcomes Framework (QOF), which financially rewards primary care physicians (general practitioners) for achieving a variety of clinical, organizational, and management indicators (British Medical Association, 2006). Four of the QOF indicators are specific to CKD, while several others apply to CKD patients (e.g., secondary prevention in coronary heart disease, hypertension, and diabetes). These indicators apply only to primary care and not dialysis treatment.

This report describes the delivery and organization of renal services in England and Wales.

## Methods

The International Study of Health Care Organization and Financing (ISHCOF), a sub-study of the Dialysis Outcomes and Practice Patterns Study (DOPPS), aims 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, & Held (2007).

This article primarily depicts the health care system in England and Wales, except where data were available only for the entire United Kingdom (which comprises England, Wales, Scotland, and Northern Ireland). Data are for adult patients only. The NHS covers the whole of the United Kingdom; funding arrangements are similar in Scotland and Northern Ireland, but the relationships between commissioners and providers differ.

The data reported in this article are based primarily on figures from the UK Renal Registry Annual Reports, the Office of Health Economics in London (Yuen, 2005), published articles, and various NHS Web sites. All monetary estimates were provided in British pounds and converted to US dollars with Organisation for Economic Co-operation and Development (OECD) purchasing power parities (PPP) from the year of each figure (OECD, 2006). Because of the small number of economic investigators and countries in this study, international comparisons reported here are informal and qualitative, unless reported otherwise.

## The epidemiology of kidney disease and provision of care in England and Wales

The UK Renal Registry was formed in 1995 and has been collecting and analyzing data on RRT since 1997. Geographical coverage is not yet complete, with 90% of units providing data (covering about 89% of the general population) (Ansell, Feest, Rao, Williams, & Winearls, 2005). However, coverage is increasing, and all units plan to provide Registry-compatible data by 2007 (Ansell, et al., 2005). National rates can only be estimated after extrapolation, and within units submitting data some “routine” items (e.g., comorbidity and ethnicity) are not reported completely.

Data on RRT are only a proxy for the epidemiology of established renal failure (ERF), a term used by the NSF for Renal Services that is equivalent to ESRD or end stage renal failure. This is because only some ERF cases are identified, referred, and accepted onto RRT. The widely used metric “acceptance rate onto RRT” refers to the incidence of patients starting RRT for the first time and is not equivalent to the incidence of ERF. There are no routine data on ERF in the population, and the mismatch between the incidence of ERF and acceptance rates is thought to be greatest in older patients and in those with significant comorbidity.

In 2004, 32,976 patients in England and Wales were on RRT, which represents a prevalence rate of about 0.063%, or 628 people per million population (pmp) (Ansell, et al., 2005). From 2000 to 2004, the prevalence of RRT increased by 24% in England and 27% in Wales, or 5.9% per annum (Ansell, et al., 2005). For the same period, the acceptance rates increased by 11.3% in England and 19.5% in Wales. These increases occurred by 2003; since then, the rates appear to be static (Ansell, et al., 2005).

Fifty-five percent of RRT patients in 2004 were treated by dialysis; of these, 74% received HD at a dialysis unit (main renal unit or satellite) and 24% were treated by peritoneal dialysis (Ansell, et al., 2005). Peritoneal dialysis has been decreasing as a proportion of dialysis provision, but it remains high in England and Wales compared with most other developed countries. Home HD accounts for only 2% of dialysis, but it is being encouraged after a favorable report by the National Institute for Health and Clinical Excellence (NICE, 2002) and endorsement by the NSF for Renal Services. The remaining 45% of RRT patients had a functioning renal transplant, although this percentage has been declining (Ansell, et al., 2005).

While acceptance rates onto RRT have increased in England and Wales, they remain relatively low compared with many other ISHCOF countries (Dor et al., 2007). The acceptance rate onto RRT was 101 pmp in 2004, compared with 340 pmp in the United States (USRDS, 2006). The difference may be even greater because England and Wales data are based on ascertainment at day zero, compared with day 90 in the United States (Ansell, et al., 2005).

One of the factors driving the increase in acceptance rates has been liberalization of thresholds for referral/acceptance. This has not been a formal process with changes in explicit criteria. Rather, professional and public perceptions of the benefits of RRT have changed due to professional education, health policies directed toward commissioners, and an increase in the number of dialysis facilities. Other factors driving the increase in RRT include an aging population, especially among ethnic minorities; an increase in CKD prevalence driven partly by reductions in competing risk mortality (e.g., from cardiovascular disease); and an increasing prevalence of type 2 diabetes. A countervailing trend is the very recent growth in specialist palliative care programs for ERF patients that renal units provide as an alternative to RRT. This is not intended to be a form of rationing, but a deliberate decision taken by patients, their families, and renal units to provide an alternative to dialysis. Participation has been encouraged by its inclusion in the NSF for Renal Services.

In 2002, England and Wales had 57 main renal units and 106 linked satellite units (Ansell et al., 2003). Since 1998, the number of satellite units has increased by 36% (Ansell et al., 2003). This increase has been driven by the need to make RRT (especially HD) more accessible, space constraints in main renal units, and professional acceptance of the effectiveness of satellite units. Satellites accommodate 44% of unit-based HD patients, an increase from 37% in 1998 (Ansell et al., 2003). Of the satellite units, 23% were run for profit by commercial companies, including all units in Wales (Ansell et al., 2003). Dialysis equipment manufacturers manage and/or own almost all private units.<sup>1</sup> Satellite dialysis facilities generally operate during the day and into the

---

<sup>1</sup> A telephone survey of privately run satellite units listed in the UK Renal Registry found that only three units in November 2005 were managed by private companies that were not dialysis manufacturers (personal unpublished data).

late evening but are not usually open on Sundays; main renal units typically are open longer hours than satellites.

Currently, formal specialist palliative care provision is low. A survey of renal units found that specialist palliative care is formally part of the role of nurses or Professions Allied to Medicine in only 39% of units covering the United Kingdom (Gunda, Thomas, & Smith, 2005). The amount of time spent delivering such care was small (mostly less than 4 h per week). Eighty percent of units had no written protocol for specialist palliative care. An additional challenge is that in some areas, access to palliative care services is restricted to patients with cancer, not ERF. However, despite the limitations in role definitions, most renal units continued to follow up with patients choosing not to have dialysis.

Twenty centers in England and Wales perform kidney transplantations (Ansell, et al., 2005); They represent 11% of all hospital trusts for adult patients (NHS England, 2006; NHS Wales, 2006).

Staffing related to RRT in England and Wales appears low relative to other ISHCOF countries (Ashton & Marshall, 2007; Durand-Zaleski, Combe, & Lang, 2007; Hirth, 2007; Kleophas & Reichel, 2007; Luño, 2007; Pontoriero, Pozzoni, Del Vecchio, & Locatelli, 2007; Van Biesen, Lameire, Peeters, & Vanholder, 2007; Wikström, Fored, Eichleay, & Jacobson, 2007); however, reports from other countries may not be comparable due to various calculation methods. In 2002, there were fewer than 4.0 whole-time equivalent (WTE) consultant nephrologists per million inhabitants (Ansell et al., 2003). WTE is a more accurate measure than the number of doctors as it takes into account time spent by nephrologists in non-nephrology service work, such as general medicine or research. In terms of RRT patients, there were 166 per WTE nephrologist, or 123 per nephrologist (Ansell et al., 2003). These figures exclude doctors with nephrology training in non-consultant grades and those in training.

In 2003, primary care physicians numbered 654 pmp (Office of National Statistics, 2005; Royal College of General Practitioners, 2005). However, this figure overestimates provision because 22% of the doctors worked part-time (Royal College of General Practitioners, 2005). In the United Kingdom, there were 0.7 WTE transplant surgeons pmp and approximately 38 new transplant patients per year per WTE surgeon (or 20 per surgeon) (Ansell et al., 2003).

Despite the low ratio of nephrologists to RRT patients, there are no formal waiting lists for dialysis. However, there are anecdotal reports of patients not being accepted because of a lack of facilities for dialysis. For example, a questionnaire to units revealed that, in 2002, the units turned away 226 patients, although it is likely most of these patients were subsequently accepted by another renal unit (Ansell et al., 2003). However, many units operate at near maximal HD capacity and may be able to offer only peritoneal dialysis to new patients.

There are waiting lists for permanent access placement for dialysis (for fistulae, grafts, and peritoneal dialysis catheters). In response to the NSF for Renal Services, a joint working party examined vascular access issues (Renal Association, The Vascular Society of Great Britain and Ireland, & The British Society of Interventional Radiology, 2006). Its survey suggested that a minority of patients commence RRT with suboptimal vascular access (i.e., temporary modes of

access) due to late referral to a renal specialist, delays in referral for vascular access surgery, or delays in the surgical pathway (i.e., clinic waiting times, diagnostic facilities, and operating slots). The latter also affected existing patients whose access failed. The working party made recommendations aimed at providing suitable models of service and organization, improving collaboration between teams, and promoting skill mix, and included standards and audit markers.

In 2003 and 2004, NHS contracts and wages for hospital consultants and primary care physicians were substantially revised; these changes are still being implemented in 2007. Hospital-based doctors are salaried, but some receive additional payments (national level of distinction and clinical excellence awards), and some also undertake a limited amount of private practice, although this is small in nephrology. For primary care physicians, the new contract (implemented in April 2004) involved a new funding formula based on capitation payments and allowances for activities. However, it is designed to reflect overall patient health needs and not the number of practitioners (i.e., payment is to the practice, not individuals). In addition, while primary care physicians were self-employed in the past, some are now salaried.

In 2004, average NHS earnings for hospital consultants were £94,700 (US\$150,000; PPP 2004) based on sample data for England (NHS Health and Social Care Information Centre, 2004). The average income for primary care physicians in 2004 was £102,400 to £128,400 (US\$162,000 to US\$203,000; PPP 2004), depending on the type of contract, based on UK data that included private and NHS work (Information Centre, 2006). However, these 2004 salaries are not directly comparable as they precede implementation of the new consultants' contract, whereas the general practitioners' contract was implemented that year. The new contracts linked changes in working practices to large pay increases of approximately 20% and 30% for hospital and primary care doctors, respectively (Day, 2007). These earnings were between four and six times the UK mean earned income (HM Revenue & Customs, 2007). While international comparisons of doctors' earnings are difficult to make, even based on data before 2004, UK salaries for both hospital consultants and primary care physicians appear higher than those in other European countries, although not as high as those in the United States (HM Treasury, 2006). It is likely that this difference has widened (Day, 2007).

In 2004, the average total earnings for all qualified nurses was £26,400 (US \$42,000; PPP 2004)(NHS Health and Social Care Information Centre, 2004). Since 2004, new pay scales, terms, and conditions for nurses and other NHS staff (except doctors, dentists, and the most senior managers) have been implemented through a system called Agenda for Change. The national education system is funded both publicly (93%) and privately (7%) at the secondary school level. A higher percentage of pupils from private schools go on to higher education. All medical schools are based in publicly funded universities (via taxation), and several new medical schools have opened to expand the number of doctors. Students now have to pay tuition fees, although loans for living expenses do not have to be repaid until after graduation and when the individual exceeds a certain income threshold. The effect on the social mix of people entering medical training is not yet known. The numbers of physicians training in nephrology has increased, but it is still controlled by a system that allocates the number of formal training posts to different regions and their constituent renal units. This system reflects an agreement between specialty Royal Colleges (here, the Royal College of Physicians) and the NHS.

NHS has experienced a major shortage of registered nurses. In addition, there have been skill mix changes in nursing with increasing use of health care support workers to supplement or replace registered nurses. Renal unit directors cited the nursing shortage as the third most important constraining factor, after lack of space and lack of capital, to developing renal services (Ansell et al., 2003). Workforce issues have been recognized with parallel processes in place in England and Wales. Workforce planning groups are reviewing health and social care workforce pressures and priorities, and the possible impact of new roles in health and social care teams in delivering all of the NSFs.

## Expenditures

In 2004, total health care expenditure was 8.7% of the gross domestic product (GDP) and £1,689 per capita (US\$2,675; PPP 2004) (Yuen, 2005). Comparisons for 2003 showed that the mean UK expenditure (not just England and Wales) was similar to the average for the 15 European Union (EU) countries but lower than the OECD average (£1,547, £1,562, and £1,734, respectively, equivalent to US\$2,467, US\$2,491, and US\$2,765; PPP 2003).

Expansion of key public services has been a main political goal of the Labour Government in power since 1997. Both national and private health care expenditures have been increasing significantly and much faster than the increase in GDP or inflation. From 1999 to 2004, national health care expenditures increased 44% in real terms (Yuen, 2005). There are no specific data on expenditure on RRT or renal services, so it is not possible to assess the change in expenditure for RRT relative to overall trends. However, it is estimated that in 2002, 1.5% of total health spending in the United Kingdom was used for RRT, suggesting an annual expenditure per RRT patient of £32,500 (US\$53,279; PPP 2002) (Dr. Hugh Rayner and Dr. Steve Smith, personal communication, November 2005).

The NHS covers the entire population through general taxation and employer/employee contributions, using public funds to pay for 98% of its health care expenditures (78% direct taxation and 20% from National Insurance Scheme contributions paid by employers and employees) and patient copayments to pay for only 2% (Yuen, 2005). The NHS uses a higher percentage of public funds to pay for health expenditures than most ISHCOF countries with public health insurance covering the whole population. These countries, except Sweden and the United States, tend to use 70–77% of public funds for health care costs (data not shown). The NHS has been a central plank of the welfare state since its introduction in 1948, with strong cross-party political support for taxation as the main source of funding.

While NHS organizations provide most publicly funded health care, government policy has led to a relatively small but growing amount of health care provided through the private sector, particularly for initiatives to decrease waiting times. Private sector involvement is through direct contracting or subcontracting from an NHS organization to cover certain services or provide additional capacity. Such provisions mainly covers diagnostics, clinic appointments, and some inpatient hospital capacity, such as elective surgery. This has been expanding with new diagnostic and treatment centers, and some pathology services have been contracted out.

Privately funded health care is available to patients willing to pay directly or those with personal insurance (much of which is part of employer benefits from private sector businesses). The main incentives to use private health care are the shorter waiting time for diagnosis and treatment and increased convenience through choice of appointments. In addition, private patients can typically choose to receive care from a specific consultant. Some NHS organizations also provide some private care (e.g., elective surgery) on-site or nearby, although this is not specifically for renal services. However, ERF treatment is publicly financed through the NHS and not covered by private insurance.

The NHS in England and Wales delivers health care via a number of routes, namely primary, secondary, and tertiary care and NHS Direct, a 24-h telephone advice line staffed by nurses. Primary care comprises primary care physicians, pharmacists, dentists, opticians, optometrists, and NHS walk-in (emergency) centers. However, a variety of other health professionals, including nurses, health visitors, and a range of specialist therapists, also work as part of this frontline team. NHS walk-in centers provide advice or treat minor injuries and illnesses 7 days a week. No appointment is required, and patients are seen by a nurse. Secondary care comprises specialized care provided by hospitals, including mental health trusts. Certain specialist services are not available in all acute hospitals and can be thought of as tertiary services (examples include cardiac surgery and neurosurgery).

Renal services are in a state of transition. While main renal units and transplant surgery can be viewed as tertiary-level provision traditionally provided at a regional level, there has been a move to expand nephrology expertise in other acute hospitals. This has happened in two ways. First, there is increasing provision of regular outpatient sessions and medical input into satellite units. Second, many district general hospitals (e.g., serving large towns and cities and their surrounding area) now have full nephrology services without transplantation, thus providing an intermediate level between secondary and tertiary care. In some cases, these have been scaled up from original satellite services.

In England and Wales, the commissioning systems for the health services for the local population differ from one another. In England, since mergers in 2006–2007, 152 PCTs overseen by 10 Strategic Health Authorities have commissioned general health services. Further changes under way include the implementation of practice-based commissioning. However, renal service commissioning is typically by local specialized commissioning consortia made up of groups of PCTs. Depending on the area covered, they may purchase care from a number of providers. In Wales, Local Health Boards commission general health services, while the Health Commission Wales (Specialist Services) commissions renal services. In addition, in England the NSF advocated the development of renal networks to engage all stakeholders, including clinical and other staff, commissioners, managers, and patients, to work across traditional service boundaries and models of care, with clear lines of accountability. This should provide a structure for service planning and delivery. The aims of such networks are to integrate care, improve clinical outcomes, make services more cost-effective, improve the patient experience, and increase equity of service provision.

While the systems for commissioning vary slightly, commissioning of renal services in both England and Wales is with hospital trusts that have main renal units (not the unit directly).

However, the main renal units may subsequently subcontract and purchase RRT from the private sector, particularly to increase capacity for dialysis at satellite units. In some places, this has been seen as an attractive alternative to expanding existing NHS facilities. Such contracting decisions are based on competitive tender, which is open to the NHS providers and private companies, with the process judged against various criteria, including contract price and speed of delivery. If a private firm is used, the organizational tasks of identifying the site and building, staffing, and equipping the unit are usually the responsibility of the firm, not the NHS.

In England, the commissioning of most health services is undergoing a major change with the introduction of Payment by Results (PbR). This is a payment system with tariffs based on the average national reference costs for Healthcare Resource Groups (HRGs), which are similar to the Diagnostic Resource Groups in the United States and elsewhere. PbR involves payment at fixed prices for activity undertaken (not actual results of treatment), although there is some adjustment through a market force factor for variations in case mix, regional wages, and costs. The tariffs include direct care services, clinical support services such as laboratory tests, follow-up and other care for inpatients, clinic visits, and accident and emergency services. The process is being rolled out so some services remain excluded from the mandatory tariff (in 2006–2007). These include renal dialysis, community and mental health services, chemotherapy, radiotherapy, critical care, and direct access radiology and pathology (Department of Health, 2006). The aim of PbR is to reward efficient, high-quality services and increase patient choice over providers.

For renal services, while there is no immediate national plan to use PbR to pay providers, it has been suggested that it will be introduced after April 2008. Furthermore, some service commissioners are planning to implement it earlier than this date, using the indicative national tariffs available. Contracts between commissioners and dialysis providers tend to incorporate a global budget through prospective payments (service level agreements) or fee for service (per outpatient HD treatment and transplant). Service level agreements theoretically account for type of activity (by mode of dialysis, outpatient care, or admission). They typically include some prospective funding for patient growth or agreements about the handling of over or under performance in planned activity. Hence, a unit may receive some additional payment (although not necessarily at the same rate) if it treats more patients than contracted. However, although risk may be shared between the commissioner and provider, there is not usually any mechanism for in-year adjustment.

At the patient level, all renal care in the NHS, except copayments for prescription drugs, is free. Certain groups, including children and many people on welfare benefits, are also exempt from paying for drugs. Government benefits cover lost wages and other sickness benefits (note these costs are not included in the costs of RRT).

There are no reliable figures on the total amount of spending attributable to ERF. An early estimate from a model suggested that, at 1992 prices, spending on RRT accounted for approximately 1% of the UK budget for health care and potentially would reach 2% when a steady state was achieved (Mallick, 1997). This work was based on data from individual units and surveys of service arrangements. The author recommended “lifecycle” costing—the costs accrued by individual patients as these incorporated costs for the pre-RRT phase, modality changes, and treatment of comorbidities. This modeling work should be replicated. However, the

available reference costs for 2004 (Department of Health, 2005) cannot be used this purpose because the dialysis-related reference costs do not include all relevant items (e.g., erythropoietin [EPO], vascular access, maintenance immunosuppressant therapy for transplant patients). In addition, full national data on RRT would require patient treatment data by modality, location (i.e., hospital/satellite), and patient characteristics (e.g., viral infections).

As noted earlier, although NHS funding has increased in recent years, there is probably still insufficient capacity for all patients who might benefit. For RRT, this is likely to affect predominantly the elderly with comorbidity, although this has not been quantified. Nephrologists control access to RRT, and there is constant pressure to accommodate the increasing number of patients who could be treated. In most geographical areas, there is no real competition between providers, so patients have little choice over facilities. Exceptions are the larger urban areas, such as Greater London and Manchester; even there, renal services have been consolidated into fewer main centers. Another example of the impact of resource constraints is the use of twice-weekly HD (albeit for less than 2% of patients, who mostly require it for geographic reasons) (Ansell et al., 2003). Other resource constraints include the use of bio-incompatible membranes, limited choice between HD and peritoneal dialysis, and restrictions on the use of EPO, especially in the pre-ERF population (see below for details).

## Specific aspects of treatment and financing

### Dialysis

In 2004, the estimated average cost for hospital-based outpatient HD was £164 per session (US\$265; PPP 2004), excluding the cost of EPO. This cost is derived using mandatory costing methods (the NHS costing manual) so that the full health service costs are attributed to services delivered. Hence, it includes elements for direct costs, such as staff and drugs, and indirect service costs, such as catering and hospital overheads, although the costing manual allows for local interpretation. There is no information on contract prices specifically for private units as such information is not publicly available.

The UK Renal Association (2002) has established national standards for dialysis, and the UK Renal Registry collects and analyzes data for participating units. Performance figures for all main renal units appear in the registry's reports and are available on the Internet. There is no penalty for poorly performing units. The only remaining anonymous data are unit survival figures, partly because of the complexities of statistically adjusting for case mix with incomplete comorbidity data. However, these data will be available in the 2007 report.

The national standard for delivered dialysis dose (Kt/V) level is greater than 1.2 eKt/V, which tends to be the international standard. However, there are multiple methods for calculating Kt/V and these yield varying results. The UK Renal Registry does not have access to all the raw data necessary to calculate Kt/V data. Therefore, it uses the simpler calculation of urea reduction ratio (URR), the percentage fall in blood urea during a dialysis session, which requires knowledge of only pre- and post-dialysis blood urea level. Using URR as a quality indicator, the national standard for HD patients is a URR over 65%. Registry data show an increase in adequacy of HD

over time, with just under 80% of patients achieving this standard in 2004 (Ansell, et al., 2005, p. 104), although improvements appear to have reached a plateau. It is uncommon for a patient's dialysis session to be shortened or missed beyond the 5% of patients who attend only twice-weekly dialysis, though many of these cases are due to preserved renal function or geographical reasons (Ansell et al., 2003).

Patients often face challenges in arranging travel to and from the HD unit. Half or more patients use NHS transport, including ambulances, hospital cars, and occasionally taxis, to attend dialysis sessions. When using these transport arrangements, patients cannot guarantee that they will arrive at their session on time. In addition, many units experience difficulties in coordinating their patients' transport home. In one study, median travel time was approximately 22 min, but it varied widely and did not account for the sometimes very long periods that patients had to wait before pickup to go to or from their dialysis session (Roderick et al., 2005). One of the aims of expanding satellite unit provision has been to improve patients' access to their regular HD facility. However, even with closer proximity patient transport is a problem. Improving transport is one of the key implementation issues of the NSF for Renal Services. A demonstration project has tackled this issue (Cheshire and Merseyside Renal Transport Action Learning Set, 2006); however, such local initiatives have yet to be translated into wider practice.

While previously practiced, units are stopping re-use of hemodialyzers (Ansell et al., 2003). The Renal Association Standards acknowledge that re-use of hemodialyzers appears to be safe and may help units save costs (Renal Association, 2002). However, the UK Medical Devices Agency advises against re-use of items marked "for single use only" (Medical Devices Agency, 2000). The main suppliers in the United Kingdom do not currently supply "for multiple use" labels for devices labeled this way in the United States. Furthermore, the increased use of high flux biocompatible dialyzers will probably result in lower prices and improve cost-effectiveness without re-use (Renal Association, 2002).

## Transplantation

UK Transplant is the national body responsible for coordinating the procurement and distribution of organs for transplantation. All patients waiting for a kidney transplant are registered by their renal unit on the UK Transplant National Transplant Database. Available organs from deceased heartbeating donors are allocated through a scheme that emphasizes absence of mismatch at HLA antigens over other factors. It favors children and those regarded as difficult to match (highly sensitized or HLA-DR homozygous recipients). Other weightings include time on the transplant waiting list, and the organization aims to reduce donor–recipient age differences and limit transport time between centers. If there are no suitable patients in the United Kingdom, the donor organs can be offered to patients in other EU countries through a reciprocal arrangement within the EU.

The allocation rules do not apply to live donor kidney transplantations (performed at all units) or non-heartbeating donor kidneys, as the latter are used by the local unit/group of units. A donor reimbursement scheme compensates hospitals for organizing deceased donor organ retrieval, but there is no direct payment to individuals for organ donation.

The main barrier to kidney transplantation in the United Kingdom has been a declining supply of deceased donor organs, and there is a consequent mismatch between the transplantations performed and the demand, as indicated by the rising number of recipients on the transplant waiting list. Factors thought to contribute to the decline in deceased donor organs include the fall in road traffic accident deaths, limited availability of intensive care beds, and a relatively high refusal rate among relatives. Also, changes in neurosurgical practices may have contributed. Through increased availability of CT scanning facilities, patients with “untreatable” head trauma are more likely to die at their local hospital than at a neurosurgical center.

In March 2006, a three-year audit of potential donors was completed (UK Transplant, 2006). The audit examined the potential number of solid organ donors in the United Kingdom and collected data on all patient deaths in intensive care units. For heartbeating donors, 15% of potential donor families were not approached, and of those approached, the overall refusal rate was 40%. The refusal rate was double for non-white potential donors. There were also temporal variations in refusal rate and by donor transplant coordinator teams. For non-heartbeating donors, 78% of potential donor families were not approached, and of those approached, the overall refusal rate was 45%. Again, the refusal rate was double for non-white potential donors.

UK Transplant has started national initiatives to increase awareness of and coordinate deceased donor organ donation within NHS hospitals, especially within intensive care units, to expand education and publicity both nationally and to specific groups (e.g., ethnic minorities), and to fund living donor and non-heartbeating donor programs and coordinators. There is now a national register of potential donors. Currently, people have to opt in to register as donors and/or carry an organ donor card, although relatives still have the right to refuse deceased donor donation. The issue of presumed consent is regularly considered and debated, but it has not been adopted. It is too early to determine whether the initiatives have had a consistent, sustained effect.

The proportion of dialysis patients placed on the transplant waiting list varies considerably among renal units (Ansell, et al., 2005), and the reasons for this require further research. Patients of ethnic minority origin (South Asian and black) who have high rates of RRT are less likely to receive a transplant due to ethnic differences in HLA types limiting supply combined with a specific shortage of donors from these ethnic groups and partly due to cultural reasons (Davis, & Randhawa, 2006).

The average length of a hospital stay for transplant surgery was 11–13 days in 2002 (Department of Health, 2003). This number falls squarely between averages reported by other ISHCOF countries (data not shown), which range from as few as seven days in the United States (Hirth, 2007), to 15 days in Italy (Pontoriero, et al., 2007).

### Prescription drugs

Except for EPO and injectables dispensed by the dialysis unit’s hospital, drugs are generally obtained in private pharmacies in the community. Certain patients are required to share the costs of drugs prescribed by the NHS. As of April 2007, patients in Wales no longer have copayments. In England, those exempt from a copayment include patients under 18 or over 60 years of age,

patients with a specified medical condition (not including any renal disease) or with certain types of physical disability, patients receiving certain state benefits (welfare), and women who are pregnant or have been pregnant in the last 12 months. All other patients are required to make a set copayment of £6.85 per prescription item (approximately US\$11; PPP 2006)(Department of Health, 2007). However, patients requiring frequent prescriptions (i.e., pre-ERF and ERF patients) can limit their copayments by purchasing a pre-payment certificate. This certificate entitles the holder to unlimited prescriptions for a four-month or 12-month period (currently £35.85 and £98.70, respectively; US\$58 and US\$160; PPP 2006).

The prescription copayment and discount apply to EPO and immunosuppressant drugs for transplant patients as well, so the patient is responsible for a maximum of 2.6% of the total cost of EPO, which is comparable to Australia and Canada. Patients do not pay for EPO in all other ISHCOF countries except the United States, where patients must cover 20% of EPO costs.

In England and Wales, doctors may prescribe drugs on national or local formularies for NHS patients. However, reimbursement mechanisms for drugs mean that sometimes there are local prescribing protocols and/or budgetary controls for specific drugs. This is the case for EPO. Some units have specialist anemia coordinators (EPO nurses) using protocol-driven prescribing. The protocols are locally determined by each renal unit, and 30% of units restricted the use of EPO (Peters, 2003). The prescription of EPO may be limited (Peters, 2003; Drs. Steve Smith, Ken Farrington & Mark Satchell, personal communication, October 2003) by quotas for the total number of patients per unit or physician, or by restrictions specific to an individual patient. It may also be limited by incentives or rules affecting whether EPO is administered subcutaneously or intravenously, and typically dosage may be limited if the patient is resistant to the drug. The EPO dose has been tailored toward maintaining patients' hemoglobin above the 10 g/dL threshold in the Renal Association Standards (Renal Association, 2002). In 2004, this standard was achieved in 85% of HD patients and 90% of peritoneal dialysis patients (Ansell, et al., 2005). However, new national guidelines on anemia management in CKD set target hemoglobin levels at 11–12 g/dL (NICE, 2006).

The prescription of EPO is also limited via drug budgets and through the process of commissioning renal services provision. In most units, EPO is funded either by the renal unit through service level agreements (31%) or by both PCTs and the unit (65%). Only 4% is funded through PCT drug budgets alone (Peters, 2003). We are not aware of any provisions for patients to pay for EPO out of pocket (i.e., through private prescription). There is no specific budget for pre-ERF EPO, and prescribing patterns vary by locality—so-called “postcode prescribing.” There is increasing tendering for EPO supply so that only one erythropoiesis-stimulating agent is used in a particular area.

Typically, other pharmaceuticals used in the treatment of RRT are prescribed by following local protocols, which take into account the Renal Association Standards (Renal Association, 2002) and, where available, National Institute for Health and Clinical Excellence (NICE) guidance, which is described in more detail below. These restrictions include the use of iron in general as well as its method of administration and achievement of target-level stores. In hemodialysis patients, intravenous iron administration is also subject to local guidelines, which specify loading doses in iron deficiency and weekly maintenance doses. Intravenous iron administration in pre-

dialysis and peritoneal dialysis patients has a protocol with an emphasis on the treatment of iron deficiency (Drs. Steve Smith, Ken Farrington, & Mark Satchell, personal communications, October 2003). Similarly, some units have informal policies about prescription of vitamin D and vitamins.

NICE produces evidence-based guidance on health care interventions, and their recommendations are intended for implementation throughout the NHS in England and Wales. However, local service commissioners usually must meet any additional financing. In the renal field, NICE guidance has so far included immunosuppressants for transplant patients and home HD (NICE, 2002, 2004) and, most recently, anemia management (NICE, 2006). The first two sets of guidance were incorporated in the English NSF for Renal Services (Department of Health Renal Team, 2004, 2005). For home HD, it recommended greater patient choice and the expansion of home HD to meet the needs of patients who were thought to be suitable within their development plans negotiated with commissioners. There has also been recent guidance on the detection and management of CKD by the Royal Colleges of Physicians and General Practitioners in conjunction with the UK Renal Association (Joint Specialty Committee on Renal Medicine, 2006). As of April 2007, the Scottish Intercollegiate Guidelines Network is in the process of producing similar guidelines for Scotland.

### Hospitalization

While there are national hospitalization data (Hospital Episode Statistics, or HES), they record only inpatient and day case activity and, hence, exclude most outpatient HD. Currently, there is no way to link routine data on the dialysis population to hospitalizations. One study found that approximately one-quarter of RRT inpatient hospital admissions were for problems associated with vascular access, although such stays tend to be of short duration (Roderick et al., 2005). Increasing the use of permanent vascular access rather than temporary catheters should reduce the number of hospitalizations (Department of Health Renal Team, 2004).

Financial costs for hospitalizations are borne by the provider, usually the same provider specified in the renal contract. The decision to admit for any reason is made on clinical grounds; there are no formal reviews of necessity. RRT patients tend to be treated in renal services beds as it is easier to ensure ongoing regular dialysis compared with, for example, general medical or surgical ward beds.

In addition to outpatient dialysis, a typical RRT patient has additional clinic visits roughly three to eight times per year (Drs. Steve Smith, Ken Farrington, & Mark Satchell, personal communications, October 2003). Some of these are for routine follow-up for their RRT, while others are for treatment of additional comorbidities, especially the management of diabetes and cardiovascular disease.

### Trends and outcomes

As in most developed countries, socioeconomic and demographic factors affect the incidence of ERF and, therefore, the need for RRT in England and Wales. Specifically, the incidence rises

sharply with age and there is emerging evidence that ERF is more common in poorer areas. A notable feature of ERF in England and Wales is the higher rate of acceptance of patients onto RRT in certain ethnic minority groups (Indo-Asian and African/Caribbean origin) (Ansell et al., 2003). These populations are younger than the white population, and it is likely that demographic change over the next decade or so will increase the incidence of ERF in such populations (Ansell et al., 2003).

Late referral for RRT is a continual problem, as it is in other countries, with 30% of patients referred less than 3 months before beginning RRT in 2002 (Ansell et al., 2003).

Between 1998 and 2004, the one-year survival for prevalent RRT patients increased significantly (84.2–87.5% in England and 78.2–87.8% in Wales), although there are signs that the improvement is now tailing off (Ansell, et al., 2005). However, mortality on RRT depends on factors such as age, comorbidity/type of renal disease, and mode of therapy (transplantation or not). The one-year survival for prevalent patients was over 97% for transplant patients compared with 85% for dialysis patients or 87% if age adjusted to 60 (Ansell, et al., 2005). The annual mortality rate for prevalent dialysis has been estimated at 17–18 per 100 patient years (Ansell, et al., 2005). It is also important to note that within England and Wales, the patients on hemodialysis are a selected group of patients of above average risk due to the greater use of peritoneal dialysis and proportion of transplantations compared with some other European countries (Ansell et al., 2003). Another factor that may influence the mortality rate of hemodialysis patients in England and Wales is the use of catheters for vascular access (Rayner et al., 2004). There are no data on the outcomes of those with ERF who opt not to be treated with RRT, except in a few units with established specialist palliative care schemes.

Demand for RRT is expected to be continual and substantial for at least the next 25 years, with some estimates predicting a doubling (Roderick et al., 2004). The anticipated demand is a result of several factors, including built-in growth even at current acceptance rates, changes in the incidence of ERF due to the rising burden of type 2 diabetes and demographic changes, and improved survival on RRT. The recent rapid expansion of satellite hemodialysis provision has been an attempt to increase service provision and improve access to patients.

## Monitoring service delivery

Mechanisms exist to monitor service delivery at a variety of levels. At a national level, the Health Commission, Healthcare Inspectorate Wales, and Care Standards Inspectorate for Wales are responsible for assessing the performance of NHS and independent health care organizations. In both primary care and hospitals, there should be clinical (or integrated) governance frameworks to ensure compliance with health care standards and national targets. Furthermore, primary care physicians have financial incentives to deliver aspects of care of importance to patients with CKD through the Quality and Outcomes Framework. However, the effectiveness of these mechanisms to promote quality improvements is unclear—some are new (QOF), while others have resulted from recent reorganizations of other bodies (e.g., formation of the Health Commission in 2004).

In terms of renal services specifically, the UK Renal Registry is an essential tool for assessing service delivery and quality of care both at unit level and nationally. It is part of the Renal Association and is independent of the Department of Health and Government (Ansell, et al., 2005). Data cover a wide range of measures, including process outcomes (e.g., frequency of dialysis), key patient outcomes (mortality data), and intermediate outcomes (e.g., hemoglobin, serum phosphate, calcium, and albumin). In addition, in the future the registry will collect data on patients with pre-ESRD under the care of nephrologists. UK Transplant also plays an important role in auditing and analyzing results of organ transplantations and contributes to the development of performance indicators, standards, and protocols.

## Conclusion

Provision of renal services is dependent on the variable public resources assigned to health care and has been subject to implicit rationing in the face of competing demands. However, there have been substantial improvements in the quantity and quality of RRT provision in England and Wales.

Acceptance rates in England and Wales are at the lower end of international comparisons, but are similar to rates in many northern European countries. While this might suggest unmet need, such comparisons are complex because analyses need to take into account differences in definitions; adjustment for underlying needs that vary by age, ethnic composition, and underlying population risks (e.g., diabetes rates); competing risks; and use of alternatives to dialysis. Regional variations exist in England and Wales, driven partly by historical provision patterns, but also responding to population need (e.g., large ethnic minority populations). A significant recent innovation has been the development of specialist palliative care programs as an alternative to RRT.

Implementation of the NSF for Renal Services has already influenced the provision of RRT services in some localities, as well as addressing prevention, detection, and management of CKD. The NSF has focused efforts to address key shortcomings as a priority, e.g., vascular access, transport, and organ availability. Furthermore, the English NSF recommends that all renal units participate in an audit through the UK Renal Registry, coverage is expected to be universal by 2007 (Ansell, et al., 2005). However, it remains to be assessed how effective the NSF will be in translating good practice into all areas of renal services.

Increased funding has been made available to allow capital investment to build dialysis capacity. Efforts are also under way to address workforce issues and improve information available to patients. In addition, major changes are occurring in the way services are commissioned. However, since finances are not earmarked and have to compete with other commissioning priorities, it remains to be seen how successful this initiative will be in sustaining increases in the quantity and quality of renal services. Finally, it is hoped that initiatives will improve the supply of organs for transplantation and reduce demand for hemodialysis capacity.

## Acknowledgments

We are grateful to advice from Dr. Donal O'Donoghue, Chairman of the English Department of Health's Renal Advisory Group; Dr. Steve Smith, Clinical Director for Renal Services, Birmingham Heartlands Hospital; Dr. Ken Farrington (East and North Hertfordshire NHS Trust); Mark Satchell, Central South Coast Specialist Services Confederation; and the UK Renal Registry. 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.

## References

- Ansell, D., Feest, T., Byrne, C., & Ahmad, A. (Eds.) (2003). *UK renal registry report 2003*. Bristol, UK: The Renal Association.
- Ansell, D., Feest, T., Rao, R., Williams, A., & Winearls, C. (Eds.) (2005). *UK renal registry report 2005*. Bristol, UK: The Renal Association.
- Ashton, T., & Marshall, M. R. (2007). The organization and financing of dialysis and kidney transplantation services in New Zealand. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9023-x
- British Medical Association (2006). *Quality and outcomes framework: Guidance 2006*. Retrieved June 2, 2006, from [http://www.bma.org.uk/ap.nsf/AttachmentsByTitle/PDFQOF2006/\\$FILE/Quality+and+outcomes+framework+guidance+-+Feb+2006.pdf](http://www.bma.org.uk/ap.nsf/AttachmentsByTitle/PDFQOF2006/$FILE/Quality+and+outcomes+framework+guidance+-+Feb+2006.pdf).
- Cheshire and Merseyside Renal Transport Action Learning Set (2006). *Recommendations for the provision of a patient centred renal transport service*. Retrieved November 24, 2006, from <http://www.kidney.org.uk/campaigns/Dialysis/PatientTransport/Renal-Transport-Cheshire-and-Merseyside.pdf>.
- Davis, C., & Randhawa, G. (2006). The influence of religion on organ donation and transplantation among the Black Caribbean and Black African population—a pilot study in the United Kingdom. *Ethnicity & Disease*, 16(1), 281–285.
- Day, M. (2007). So how much do doctors really earn? *British Medical Journal*, 334, 236–237.
- Department of Health (2003). *National reference costs 2002*. London: Department of Health.
- Department of Health (2006). *Payment by results: Implementation support guide 2006/07 (technical guidance)*. Version 3. Retrieved February 2, 2007, from <http://www.dh.gov.uk/assetRoot/04/13/84/14/04138414.pdf>.
- Department of Health (2005). *National reference costs 2004*. London: Department of Health.
- Department of Health (2007). Charges and optical voucher values. London: Department of Health. Retrieved March 30, 2007, from <http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH4131675>.
- Department of Health Renal Team (2004). *The National service framework for renal services. part one: Dialysis and transplantation*. London: Department of Health.
- Department of Health Renal Team (2005). *The National service framework for renal services. part two: Chronic kidney disease, acute renal failure and end of life care*. London: Department of 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 Financing and Economics*. DOI: 10.1007/s10754-007-9024-9
- Durand-Zaleski, I., Combe, C., & Lang, P. (2007). International Study of Health Care Organization and Financing for end-stage renal disease in France. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9025-8
- Gunda, S., Thomas, M., & Smith, S. (2005). National survey of palliative care in end-stage renal disease in the UK. *Nephrology Dialysis Transplantation*, 20, 392–395.
- Hirth, R. A. (2007). The organization and financing of dialysis and kidney transplant care in the United States of America. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9019-6
- HM Revenue & Customs. (2007). Table 3.6 earned income 2004–2005, taxpayers only. Retrieved February 8, 2007, from [http://www.hmrc.gov.uk/stats/income\\_distribution/table3-6.pdf](http://www.hmrc.gov.uk/stats/income_distribution/table3-6.pdf).
- HM Treasury (2006). *International comparisons of GP and nurses pay*. Retrieved February 6, 2006, from [http://www.hm-treasury.gov.uk/media/69E/12/foi\\_doctors1\\_0206.pdf](http://www.hm-treasury.gov.uk/media/69E/12/foi_doctors1_0206.pdf) and [http://www.hmtreasury.gov.uk/media/69E/1B/foi\\_doctors2\\_0206.pdf](http://www.hmtreasury.gov.uk/media/69E/1B/foi_doctors2_0206.pdf).
- Information Centre (2006). *GP Earnings and expenses enquiry 2004/2005 headline results*. Leeds: Information Centre, Primary Care Statistics.
- Joint Specialty Committee on Renal Medicine of the Royal College of Physicians and The Renal Association, and the Royal College of General Practitioners (2006). *Identification, management and referral of adults with chronic kidney disease. Guidelines for general physicians and general practitioners. Concise guidance to good practice, Number 5*. London: Royal College of Physicians.
- Kleophas, W. & Reichel, H. (2007). International Study of Health Care Organization and Financing: Development of renal replacement therapy in Germany. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9020-0
- Luño, J. (2007). The organization and financing of end-stage renal disease in Spain. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9021-z
- Mallick, N. P. (1997). The costs of renal services in Britain. *Nephrology Dialysis Transplantation*, 12(suppl 1), 25–28.
- Medical Devices Agency (2000). *Single-use medical devices: implications and consequences of reuse. Device Bulletin DB 2000(04)*. London: Department of Health.
- National Institute for Health and Clinical Excellence (NICE) (2002). *Guidance on home compared with hospital haemodialysis for patients with end-stage renal failure*. Technology Appraisal No. 48. London: National Institute for Health and Clinical Excellence.
- National Institute for Health and Clinical Excellence (NICE) (2004). *Immunosuppressive therapy for renal transplantation in adults*. Technology Appraisal 85. London: National Institute for Health and Clinical Excellence.
- National Institute for Health and Clinical Excellence (NICE) (2006). *Anaemia management in people with chronic kidney disease*. NICE clinical guideline 39. London: National Institute for Health and Clinical Excellence.
- NHS England (2006). NHS in England (Acute Trusts). Retrieved November 24, 2006, from <http://www.nhs.uk/England/AuthoritiesTrusts/Acute/list.aspx>

NHS Health and Social Care Information Centre (2004). *NHS staff earnings survey*. Leeds: Health and Social Care Information Centre.

NHS Wales (2006) NHS categorised organisations – NHS Trusts Retrieved November 24, 2006, from Wales <http://www.wales.nhs.uk/catorgs.cfm#2>.

Office of National Statistics (2005). *Corrected - 20/12/05 - T 13: Mid-2003 to mid-2004 population estimates; components of population change for health areas in the United Kingdom; mid-2004 population estimates*. Retrieved February 1, 2007, from <http://www.statistics.gov.uk/STATBASE/Expodata/Spreadsheets/D9093.xls>.

Organisation for Economic Co-operation and Development (OECD) (2006). Purchasing power parities (PPP) for OECD countries since 1980. Retrieved November 24, 2006, from <http://www.oecd.org/dataoecd/61/56/1876133.xls>.

Peters, J. (2003). *Renal services for dialysis: Commissioner & provider perspectives*. Peterborough: National Kidney Research Fund.

Pontoriero, G., Pozzoni, P., Del Vecchio, L., & Locatelli, F. (2007). International Study of Health Care Organization and Financing of renal replacement therapy in Italy: An evolving reality. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9016-9

Rayner, H. C., Pisoni, R. L., Bommer, J., Canaud, B., Hecking, E., Locatelli, F., Piera, L., Bragg-Gresham, J.L., Feldman, H.I., Goodkin, D. A., Gillespie, B., Wolfe, R. A., Held, P. J., & Port, F. K. (2004). Mortality and hospitalization in haemodialysis patients in five European Countries: Results from the dialysis outcomes and practice patterns study (DOPPS). *Nephrology Dialysis Transplantation*, 19, 108–120.

Renal Association (2002). *Treatment of adults and children with renal failure: Standards and audit measures*, 3rd edn. London: Royal College of Physicians of London.

Renal Association, The Vascular Society of Great Britain and Ireland, & The British Society of Interventional Radiology (2006). *The organisation and delivery of the vascular access service for maintenance haemodialysis patients August 2006. Report of a Joint Working Party*. Retrieved October 27, 2006, from <http://www.vascularsociety.org.uk/Docs/VASCULAR%20ACCESS%20JOINT%20WORKING%20PARTY%20REPORT.pdf>.

Roderick, P., Davies, R., Jones, C., Feest, T., Smith, S., & Farrington, K. (2004). Simulation model of renal replacement therapy: Predicting future demand in England. *Nephrology Dialysis Transplantation*, 19, 692–701.

Roderick, P., Nicholson, T., Armitage, A., Mehta, R., Mullee, M., Gerard, K., Drey, N., Feest, T., Greenwood, R., Lamping, D., & Townsend, J. (2005). An evaluation of the costs, effectiveness and quality of renal replacement therapy provision in renal satellite units in England and Wales. *Health Technology Assessment*, 9, 24.

Royal College of General Practitioners (2005). *General practice in the UK: A basic overview. RCGP Information sheet No 4* May 2005. Retrieved February 1, 2007, from [http://www.rcgp.org.uk/pdf/ISS\\_INFO\\_04\\_MAY05.pdf](http://www.rcgp.org.uk/pdf/ISS_INFO_04_MAY05.pdf).

UK Transplant (2006). *Potential donor audit 36-month summary report*. Retrieved November 24, 2006 from [http://www.uktransplant.org.uk/ukt/statistics/potential\\_donor\\_audit/pdf/pda\\_36\\_month\\_summary\\_report.pdf](http://www.uktransplant.org.uk/ukt/statistics/potential_donor_audit/pdf/pda_36_month_summary_report.pdf).

United States Renal Data System (2006). *Annual data report: Atlas of chronic kidney disease and end-stage renal disease in the United States*. Retrieved March 28, 2007, from <http://www.usrds.org/adr.htm>.

Van Biesen, W., Lameire, N., Peeters, P., & Vanholder, R. (2007). Belgium's mixed private/public health care system and its impact on the cost of end-stage renal disease. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9013-z

Wikström, B., Fored, M., Eichleay, M. A., & Jacobson, S. H. (2007). The financing and organization of medical care for patients with end-stage renal disease in Sweden. *International Journal of Health Care Finance and Economics*. DOI: 10.1007/s10754-007-9014-y

Yuen, P. (2005). *Office of health economics compendium of health statistics 2005–2006, 17th ed.* Oxford: Radcliffe Publishing.