The economics of end-stage renal disease care in Canada: incentives and impact on delivery of care

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Abstract

Examining international differences in health outcomes for end-stage renal disease (ESRD) patients requires an understanding of ESRD funding structures. In Canada, funding for all aspects of dialysis and transplant care, with the exception of drugs (for which supplementary insurance can be purchased), is provided for all citizens. Although ESRD programs across Canada's 10 provinces differ in funding structure, they share important economic characteristics, including being publicly funded and universal, and providing most facets of ESRD care for free. This paper explains how ESRD care fits into the Canadian health care system, describes the epidemiology of ESRD in Canada, and offers economic explanations for international discrepancies.

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International Study of Health Care Organization and Financing

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Introduction

Health care outcomes for end-stage renal disease (ESRD) patients in Canada are generally considered to be good, when international comparisons with the United States and other European countries are made based on global indices such as patient survival (CIHI, 2005; ERA-EDTA, 2004; USRDS, 2004).When examining potential differences in health outcomes for ESRD patients across countries, it is important to consider how the funding structure for ESRD care might affect such outcomes, and the cost of achieving those outcomes. For instance, coverage for dialysis and transplantation is provided for all Canadian citizens, whereas coverage for novel, but unproven therapies, such as sevelamer or cinacalcet, may be limited or not available. How this might impact health outcomes for Canadian ESRD patients, in comparison to ESRD patients in other countries, requires consideration. In order to understand the funding for ESRD care in Canada, it is important to have a general understanding of how the health care system is structured and funded.

Canada is a federation of ten provinces and three territories that share the responsibilities of governing the nation with the federal government. However, the provision of health care is a provincial (or territorial) responsibility; therefore, within each province health care is provided and funded in a slightly different fashion. Generally speaking, the funds for the publicly-funded component of health care are provided by each province or territory. Approximately 30% of these funds come from the federal government, which transfers these health-care directed funds to the provinces as part of a social net each year. To be eligible for these payments, provinces must abide by the principles of the Canada Health Act of 1984. This act has five governing principles: (1) public administration of health care by a provincial health insurance plan, (2) comprehensiveness of health care coverage (i.e., all services deemed medically necessary are covered), (3) universality (all citizens receive coverage), (4) accessibility (insured services must be reasonably accessible to all Canadians), and (5) portability (i.e., health care coverage is available to Canadians who move between provinces). If any of these conditions are not met by a province, then the federal government can withhold transfer payments to the province. In this way, the federal government is able to maintain some uniformity of health care provision across Canada. In general, health care in Canada is publicly funded and privately delivered. Hospitals are almost entirely publicly funded not-for-profit institutions. The majority of physicians are independent contractors billing the provincial health insurance plans for health services rendered to patients.

Funding for ESRD care is provided by the provincial health insurance plans of each province. Different models exist across Canada for funding the care of kidney disease patients, but two models characterize the general funding structure in most provinces. Within British Columbia and Alberta, for example, provincial funding for the care of dialysis patients is transferred to a regional renal program, which covers the majority of costs for outpatient dialysis, medications, and inpatient hospitalizations. Alternatively, in provinces like Ontario, funding for both inpatient and outpatient dialysis care is generally transferred to local acute care hospitals. ESRD programs are then allocated annual funding from the local hospital, generally on the basis of the previous year's budget, with adjustments made for program growth. Within both models, physicians are remunerated separately by their respective provincial government; yet, as will be discussed later, the method of remuneration varies by province. The differences in these funding approaches

must be taken into account when considering the relationship between health care outcomes for Canadian ESRD patients and health care funding.

Methods

The International Study of Health Care Organization and Financing (ISHCOF) is a substudy of the Dialysis Outcomes and Practice Patterns Study (DOPPS) aiming 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, Germany, France, Italy, Japan, New Zealand, Spain, Sweden, the United Kingdom, and the United States). Details of the ISHCOF methods are described in Dor, Pauly, Eichleay, and Held (2007).

Sources of data for this report include the Canadian Organ Replacement Register (CORR), the Canadian Institute for Health Information (CIHI), and published articles. All monetary estimates were provided in national currency units and converted to US dollars with OECD purchasing power parities (PPP). In 2002, the PPP was approximately 1.23, or 0.81 USD to the Canadian dollar (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.

The gross epidemiology of kidney disease and provision of care in Canada

As of December 1, 2002, Canada had an ESRD population of 29,162, which represents a prevalence of 920 per million population (pmp), of which 41% had a functioning kidney transplant (CIHI, 2005). The incidence rate of ESRD was 153 pmp. Between 1998 and 2002, the prevalence of ESRD in Canada increased 33%, while the incidence increased 17%. The prevalence of patients with kidney transplants kept pace during that time with an increase of 31%, while the number of kidney transplants performed annually increased 2.5% (from 987 to 1,012) (CIHI, 2005).

The vast majority of Canada's hemodialysis patients (13,620) are treated at the 92 hospital-based dialysis facilities and their associated satellite units. The parent hospitals are generally urban-based, yet they are responsible for the funding and administration of satellite units in both urban and rural areas. Less than 3% of hemodialysis patients (384) receive treatment at 13 independent health facilities (IHFs), which are all non-profit facilities, including the nine that are privately owned. In addition to these IHFs, there are a small number of private for-profit facilities primarily used by foreign tourists to Canada and occasionally by transient Canadian dialysis patients who are traveling within the country. Publicly accessible data for these units is not available as they do not report to the Canadian Organ Replacement Registry (CORR) and in addition, the Canadian patients they treat are already captured in the CORR database by their regular dialysis unit. In general, the majority of dialysis facilities operate both day and night, with three shifts per day from 7:00 a.m. to 11:00 p.m., six days per week, or seven days with weekend hours of operation split between Saturday and Sunday. A small number of units operate two shifts per day, and some satellite units are open only three days per week. Because dialysis

units are either located within acute treatment centers or in satellite units located within their catchment area, the units tend to be geographically dispersed and there is little competition (for patients) among them. Even in the large urban centers of Ontario and Quebec, where funding is hospital-based and several hospitals may provide ESRD therapy in a geographic area, capacity is limited and patients have limited ability to select their dialysis unit or their preferred dialysis shift. Since information on the quality of care provided by specific dialysis units is not available (publicly or otherwise), patients' decisions as to where they receive care are not likely influenced by expected quality of care.

Compared to the US, Canada has a relatively high patient/hemodialysis station ratio, which may indicate a certain degree of operative inefficiency as the amortized equipment costs are small in relation to the labor costs per treatment session. However, increasing the number of dialysis stations to allow the same complement of nurses and technicians to treat more patients may not be feasible in Canada; health care unions within hospitals would vigorously resist the increase in the current patient/staff ratio and hemodialysis units would find it increasingly difficult to attract and retain staff. The high patient/hemodialysis station ratio may result from delays caused by central control of new dialysis facilities or expansion of existing ones, a lack of available capital to purchase new equipment or build new dialysis units in any given year, and the inability of many institutions to run deficit budgets. The relative lack of availability of in-center hemodialysis stations may contribute to Canada's relatively higher utilization of less costly, equally effective independent modalities of therapy (i.e., home hemodialysis and peritoneal dialysis) compared to the US and other countries in the DOPPS.

We are not certain as to the reasons for the relatively low prevalence of ESRD in Canada compared to the US. Canadian nephrologists apply criteria about eligibility for dialysis similar to those of British and American nephrologists (McKenzie, Moss, Feest, Stocking, & Siegler, 1998). Therefore, negative selection by nephrologists is not a factor in keeping incidence rates low. It is possible that the lack of dialysis stations, a perceived shortage of nephrologists, and a lack of knowledge about eligibility for ESRD care is impairing referral for treatment from family physicians or general internists. This possibility was postulated in a study that administered a questionnaire to physicians in Ontario in the 1990s and found that, in the three years before the questionnaire, 14.2% of family physicians and 44.6% of internists had cared for a patient who had died of renal failure without referral for dialysis therapy (Sekkarie, Cosma, & Mendelssohn, 2001). However, it is possible that other factors, including differences in underlying population demographics and characteristics, and possibly higher use of renoprotective agents (Hemmelgarn et al., 2006) are also playing a role in the relatively low prevalence of ESRD in Canada.

In the last decade, Canada changed from having a perceived surplus to having a perceived shortage of physicians (CIHI, 2002). Between 1993 and 2000 there was a 5% drop in the "real" physician-to-population ratio. This resulted in difficulty accessing primary care and specialty physicians as well as longer waiting lists. Factors that contributed to this shortage include a drop in the number of postgraduates entering practice (due to longer training periods), rising retirement rates, and the decline in the number of international medical graduates entering Canada. Net migration and a reduction in medical school class size played lesser roles. In the last five years, medical school class sizes have increased with commensurate increases in

postgraduate residency positions. In addition, most provinces are trying to enhance the training and certification of international medical graduates.

In 2002, Canada had 30,258 primary care physicians, earning an average income of $192,932Cdn (US$156,855; PPP 2002), and 29,521 specialist physicians (Scott's Medical Database, 2001). The National Physician Database does not record the number of nephrologists in the country. Although the Canadian Society of Nephrology has 450 registered members, this may not accurately reflect the number of full-time equivalent nephrologists practicing in Canada. In 2002, the average annual income for internal medicine specialists was $281,770Cdn (US$229,081; PPP 2002), and nephrologists generally earn incomes above this average (CIHI, 2004).

In Canada there is a perceived shortage of nephrologists (as of other specialists), despite increased funding for nephrology training positions and the fact that Canadian nephrologists are remunerated well by Canadian and international standards. This shortage is especially problematic outside of major urban centers. We suspect that the root cause is more complex than the characteristics of the funding model. Among the many factors influencing career choice, relatively poor work/life trade-off issues and the emotional burden of dealing with the very complex, progressive debilitating issues of chronic kidney disease (CKD) over a protracted period of time are likely significant negative factors for residents considering a career in nephrology. Furthermore, many trainees perceive a shortage of dialysis practice opportunities in large urban centers and may place more emphasis on desired location rather than on job availability. It is unclear how best to deal with these issues. A strategy aimed solely at physician remuneration is not likely to be a long-term solution within the fixed global health care budget, since raising physician fees across the board may not be feasible and raising nephrologist remuneration on its own may not be palatable to provincial medical associations. In locations where a real nephrologist shortage exists, possible solutions may include the increased use of non-nephrologist physicians, physician assistants, nurse practitioners, social workers and psychologists, in a team approach to the management of patients with chronic kidney disease.

Waiting lists — both for permanent access placements for dialysis and for kidney transplantation— continue to be an issue within Canada. Canada relies excessively upon central venous catheters, compared to other countries, and this is worsening over time (Mendelssohn et al., 2006b; Mendelssohn et al., 2007). In the case of permanent access, the cause appears to be insufficiency of resources — such as daytime operating room slots, operating room nurses, vascular surgeons, and anesthesiologists—that occurs to varying degrees across the country.

As of 2003, there were 2,845 patients waiting for a kidney transplant. The waiting list for transplantation is primarily related to a lack of suitable donors, as is almost uniformly true across all DOPPS countries. Since 1994 the number of deceased organ donors (all organ transplants) has remained constant between 400 and 425 per year. The crude rate of deceased donor kidney transplants fell from 24.3 to 20.2 pmp between 1993 and 2002, while the living donor kidney transplant rate increased from 7.3 to 12.7 pmp during the same period. In 2002, 1012 kidney transplants were performed[1]; roughly 60% were from deceased donors, 30% were from living related donors, and 10% were living unrelated donors. The proportion of transplants from living

[1] 1 Including simultaneous kidney / pancreas transplants (approximately 35–40 per year).

donors varies greatly across the country, from 17% in Quebec to 62% in British Columbia. The average dialysis duration prior to the first deceased-donor transplant varies across Canada, from 562 days in Saskatchewan to 1734 days in British Columbia. The variability in organ donation and transplant rates across the country arises from many factors, including residence location, ethnicity, and cultural factors (Tonelli et al., 2006). At present, Canada does not have a centralized transplant waiting list or organ sharing program. The barriers frequently cited to such a program include the provincial health mandate and unique transportation logistics.

Expenditures

Overview

In 2002, Canadian health care expenditures represented 9.3% of the gross domestic product, or approximately $3,572 Cdn (US$2,904; PPP 2002) per person per year (CIHI, 2003). From 1997 to 2002, inflation-adjusted public-sector health care spending per person increased annually by approximately 5.1%, while private-sector health care spending per year increased by 3.1% per year. Given that ESRD care is funded almost exclusively through the public sector, it is notable that 1.2% of total health care expenditures in Canada are spent on ESRD care (i.e., care of dialysis and transplant patients). ESRD care costs vary greatly by modality. Recent Canadian costing studies suggest that the total health care cost of treating ESRD patients with in-center hemodialysis, home hemodialysis, and peritoneal dialysis on average is $66,000–89,000 Cdn, $32,000–44,000 Cdn, and $43,000–45,000 Cdn per year of therapy, respectively (US$53,659–72,357, US$26,016–35,772, and US$34,959–36,585, respectively; PPP 2002) (Goeree, Manalich, Grootendorst, Beecroft, & Churchill, 1995; Lee et al., 2002; Laupacis et al., 1996). Although in-center HD is the most expensive (even after controlling for differences in patient comorbidity) (Lee et al., 2002), all dialysis patients, regardless of modality, cost more than functioning transplant patients ($27,875 Cdn per year after the first year) (US$22,663; PPP 2002) (Laupacis et al., 1996). Using these cost estimates and weighting them by the proportion of patients treated with each renal replacement modality, the annual cost per ESRD patient is $55,466 Cdn (US$45,094; PPP 2002) (see methods in Appendix A).

Funding for health care

Funding for health care is mostly derived from general taxation. In Canada, people earning higher incomes have higher rates of personal income tax, and therefore pay more income tax annually. Consequently, funding for health care is generally progressive, in that those with a greater ability to pay do pay a higher proportion of their income to support health care funding. Some provinces fund a portion of health care through the use of targeted “health care premiums,” although these account for less than 15% of health care expenditures. Low-income earners, including seniors and students, are typically exempt from paying such premiums. In Canada in 2002, 70.5% of health care expenditures came from the public sector, with approximately one-third of this public funding arising from the federal government (the remainder coming from the provincial governments) (CIHI, 2003). The largest component of private-sector spending relates to private health care insurance premiums, followed by out-of-pocket expenditures on pharmaceuticals and dental services.

Private health care insurance can only be purchased to cover those aspects of care that are not entirely covered by government insurance, such as outpatient pharmaceuticals, dentistry, physiotherapy, and certain amenities during a hospital stay (e.g., a private room or television). Private insurance does not buy improved access to health care providers or additional benefits for ESRD patients, such as a home health care nurse or transportation costs. Most aspects of ESRD care, including dialysis, are considered necessary medical treatment and, therefore, would be automatically covered, without copayment, by government health plans.

Every provincial ministry of health contracts with an independent pharmaceutical insurance plan to provide government-sponsored drug insurance, which is paid for out of general taxation dollars and by prorated, income-based insurance premiums. Pharmaceutical coverage is provided by such government-sponsored drug insurance plans for citizens aged 65 years and older, and must be available to all Canadian citizens who apply and pay an annual insurance premium (prorated, based on income). Many employers also provide health care benefits, which often include coverage for items not covered by the government health plan, including pharmaceuticals. Such supplementary insurance can also be purchased privately by unemployed or self-employed citizens who have no existing supplementary insurance. It can be purchased privately from the government-sponsored insurer or from another private insurer acting competitively in this relatively free market. Consequently, all patients who do not already have drug insurance (i.e., those less than 65 years old) are eligible to acquire insurance to pay for medications, although there is typically a three-month waiting period before benefits begin. In general, patients cannot be denied coverage by the government-sponsored drug insurance plan. Although each province's government sponsored drug insurance plan differs in its rules and regulations, most involve a patient copayment (often 20–30% of the total cost of the prescription, and sometimes combined with a maximum copayment per prescription of $25–30 Cdn (US$20–24; PPP 2002)). In some provinces, patients > 65 years of age receive prescriptions without copayment, typically combined with a yearly limit (often in the $500–1,500 Cdn range, which may vary with income level) (US$407–1,220; PPP 2002), after which medications are provided without charge to the patient. Those who have coverage that requires a copayment for medications may purchase supplementary insurance to cover or cap this copayment. Given the expense of medications required for the treatment of ESRD patients, the majority of ESRD patients, even those with private drug insurance, apply for and receive government-sponsored drug insurance, subject to the caveats noted above.

Other benefits such as lost wages because of illness (such as ESRD)are not covered through government health care insurance. Patients who were previously employed and become unable to work because of their illness may qualify for disability coverage through private insurance (often offered through the employer) or through the Canada Pension Plan (offered through a federal government program that is supported by contributions from employees and employers), or for unemployment insurance, subject to the rules and regulations of the plan in question. Those who were not employed before developing ESRD and do not have other forms of income, such as a retirement pension, have to apply for other forms of government support — such as the Canada Pension Plan, long-term disability, or social assistance — each of which have different benefits. Obtaining this support is perceived as nontransparent, time-consuming, and difficult, and local ESRD programs usually employ social workers to help patients through the process. Patients on

some forms of government assistance may be eligible to receive free medications through insurance. While this provision is necessary, it can lead to reliance on government assistance, because patients may risk losing their 100% drug insurance benefits if they take a low-paying job without health benefits.

Physician remuneration in Canada

As previously stated, healthcare in Canada is generally publicly funded and privately delivered. The majority of physicians within Canada are paid by their respective provincial government, although a minority of specialists are paid directly by their hospital or health region. While some primary care practitioners (PCPs) in Canada have opted to be paid through a capitation system, the majority of PCPs in Canada are paid entirely through fee-for-specific services. Similarly, most nephrology specialists are paid through fee-for-service, although remuneration differs in each of the provinces. British Columbia and Alberta remunerate nephrologists almost exclusively based on fee-for-specific-services. In some tertiary care centers in Canada, nephrologists (like other medical specialists) are compensated directly by their hospital or health region for all clinical, research, and administrative duties through alternate funding plans. For physicians who continue to be reimbursed in a fee-for-service model, the reimbursement for caring for hemodialysis patients differs by province. However, generally the rate paid to nephrologists for assessing patients while on hemodialysis ranges from $35–50 Cdn (US$28–41; PPP 2002) per treatment. This rate applies regardless of the number of dialysis sessions per week, but the vast majority of patients receive dialysis three times per week.

In Ontario, about 70% of nephrologists' remuneration is based on a weekly prospective payment system for caring for all dialysis patients (i.e., capitation), with fee-for-service accounting for the remainder. This prospective payment per ESRD patient (about $6,800 Cdn per year) (US$5,528; PPP 2002) is the same whether the patient receives peritoneal dialysis, home hemodialysis (daily or thrice weekly) or center-based hemodialysis (Mendelssohn, Langlois, & Blake, 2004).

On the other hand, a small portion (about 5%) of nephrologists' payments in Alberta is derived through prospective payments for home hemodialysis and peritoneal dialysis. This weekly fee remunerates nephrologists regardless of how many times a patient is seen (if at all), and covers the review of laboratory data, telephone conversations with nurses or the self-care dialysis patients, and regular clinic visits. This weekly fee equates to about 25% of the fee paid to nephrologists for caring for in-center hemodialysis patients. In other provinces, the remuneration system for nephrologists falls somewhere between these two examples.

Funding and provision of ESRD services in Canada

Under either a regional program or hospital-based budget, if an ESRD program wants funds for a new initiative (e.g., a nocturnal or daily hemodialysis program), it can either request the additional necessary funding from the provincial health ministry or compete with other hospital-funded health programs for funding from the local hospital, on the strength of their business plan and various political considerations. The cost of ancillary services, such as laboratory tests and radiology examinations, also fall under the global budget for the ESRD program, hospital, or health region, depending on local policy. One advantage of this funding structure is that the

financial implications of selecting new interventions that may impact on resource use in other health care "silos" must be fully considered by local ESRD programs. For instance, programs choosing to perform vascular access monitoring must bear the cost of additional angiograms or angioplasties engendered by the monitoring.

Although the global budgets for health regions, hospitals, and regional ESRD programs are generally capped, regions occasionally run a deficit. This may give health providers the perception that it is not mandatory to adhere to the fixed annual budget. However, enacted and proposed provincial legislation may limit the ability of hospitals and health regions to run deficits.

With few exceptions, dialysis providers in Canada are publicly owned, operated, and funded. In British Columbia and Alberta, dialysis units (including peritoneal dialysis training facilities) are operated by the respective ESRD programs. In other provinces, such as Ontario, where budgets for dialysis units flow through a hospital, they typically operate dialysis units using hospital staff.

Anecdotally, regional disparities in the financing of health care for ESRD patients may exist. The extent to which this, as opposed to local practice patterns, explains differences in the use of specific technologies across Canada (such as nocturnal hemodialysis, vascular access monitoring, or the application of computer databases for clinical care) is uncertain. The uptake of nocturnal hemodialysis in many provinces that do not have regionalization has been delayed or prevented by funding issues.

Potential impact of funding structure on quality of care

There are several aspects of the Canadian health financing system that are likely to positively affect the quality of care for patients with kidney disease in Canada. The first is the universality of care within Canada. All permanent residents and citizens of Canada are eligible for health care insurance, so all CKD and ESRD patients have access to similar treatments and benefits, regardless of socio-demographic status. Given that the most financially deprived patients usually have the greatest health care needs, this is a significant advantage for patients with chronic health conditions such as CKD. In theory, easy access to primary and specialist care may allow for earlier detection of kidney disease, and for implementation of effective therapies to slow progression of CKD and to modify cardiovascular risk factors. Whether this affects incidence rates and whether Canadian incident dialysis patients are healthier than those in countries where access to CKD care, are not as readily available, is not known.

Care for ESRD is funded and provided in some areas of Canada by regional renal programs. Although this funding approach has not been formally studied, it is thought to enhance ESRD patient care by increasing the flexibility with which funding can be moved to support strategic initiatives within ESRD care, compared to the provinces that use hospital budgets. For instance, the importance of quality improvement initiatives has been recognized by many renal programs. Within a large ESRD program, a quality improvement initiative would be nearly impossible without a linked computer database that includes clinical, medication, laboratory, demographic, and outcomes data. Anecdotally, the renal programs with the most advanced computerized databases are each funded by regional renal programs (Manns et al., 2001). Such funding might

be difficult to justify in situations where the funding request is competing with a request for funding for a new treatment. This flexibility may also enhance a program's ability to build satellite hemodialysis units to treat patients in rural areas. Lastly, regionalization has given many ESRD programs the budgetary flexibility to set up nocturnal hemodialysis programs, which may improve outcomes for hemodialysis patients (Walsh, Culleton, Tonelli, & Manns, 2005).

Three other strengths of the Canadian system deserve mention. First, the centered nature of the health care system has caused ESRD care to be centered around university centers. Although community-based regional programs have evolved in the larger urban centers over the past 10 years, in some provinces a university-based program remains the only or the dominant provider group. While this may disadvantage patients living at a distance from major urban centers, some studies suggest that university-based centers may deliver a higher standard of care, though this has not been demonstrated in a Canadian setting (Nissenson, Prichard, & Cheng, 1993). Second, most renal programs provide fully integrated care that includes hemodialysis, home dialysis, general nephrology, and multidisciplinary predialysis care. In some provinces this multidisciplinary care is funded directly by the government; elsewhere, programs have shifted resources to fund it. These models are well developed in Canada and promote pre-emptive transplantation or home-based dialysis for suitable patients (Curtis et al., 2005; Goldstein, Yassa, Dacouris, & McFarlane, 2005; Levin et al., 1997; Mendelssohn, Toffelmire, & Levin, 2006c). Finally, the non-profit nature of the Canadian system means that there are no incentives for physicians or facilities to compromise quality of care for the sake of seeking higher profits.

However, some economic incentives may negatively affect the care of patients with kidney disease in Canada. The areas that may be affected include (1) access to dialysis, including non-referral and late referral (discussed above); (2) quality of dialysis (discussed below); and (3) modality mismatching. For instance, in the early 1990s, hemodialysis stations were severely limited in Edmonton and Toronto, which lowered the access and quality of patient care and increased the use of PD by patients who otherwise would have preferred hemodialysis (Kjellstrand & Moody, 1994; Mendelssohn & Chery, 1994; Nissenson et al., 1993). While the problem of hemodialysis station shortages is not as acute today, there are still concerns in some areas of Canada about hemodialysis overcrowding and delays in expansion approvals in some regions.

The largest portion of remuneration for most Canadian nephrologists comes from caring for hemodialysis patients. In theory, it is possible that relatively high hemodialysis-related fees may reduce the quality of care for CKD patients overall by encouraging "early start dialysis" for CKD patients who otherwise have no indication to initiate dialysis. The extent to which this occurs is likely very limited given patient preference and the relative scarcity of hemodialysis stations; moreover, empirical research does not show that this is an issue (Curtis et al., 2002). It is possible, though, that this remuneration schedule takes nephrologists away from caring for the increasing number of patients who have earlier stages of CKD and who are at risk of progressing to dialysis, and may reduce time spent caring for home dialysis patients as well.

In many provinces, physicians are reimbursed more for supervising a patient receiving hemodialysis than they are when caring for a patient receiving peritoneal or home hemodialysis. This may be an economic disincentive to using peritoneal dialysis for appropriate patients; PD is

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less expensive for ESRD programs (Lee et al., 2002) and associated with similar outcomes (Fenton et al., 1997; Foley et al., 1998). However, a recent study suggested that physician fees are not a major determinant of dialysis modality distribution: When the Ontario government raised home dialysis fees in 1998, no major shift in modality was observed (Mendelssohn et al., 2004).

Lastly, given that health care is provided through a publicly funded system, the choice of therapies, in particular new pharmaceuticals, is limited. The use of novel but unproven therapies may be restricted. For instance, cinacalcet are not funded by any government-sponsored formulary, and sevelamer is funded only in a limited fashion for selected patients with specific abnormalities of mineral metabolism. Generally, only new drugs that have been shown to be effective (improving hard clinical outcomes) and cost-effective (Manns et al., 2000) by the Canadian Common Drug Review process (McMahon, Morgan, & Mitton, 2005) are available through government-sponsored formularies. Some nephrologists and patients view this as counterproductive since it limits their choice of therapies, a situation that may be less likely in the United States. However, given the nature and characteristics of the Canadian public system, such rationing of funds for new therapies, particularly those for which hard clinical outcome data are not available, is likely to continue.

Specific aspects of treatment and financing

Prescription drugs for ESRD patients

Canada does not have a national prescription drug program; policies and coverage differ by province. A particularly comprehensive drug program is available in British Columbia, where all ESRD patients registered with the BC Renal Agency are eligible to receive “renal” medications from a restricted pharmacopeia free of charge. In other provinces, as noted, government-sponsored drug insurance is universal for patients over the age of 65, and it is available for a modest fee to those who are younger than 65 and lack private third-party insurance, after a three-month waiting period. In general, patients are required to pay some of the costs for prescription medications. Although a copayment of 15 to 25% is common for patients with government-sponsored or private insurance, the government-sponsored programs have a yearly maximum limit that is prorated according to income.

Some ESRD drugs are provided to patients without the requirement for third-party or government-sponsored insurance. This is the case for anti-rejection drugs, which are free to all Canadian transplant patients. Drugs such as TPA, used for locking thrombosed central venous catheters, are provided by the ESRD program under global budgets. Historically, injectable drugs, such as erythropoietin and intravenous vitamin D, are purchased by the patient at a pharmacy and brought to the dialysis center for injection. Most patients have a small copayment for erythropoietin (up to the stated maximum per year). While dialysis facilities have not historically dispensed outpatient drugs, the advent of erythropoietin-related pure red cell aplasia (PRCA) has stimulated many hemodialysis facilities to provide and administer intravenous erythropoietin for patients (to ensure appropriate handling), in which case a fee is not charged to the patient and profit is not taken by the facility (Casadevall et al., 2002; Pisoni et al., 2004).

Iron, which is given intravenously to about 60% of Canadian hemodialysis patients (Pisoni et al., 2004), is provided to patients by the dialysis unit, with funding coming from the global budget. Oral iron, which is used less frequently than intravenous iron, at least for hemodialysis patients, requires a copayment because it is dispensed by pharmacies.

Adherence to clinical practice guidelines

Structured clinical practice guidelines (CPGs) have been introduced to minimize inappropriate practice variability in the management of common clinical conditions (Bargman et al., 1999; Churchill, Blake, Jindal, Toffelmire, & Goldstein, 1999; Deziel et al., 1999; Ethier et al., 1999; Jindal et al., 2006a–b; Mendelssohn et al., 1999). Within ESRD programs in Canada, there has been significant interest in setting up formal (or informal) protocols designed to improve adherence to CPGs and encourage appropriate therapy in several areas, including anemia management, optimization of mineral metabolism, and access placement and monitoring. These efforts are perhaps most advanced in the area of anemia management, where the nursing-led protocols set up by some centers enable nurses to change doses of intravenous iron and EPO based on a defined protocol and according to the monthly hemoglobin and iron levels (Culleton, Gautam, Peterson, McVeigh, & Hons, 2003). The target levels are typically defined locally, but are usually based on KDOQI and CSN anemia guidelines (target Hb 11.0–12.0 g/dl) (NKF, 1997). Some centers allow Hb to rise to 13.5 g/dl in patients without cardiovascular disease, while physicians in some centers continue to individualize anemia therapy for patients. Although government and third-party insurance companies have not historically restricted the dose of erythropoietin used or the target hemoglobin achieved, with the increased use of erythropoietic agents, some government insurance plans are mandating adherence to published CPGs for continued reimbursement of erythropoietin. Historically, almost all centers in Canada mandated that erythropoietin be given subcutaneously, to reduce costs. Since the onset of pure red cell aplasia and the publication of guidelines developed in response to PRCA, erythropoietin is now given intravenously to hemodialysis patients in almost all centers (Pisoni et al., 2004). A recent DOPPS examination of the impact of CPGs on HD care in Canada shows improvements in the percentage of patients with Kt/V> 1.2 and hemoglobin > 11.0 g/dl since the CSN guidelines were published in 1999 (Mendelssohn et al., 2007 [in press]).

The National Kidney Foundation and the Canadian Society of Nephrology have published clinical practice guidelines on access placement and monitoring (Jindal et al., 1999, 2006d; NKF, 2001; Tonelli et al., 2006). Both sets of guidelines endorse AV fistulae as the optimal HD access, though the CSN guidelines do not set forth a specific target for maximum catheter use, as the NKF KDOQI does. Of concern, CVC utilization is increasing over time (Mendelssohn et al., 2007 [in press]). Given targeted funding for ESRD programs, many Canadian centers have tried to improve clinical outcomes by optimizing vascular access care for hemodialysis patients. Many centers now use an experienced HD nurse as a vascular access coordinator. As one specific example, many centers screen patients with online access blood flow measurements. Patients who have a significant reduction in access blood flow (> 20%) or an absolute blood flow of < 500 or 650 ml/min (for fistula or grafts, respectively) are referred for angiography and further assessment (Jindal et al., 1999, 2006d; NKF, 2001). While most centers monitor both grafts and fistulae, some centers do not monitor all grafts, given recent randomized controlled trials (RCTs) showing that online blood flow monitoring may not be effective at prolonging the life of a graft

(Dember, Holmberg, & Kaufman, 2004; Ifudu, Dawood, Homel, & Friedman, 1998; Ram et al., 2003). Funding for online access monitoring, angiography, and vascular access surgery usually come directly out of ESRD program or hospital budgets, with no charge to patients.

It has been mentioned already that the non-profit nature of ESRD care in Canada has meant that quality of care has not been compromised for the sake of profit to physicians or facilities. However, there is a downside to this arrangement. Patients might be seen by government planners as a source of increased costs, which may serve as a reason to delay dialysis expansions in an unstated effort to keep incidence rates from climbing. Furthermore, if funding of ESRD programs falls to levels that are below treatment costs, then quality of care may be compromised. For this reason, augmented tracking of quality of care indicators at the facility, provincial, and national levels is essential.

Hospitalization

There were approximately 32,000 inpatient hospital admissions (all causes) for dialysis patients in Canada in 2002 (based on an average of 1.87 hospital admissions per dialysis patient per year with a range of 1.54–1.98 admissions per year (Goeree et al., 1995; Lee et al., 2002; Murphy et al., 2000). The average inpatient length of stay per dialysis patient has been reported as 8.5 and 14.0 days per year; the first number comes from a cohort of prevalent dialysis patients on a transplant waiting list, and the second number comes from a selected cohort of prevalent dialysis patients (Laupacis et al., 1996; Lee et al., 2002). Average length of stay per hospital admission was 11.7 days per admission for this latter cohort of patients. For incident dialysis patients, 18.4% of hospital admissions were required to manage an access-related complication, contributing to 13.8% of total hospital length of stay (Manns et al., 2005). It should be noted that patients are not routinely admitted for access surgery. This, and the fact that hospitals are funded under a global prospective payment system, rather than a diagnosis-related group (DRG) system, may explain why average length of stay appears longer than in some other countries. It should be noted that Canada does not have a national dialysis database collecting information on hospitalization and length of stay for dialysis patients. We used data from published studies that selected patients in a variety of ways and may not be representative of the overall Canadian dialysis population. It is possible, therefore, that these are underestimates.

Transplantation

Twenty-three of the 761 Canadian hospitals perform transplants using approximately 75–100 transplant surgeons. Patients receiving or donating an organ are not required to share in the cost of the transplantation procedure. All transplant patients in Canada receive anti-rejection drugs at no cost throughout the life of the transplanted organ. Other non-immunosuppressive medications are covered through government-sponsored insurance programs, and standard copayments may apply.

Patients spend 11.3 days on average in the hospital for transplantation surgery, a few days less on average than patients in other ISHCOF countries (data not shown). This figure is based on a single Canadian center's experience, since hospital days are not tracked by the Canadian Organ Replacement Register.

Unlike many ISHCOF countries, Canada has no system for rationing transplants other than by the time a patient has spent on the waiting list, with allowance for tissue matching. Nonetheless, the probability of transplantation increases with income; the highest-income quintile enjoyed a 7.3% transplant rate, while the lowest quintile had a 4.5% rate. Racial differences seem to affect the rate of transplantation. Caucasian, Asian, and Middle Eastern patients received more transplants, at rates of 5.7, 5.9, and 6.9% respectively, than Black, Indian, Pacific Islander, and Aboriginal patients, who received transplants at rates of 3.8, 3.7, 3.5, and 3.2%, respectively (Kim Bidovinac, personal communication, 2005). This difference may be caused by some racial groups' reluctance to consider living-related kidney donation. Other possible explanations, including differences by geography, are explored in a recent Canadian publication (Tonelli et al., 2006). Finally, it is possible, although unproven, that differences in transplant rates steam from differences in education levels, with more educated patients and families being more willing to consider living-related kidney donation.

Dialysis

As of 2002, 78.6% of dialysis patients were treated with hemodialysis at an in-center or satellite dialysis unit, 1.3% with home hemodialysis and 20.1% with home peritoneal dialysis. Approximately 2.1 million outpatient HD treatments occur per year. The average treatment time was 240 min and the vast majority of patients receive three treatments per week. Given the availability of inexpensive single use dialyzers, very little dialyzer reuse occurs in Canada (Manns, Taub, Richardson, & Donaldson, 2002). Nearly 50% of Canadian PD patients receive automated peritoneal dialysis at night, and the use of non-dextrose solutions, including icodextran, is common (CIHI, 2005). However, new biocompatible bicarbonate-based PD solutions are not widely used given their expense and the lack of clinical information about their effectiveness.

As noted above, Canada does not have a national dialysis database and cost estimates must therefore be extrapolated from other sources. Hemodialysis-associated costs were recently collected prospectively from a prevalent cohort of 126 chronic hemodialysis patients in Southern Alberta (Lee et al., 2002). Assuming this study is representative of the Canadian dialysis population, the weighted average cost of in-center hemodialysis (including equipment costs, staff, consumable items, reverse osmosis water, and applicable overhead costs—but excluding inpatient hospitalization, non-dialysis outpatient expenses, drugs and physician costs) is $248 Cdn (US$202; PPP 2000) per treatment and $38,700 Cdn per year (US$31,463; PPP 2000). The annual dialysis-related costs of continuous ambulatory peritoneal dialysis (CAPD) and home hemodialysis are lower ($21,410 Cdn and $21,740 Cdn, respectively) (US$17,406 and $17,674, respectively; PPP 2000). For more specific estimates, see Appendix A.

Both inpatients and outpatients are treated primarily by nephrology specialists. Outpatient office visits to specialists can last 45–60 min for new consultations and 15–30 min for follow up assessments. Visits to primary care physicians usually last 10–20 min.

While there are no limitations by provincial plans or ESRD authorities on the dialysis dose that may be given a patient, other than the global budgets allocated to dialysis, most units aim for and

achieve the national standard of at least 1.3 single-pool Kt/V. Tight scheduling, limitations in nursing resources, and the supply of dialysis machines generally restrict the ability to increase dialysis dose by lengthening of dialysis sessions beyond the norm of 4 h, or by providing more than the usual 3 sessions per week. Patients are deterred from missing or shortening sessions when they are educated about the consequences, and when the social experience and relationships with staff are positive. However, the skipping or shortening of sessions may occur when patients have inadequate transportation or encounter inclement weather.

Trends and outcomes

In 2002, patients over 65 years of age made up 54.5% of new incident ESRD patients. While the overall incidence was 153 pmp, the rate was 615 pmp in patients 65–74 years and 741 pmp in those age 75 and over. Also, Aboriginal patients in Canada experience ESRD at a rate several times higher than the general population due to an epidemic of diabetic kidney disease. They represent 3% of prevalent patients and 5% of incident patients.

In 2000, the annual crude mortality rate was 14.4% for Canadian dialysis patients overall (Dr. Marcello Tonelli, personal communication, October 2005). DOPPS shows that mortality rates in Canada are lower than in the USA and comparable to those in Europe, but not as low as those seen in Japan (Dor, Pauly, Eichleay, & Held, 2007).

Conclusion

When considering any potential differences in health outcomes for Canadian ESRD patients, it is important to note that the funding structure for ESRD care differs across the provinces and territories. These discrepancies make it difficult to draw general conclusions about the impact of ESRD funding on specific patient outcomes. However, important common economic factors do exist across Canada, which may contribute to good patient outcomes. A major factor is Canada's health care coverage for all patients at all stages of kidney failure: no one goes without coverage, though certain elements of care (medications) are not covered for all. In addition, since remuneration for provision of outpatient dialysis is not typically tied to a fixed "dialysis fee," there is often room to fund extra services within ESRD programs, including nocturnal hemodialysis for selected patients, as well as new and ongoing quality improvement initiatives.

There are some economic incentives that may inadvertently impinge on the care of kidney disease patients in Canada. While quality of care and survival outcomes are generally very good in international comparisons, access to vascular surgeons and operating rooms is problematic and may partly explain Canada's overreliance on central venous catheters. Lastly, given that health care is provided through a publicly funded system, the use of novel (and usually expensive) therapies, such as sevelamer or cinacalcet, may be limited. Generally, only new drugs that have been shown to be clinically effective and cost-effective are available through government-sponsored formularies. While this may be perceived as limiting patients' choice of therapies, which might be less likely to occur in the United States, such rationing of funds for new and unproven therapies is likely to continue, given the scarcity of resources within the Canadian public system.

There is no formal rationing of ESRD care in Canada. However, it is possible that the structure and financing of the Canadian health care system is one of the factors that contributes to in the relatively low prevalence of ESRD that is found in Canada compared to the US.

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Appendix A: Estimating the expenditure per ESRD patient in Canada

The annual expenditure per ESRD patient in Canada ($55,466 Cdn or US$45,094; PPP 2002) was estimated as a weighted average of modality-specific costs (Table A1). This appendix explains our estimation methodology.

The number and percentage of patients in each modality were obtained from the Canadian Organ Replacement Register (CIHI, 2005). Annual expenditures for home hemodialysis, peritoneal dialysis, and functioning transplants are the midpoints of ranges reported in this paper, which were obtained from several sources (Goeree et al., 1995; Laupacis et al., 1996; Lee et al., 2002). Estimation methods for annual expenditures for hemodialysis and new transplant patients are described below. Data reported in USD were converted to Cdn (US$60,419; PPP 2002) using PPP for the reported year (OECD, 2006).

Table A1. Total annual expenditure per ESRD patient in Canada, 2002

Modality	Patient count*	Weight*	Expenditure per patient (Cdn)	Weighted expenditure per patient (Cdn)
Hemodialysis	13,394	0.460	88,653	40,780
Home hemodialysis	226	0.008	38,000	304
Peritoneal dialysis	3,421	0.118	44,000	5,192
New transplant	968	0.033	105,300	3,475
Functioning Transplant	11,078	0.381	15,000	5,715
Total	29,087	1.000		55,466

* CORR 2005.

Table A2. Annual expenditures per HD patient in Canada, by dialysis facility type, 2002

Cost category	Expenditure per HD patient (Cdn)	
	Satellite	In-center
Hemodialysis*	37,093	41,060
Dialysis physicians	6,450	6,450
Non-dialysis MD visits	7,401	7,943
Hospitalizations	17,592	17,592
Epo	7,747	7,747
Drugs other than Epo*	4,710	5,096
Other*	3,104	4,369
Total	84,097	90,257

* Table 2 in Lee et al. (2002) provides data for the year 2000. These figures have been inflated 6% to reflect costs in 2002.

Estimating costs for hemodialysis patients

There are some concerns that the mean annual hemodialysis estimate reported by Lee et al. (2002) of $74,315 Cdn (US$60,419; PPP 2002) is biased low because the sample used to obtain it had only a 50% enrollment rate and excluded incident patients. In addition, Lee et al. may have underestimated hemodialysis costs for 2002 because the study used data from 1998 to 2000 and focused on patients in only one Canadian province, Alberta. For these reasons, we re-estimated the expenditure for hemodialysis patients in Canada by summing the following component costs (Table A2).

Hemodialysis cost

Our starting point was the annual cost for maintenance hemodialysis treatment reported by Lee et al. (2002) for both in-center and satellite units. Lee et al.'s figures, which estimate costs in 2000, were inflated 6% to better represent the year 2002. The revised annual estimates for maintenance HD costs in 2002 were $41,060 Cdn (US$33,382; PPP 2002) for in-center dialysis and $37,093 Cdn (US$30,157; PPP 2002) for satellite dialysis.

Dialysis physician reimbursements

A range of physician reimbursements for dialysis treatment are described in the main part of this paper. For this estimation, we used the midpoint of that range ($43 Cdn (US$5,244; PPP 2002) per treatment) and assumed that each patient receives 150 treatments per year. These assumptions yielded an annual dialysis reimbursement for physicians of $6,450 Cdn (US$5,244; PPP 2002), which was used for both in-center and satellite unit estimations.

Reimbursements for physicians outside of the dialysis unit

Hemodialysis patients often visit physicians outside of the dialysis facility for non-dialysis related healthcare. An accurate measure of these costs is not available in Canada and we present three separate estimations below.

Based on an available estimate of total annual physician billing (Lee et al., 2002), and assuming that physicians claimed a dialysis fee on every occasion, the non-dialysis physician billing can be estimated as $3,693Cdn per year from a prevalent cohort of Canadian dialysis patients. However, this is likely an underestimate given the assumption noted above, and the fact that this cohort was likely healthier than the overall Canadian dialysis population.

An alternative way of estimating non-nephrologist claims is to use data from the USRDS (2005), which reports that 8.8% of the total cost per hemodialysis patient is spent on non-nephrologist physician payments. Since physician salaries are similar in Canada and the United States, this percentage, when applied to the Canadian data, yields an estimate of annual non-nephrologist charges of $7,943Cdn (US$6,458; PPP 2002) for in-center dialysis units and $7,401Cdn (US$6,017; PPP 2002) for satellite units.

A third method is to use USRDS the estimate that non-dialysis physician costs, for both inpatient and outpatient care, cost twice as much as the fee for dialysis unit physician charges in the US (USRDS, 2003). Applying this relationship to the Canadian estimate, other physicians bill twice as much as those in the dialysis unit, for a total of $14,000Cdn per patient per year.

Given that it is uncertain which estimate is closest to the truth, we used the estimates of $7,943 Cdn and $7,401 Cdn (US$6,458 and US$6,017, respectively; PPP 2002) for in-center and satellite units, which represent the middle estimates of the three methods.

Hospitalization costs

According to the Canadian literature, an average HD patient has 1.87 admissions per year and spends about 11.25 days per year in the hospital. However, the DOPPS data for Canada demonstrate an average length of stay of 10.15 days, which, at 1.87 admissions per year, is equivalent to 18.98 days per year in the hospital. Averaging the estimates from both the Canadian literature and the DOPPS, we calculated an average of 15.1 hospital days per HD patient per year.

To estimate the cost per hospital day ($1165 Cdn) (US$947; PPP 2002), OECD data on the annual, per-capita expenditure for in-patient care ($1006 Cdn), the average number of overnight hospital stays per capita (0.094), and the average length of acute care stay per capita (7.3 days) of the general population in 2001 were used (OECD, 2004).

Using this average number of hospital days per HD patient and the OECD cost per hospital day, the annual cost per patient for hospitalizations would be $17,592 Cdn (US$14,302; PPP 2002). We assumed that hospitalization costs are the same for patients in both in-center and satellite units, which is reasonable given that the DOPPS estimate of length of stay was derived from a random sample of in-center and satellite HD patients.

The cost for HD patient hospitalizations may be an overestimate, since the first few days in hospital are likely to be much more expensive than subsequent days and HD patients are likely to have longer stays than the general population. Lee et al. (2002) offer an alternative estimate for

hospital stays (US$6,148 in 2000); however, the authors note that this estimate is biased low due to the exclusion of incident patients and low enrollment in the study.

Drug costs

Lee et al. (2002) estimated that each year, each in-center HD patient consumed $7,765 Cdn (US$6,313; PPP 2002) of EPO. The DOPPS study estimates similar expenditures ($7,747 Cdn) (US$6,298; PPP 2002), considering a mean EPO dose of 10,808 units per week, that 91% of patients use EPO (Pisoni et al., 2004), and that the price is $15 Cdn per 1000 units of EPO (Alberta Blue Cross, 2005). Since the DOPPS sample includes patients dialyzing in both types of facilities, we have used the DOPPS estimate for both in-center and satellite units.

For drugs other than Epo, in-center and satellite unit HD patients spend $5,096 Cdn (US$4,143; PPP 2002) and $4,710 Cdn (US$3,829; PPP 2002) per year, respectively. These figures were obtained from Lee et al. (2002) and inflated 3% per year to achieve estimates for 2002.

Other costs

These other, outpatient, non-dialysis costs were measured by Lee et al. (2002) and include: clinic visits, emergency room visits, day surgeries, laboratory costs, and diagnostic imaging.

Transportation costs are not included in this estimate. Considering the great distances some patients must travel in order to receive dialysis care in less population regions, transportation may have a large impact on the cost of ESRD services in Canada.

Weighting HD expenditure by facility type

Summing the above HD components yields an annual expense of $84,907 Cdn for HD patients in satellite units and $90,257 for in-center HD patients (US$69,030 and US$73,380, respectively; PPP 2002). As noted above, 74% of dialysis facilities are in-center units and 26% are satellite units. The total expenditure estimates from Table A2 were weighted by these percentages to obtain the estimate for annual expenditure per HD patient used in Table A1, $86,653 Cdn (US$72,076; PPP 2002).

Estimating costs for new transplant patients

Laupacis et al. (1996) provide costs for various stages of transplantation (one year pretransplant, the first 3 months of transplant, 4–12 months post-transplant, and the second year of transplant). For our estimate, however, we are interested in the costs for the year of transplantation. Assuming that a patient is transplanted in the middle of a year, they would have received dialysis for 6 months, had the operation, and accrued costs as a transplant patient for the remaining 6 months. Using the Laupacis et al. (1996) estimates, we calculate a cost of $33,391 Cdn for 6 months of dialysis, $40,914 Cdn for the transplantation and first 3 months, and then $8,459Cdn for the last 3 months of the year (US$26,713, US$32,731, and US$6,767, respectively; PPP 1994). These estimates yield an annual cost of $82,764 Cdn (US$66,211; PPP 1994) per new

transplant patient in 1994. If we bring this figure up to 2002 prices, assuming an inflation rate of 3% per year, the annual cost becomes $104,843 Cdn (US$85,238; PPP 2002).

Alternatively, if we assumed that each transplant costs roughly $70,000 Cdn (US$56,910; PPP 2002), including failures, organ recovery, and maintenance (Laupacis et al., 1996), and that dialysis patients who receive transplants are distributed between PD and HD similarly to the Canadian dialysis population (45.2% HD, 11.6% PD), then the cost of 6 months of dialysis is $35,300 Cdn (US$28,699; PPP 2002) and the total annual cost for a new transplant patient is $105,300 Cdn (US$85,610; PPP 2002). For the estimate provided in Table A1, we used this estimate for patients in the year of transplant.

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