

CADTH Health Technology Review

# Sustainability of Chronic Kidney Disease Care

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## Key Messages

- Strategies to contain the cost of chronic kidney disease (CKD) care and to improve patient outcomes were found across the continuum of care, from prevention and early disease management through later-stage interventions such as conservative management, dialysis, and transplantation. A variety of health system strategies, including funding reform, were identified to help support and enable sustainable CKD care.
- For those at risk of CKD or in early stages of the disease, public health interventions to support healthy behaviours and ensure access to primary health care seem crucial to preventing or delaying disease progression.
- For later-stage patients requiring renal replacement therapy, enhancing access to transplantation and home-based dialysis has the potential to reduce costs while improving outcomes and quality of life. Conservative management without dialysis is an option for those who may not be good candidates for renal replacement therapy or who wish to choose a less-invasive care option.
- From a health system policy perspective, funding reform may be warranted to enhance team-based CKD care with good continuity. Policy-makers should also consider the ways in which improving financial supports for caregivers, providing travel and expense reimbursement for home dialysis patients and living organ donors, and providing support for utility and ancillary costs of home dialysis could incentivize sustainable CKD care.

## Issue

Chronic kidney disease is a chronic health condition that is a significant health system cost driver. The prevalence of CKD is expected to double worldwide by 2030 as a result of increasing risk factors and increasing rates of disease survival. Given the high cost of providing CKD care, there is growing concern about the future sustainability of CKD care.

## Background

Chronic kidney disease (CKD) is defined as the presence of kidney damage or reduced kidney function for more than 3 months. It is diagnosed through either the presence of a measured or estimated reduction in glomerular filtration rate (to  $\leq 60$  mL/min per  $1.73$  m<sup>2</sup>) or the presence of abnormalities in urine sediment, renal imaging, or biopsy results.<sup>1</sup> CKD is estimated to affect between 1.3 and 2.9 million Canadians, with more than 37,000 Canadians (excluding Quebec) estimated to be living with kidney failure (stage 5 CKD, or end-stage renal disease [ESRD]) in 2016.<sup>1,2</sup>

In addition to the human costs of the disease, economic studies show that CKD is a significant health system cost driver. A recent Canadian study found that the annual cost of caring for Canadians with pre-dialysis stages of CKD was approximately \$32 billion per year.<sup>3</sup> The costs associated with treating ESRD alone are estimated to account for approximately 1.2% of annual health spending in Canada.<sup>2</sup> Due to increasing risk factors for CKD, such as cardiac disease and diabetes, improved survival overall and with kidney failure, and increased

access to renal replacement therapy (RRT), the prevalence of kidney failure is expected to double internationally by 2030.<sup>2</sup>

Given the high cost of caring for the CKD population and the increasing prevalence of the condition, there is growing concern about the sustainability of providing this care in an increasingly resource-constrained health system.

## Methods

A literature search was conducted for peer-reviewed and grey literature about CKD that mentioned sustainability or program evaluation. To investigate the extent to which fiscal sustainability has been addressed in other chronic care models, we conducted a search using the same keywords about sustainability substituting a comparable chronic disease, congestive heart failure (CHF). This search returned 196 results, of which 46 were deemed relevant and selected for further review. A grey literature search was also conducted using CADTH's Grey Matters checklist.

## Results

Strategies to contain the cost of CKD care and improve patient outcomes were found across the continuum of care, from prevention and early disease management through later-stage interventions such as dialysis and transplantation. A variety of health system strategies, including funding reform, were identified to help support and enable sustainable CKD care.

### Prevention

It is generally accepted that public health interventions aimed at primary and secondary prevention must play an important role in reducing the overall burden of CKD.<sup>4</sup> Addressing social determinants of health, promoting healthy diets and active lifestyles, reducing sodium in packaged foods, and smoking cessation are all public health interventions that could address risk factors for CKD.<sup>4,5</sup> For individuals at higher risk of CKD, early screening and interventions aimed at maintenance of healthy body weight, increasing physical activity, lowering blood pressure, and preventing and controlling diabetes could prevent the development of CKD.<sup>4</sup> Also crucial to both primary and secondary prevention is access to primary health care. Early identification of CKD risk factors and prescription of lifestyle modification could largely be done by primary care providers. In early disease stages, commonly used and comparatively inexpensive medicines can help to slow disease progression and address secondary risk factors.<sup>4</sup>

### Diagnosis

Timely identification and diagnosis of early CKD is necessary to implement interventions aimed at slowing disease progression and preventing the need for more invasive, resource-intensive, and costly care such as dialysis. This literature search found little evidence that directly addressed sustainability of existing diagnostic and testing strategies. However, evidence suggests that enhanced screening efforts at the level of the whole population

are neither effective nor warranted.<sup>4,6</sup> A UK study found that existing electronic medical record (EMR) data were adequate to identify individuals with CKD and their comorbid health conditions.<sup>6</sup> However, given existing persistent gaps in EMR adoption in Canada and challenges with interoperability between EMRs used in primary care and other care settings, it is unclear if this is fully applicable in the Canadian context.

Clinical toolkits such as the Ontario Renal Network's KidneyWise toolkit are available to assist primary care providers with risk identification and diagnosis of CKD.<sup>7</sup> Evidence-based clinical toolkits can enhance the provision of sustainable care by providing clinicians with the right information to drive prescribing, diagnostic test ordering, and referral to nephrology. Also, clinical toolkits can help clinicians more readily identify when symptoms or abnormal laboratory results may be a result of a comorbidity or a concurrent condition such as viral gastroenteritis, benign prostatic hypertrophy, or undisclosed NSAID use.<sup>7</sup> This is of importance given the prevalence of comorbid conditions in CKD.<sup>1</sup>

## Early-Stage Management

In individuals with early-stage CKD or acute renal injury, secondary prevention such as lifestyle interventions; use of drugs that block the angiotensin pathway or control blood pressure and glycemia; and use of statins may be indicated to help prevent further progression of the disease.<sup>4,7</sup> Early-stage disease is highly amenable to primary care,<sup>7</sup> and appropriate, high-quality care can prevent disease progression, which in turn reduces resources used due to hospital admissions, the need for dialysis, and other necessities of late-stage CKD management.

Authors have noted that telemedicine and remote monitoring, whether synchronous or asynchronous, may play an important role in ensuring appropriate management of early CKD patients, particularly for those in rural and remote areas.<sup>4</sup> Depending on the funding model or reimbursement structure, telemedicine and remote monitoring has the potential to reduce costs and provide increased continuity of care for many chronic disease patients.

In some jurisdictions, primary care practitioners are believed to lack training and education in CKD management as part of standard curricula.<sup>4</sup> Strengthening educational opportunities for primary care providers would better position them to counsel patients and initiate preventive care. One study of local learning collaboratives, a quality improvement intervention that brought together small groups of primary care practices caring for patients with or at risk of CKD, identified a number of improvements as a result of shared learning.<sup>8</sup> Improved adherence to evidence-based guidelines was achieved in some local collaboratives, with increases in the number of providers providing patient education, enhanced medication review, appropriate prescribing and laboratory test ordering, and charting improvements (including CKD in the "problem" list and reporting of estimated glomerular filtration rate).<sup>8</sup> Clinicians reported improved self-efficacy in caring for CKD patients, and felt that viewing their practice's and their own performance data were a significant motivator to ensure adherence with best practices.<sup>8</sup>

## Late-Stage Interventions

Late- or advanced-stage CKD is defined as patients in stages 3 to 5 of disease progression. Stages 3 and 4 of CKD are indicated by moderately or severely decreased renal function as measured by glomerular filtration rate.<sup>9</sup> Stage 5 (or ESRD) patients are experiencing renal failure and may be reliant on RRT such as dialysis.<sup>9</sup> For those with ESRD, treatment options are limited to dialysis (hemodialysis [HD] or peritoneal dialysis [PD]) or kidney transplant,

both of which are resource intensive.<sup>2</sup> Conservative management, alternatively referred to as non-dialysis supportive care, may also be chosen by patients who are not good candidates for RRT or who do not wish to proceed with further invasive care.<sup>10</sup>

## Conservative Chronic Kidney Disease Management

Conservative management (CM) is an alternative that involves delaying or not initiating RRT, instead focusing on management of ESRD symptoms.<sup>11</sup> CM may include managing symptoms of ESRD such as acidosis, anemia, bone mineral metabolism issues, and hypertension through pharmaceutical and non-pharmaceutical means.<sup>10</sup> CM represents a balance between restorative and supportive care and should arise from shared decision-making, with a clear focus on the patient's goals for their care.<sup>12</sup> Patients may choose CM for a variety of reasons, including the presence of other comorbid health conditions, a desire to avoid the discomfort and disruption of a dialysis regime, or because they wish to focus on friends and family as they near the end of life.<sup>12</sup> Age is also a factor; US data suggest that nearly half of ESRD patients aged 85 and older do not receive dialysis.<sup>13</sup> Canadian data have shown a similar trend in that individuals older than the age of 65 are less likely to receive dialysis than younger age cohorts.<sup>14</sup>

Evidence is mixed on the extent to which older patients with multiple comorbidities or frailty can benefit from dialysis. The potential futility of dialysis increases in "oldest old" populations (age 80 and older).<sup>15</sup> More than half of octogenarians and nonagenarians on dialysis die within the first year.<sup>15</sup> For patients, HD is invasive, time-consuming, and comes with side effects including headaches, nausea, and fatigue. Given these factors, Choosing Wisely Canada recommends that patients speak with their health providers, families, and other carers before initiating dialysis to discuss whether dialysis is the correct choice for them as opposed to maximal conservative care focused on symptom management.<sup>16</sup> There are a variety of existing Canadian care pathways for CM, including those from British Columbia and Alberta.<sup>17,18</sup> These pathways emphasize the importance of advanced care planning, connecting the patient with palliative care and other health system resources that may be able to support them in their decision to forgo or stop RRT, and focusing on providing support to family and caregivers.<sup>17,18</sup> Reducing the use of dialysis in cases where it has little chance of providing long-term benefit is important not only for reducing health system cost, but also in maximizing the quality of life of those living with ESRD.

A 2020 CADTH Rapid Response report examined the question of the clinical effectiveness and cost-effectiveness of CM compared with dialysis in patients with stage 4 CKD or ESRD.<sup>10</sup> Key findings included the following:

- CM and dialysis were found to have similar outcomes in older adults with stage 4 CKD.
- CM was associated with shorter survival and increased mortality compared with dialysis in those with ESRD. However, when severe comorbidities were present in this population, no differences were found.
- Quality of life, symptom prevalence, and functional outcomes were between CM CKD patients and those receiving dialysis care. No differences were found in overall quality of life between the 2 groups in the ESRD population.
- No high-quality economic studies examining cost-effectiveness that were applicable to the Canadian context were found. One Indonesian study found that CM was the most cost-effective treatment option.<sup>10</sup>

## Centre-Based Dialysis

Dialysis has a significant and growing impact on health spending in Canada. In 2016, 58.4% of patients with kidney failure in Canada (excluding Quebec) were on dialysis.<sup>2</sup> A 2016 CIHI report found that the number of patients on dialysis in Canada had increased by more than 30% between 2004 and 2014. Yearly health expenditures for patients on dialysis totalled approximately \$1.9 billion, representing about 1.1% of all health expenditures in Canada.<sup>19</sup> Centre-based HD requires dedicated space and specialized equipment and has a high operational cost when considering not only health professional costs but also costs associated with the high electrical and water usage required to support this therapy. Existing centre capacity is likely to be burdened by the increasing prevalence of CKD in coming years.<sup>20</sup> Canadian dialysis centres have, in some cases, had to adjust operating hours and staffing to meet current demand. For example, in 2015 the Northern Alberta Renal Program announced that some of their dialysis sites would begin offering dialysis 7 days a week. For patients, this operational change meant that their 3 times weekly treatments would be scheduled whenever space was available, rather than at a stable time slot as most patients prefer.<sup>20</sup>

Dialysis patients are also at high risk of being hospitalized, which contributes to the costs driven by the modality. Evidence shows that hospital admissions for dialysis patients could be reduced by reducing infections by adhering to evidence-based infection control guidelines and through patient education.<sup>19</sup> Pediatric patients are at particular risk of hospitalization.<sup>19</sup> Access to earlier transplantation may be a way of reducing hospitalizations,<sup>19</sup> although this is highly dependent on organ supply and transplant centre capacity. Indigenous populations also have higher rates of dialysis-related hospitalization, and this may be addressed through culturally appropriate patient and clinician education, mobile clinics, and the establishment of satellite dialysis facilities in Indigenous communities to enhance care continuity.<sup>19</sup>

## Home Dialysis

Home dialysis modalities including PD and home HD were used by 18.9% and 4.7% of patients with renal failure in Canada (excluding Quebec) in 2016.<sup>2</sup> A 2017 CADTH Health Technology Assessment found no significant difference in patient quality of life outcomes between centre-based and home-based dialysis, and concluded that younger, healthier patients may in fact have better survival rates with home-based care.<sup>21</sup> Home-based dialysis, particularly HD, was found to be less costly than centre-based dialysis when considered from both a health system payer perspective and from a societal perspective (which includes costs borne by patients including travel and home utility costs, as well as labour force productivity measures).<sup>21</sup> Some patients also prefer home dialysis because it minimizes disruption to their lives and daily routines, and allows them to receive care closer to home, especially for those in rural and remote settings.<sup>21</sup>

Given that home dialysis, particularly HD, provides similar clinical benefits at lower cost and is preferred by some patients, it seems that any strategy to enhance sustainability of CKD care and to address capacity issues in centre-based dialysis must consider ways to enhance the use of these therapies. However, several issues must be considered to support successful scaling up of home dialysis programs in Canada. These include consideration of whether home and community infrastructure can support the demands associated with home dialysis stability of the electrical grid within given areas, water quality, and access to emergency services for home dialysis patients.<sup>22</sup> A 2017 CADTH Environmental Scan found some variability across Canada in the availability of public funding for home dialysis patients. No jurisdiction that responded to the survey provided travel funds to patients or their family for home-based dialysis training, but generally funding for home renovation to support

dialysis was available to patients.<sup>22</sup> Although not unique to CKD, access to formal home care for home dialysis patients varied, while financial supports for informal caregivers were largely non-existent.<sup>22</sup> Ensuring that patients are supported in directing their own care and managing potential complications and side effects would seem to be key to the long-term viability of home dialysis.

Authors have also cautioned that many implementation challenges would be associated with the adoption of a “home-first” dialysis policy.<sup>2</sup> In addition to the costs passed on to patients, significant training, education, and change management would be needed to support a home-first policy. In addition, a home-first policy would limit patient choice, which may have negative effects on adherence and outcomes.<sup>2</sup>

### Transplant

Kidney transplant is a costly intervention, with a one-time cost of approximately \$23,000, and on-going annual medication costs of around \$6,000. However, transplant is the preferred treatment for most ESRD patients and is cost-effective when compared with long-term dialysis.<sup>23</sup> Over a 5-year period, the cost of a transplant is expected to be nearly \$250,000 less than the cost of centre-based dialysis.<sup>23</sup> Transplant recipients also have better survival rates compared with dialysis recipients.<sup>23</sup>

Organ supply is the main limiting factor to more transplantations. Part of the organ supply for renal transplant comes from deceased donors after either brain death or cardiac death. Canadian Blood Services has done considerable work on policies and clinical practices that may enhance deceased donation, including removing barriers to donation after cardiac death.<sup>24</sup> However, it is known that patient outcomes are better after transplants received from a living donor.<sup>25</sup> Data from British Columbia suggests that the success rate following living donor transplant is 97%, and the organ lasts 15 to 20 years compared with the deceased donor success rate of 93% for which the organ lasts only 10 to 15 years.<sup>26</sup> Improved patient outcomes and cost savings are also achieved with pre-emptive transplantation, which is transplantation before the initiation of dialysis.<sup>27</sup> Pre-emptive transplantation is only possible with living donation.

A number of interventions could potentially enhance living kidney donation. Participation in living donor paired exchange registries and the creation of specialized living donation teams have been shown to be effective at enhancing donation within individual transplant sites.<sup>28</sup> Public education that addresses common misconceptions about living donation may also be helpful, as would financial assistance to support living donors with travel costs and potential lost income.

### Improving the Policy-Relevant Evidence Base

Although the burden of CKD is well-documented, data gaps exist. One area where systematic data seems to be missing is on the consequences of untreated CKD or CKD that is not identified until advanced disease stages.<sup>4</sup> Although a few recent Canadian economic analyses exist,<sup>3,25</sup> more evidence about economic effectiveness of CKD treatment modalities using standard measures such as cost per quality-adjusted life-year would help to build the case for investment in early intervention to prevent end-stage disease. Renal registries have been identified as an important support to building the evidence base around the CKD population as well as practice standards and treatment efficacy.<sup>4</sup>

Analyses of CKD care that include fulsome examinations of the available and necessary resources to support the entire continuum of care, including health human resources, physical infrastructure, and training and educational resources, would be most helpful in supporting sustainable health policy development.

### Health System Funding Reform

Existing funding silos that are a product of historical global budgeting and fee-for-service delivery systems within the Canadian health system can act as an impediment to high-quality care for complex patients.<sup>29</sup> In 2015, the Alberta-based Institute for Health Economics (IHE) held a roundtable to explore innovative funding models for kidney care in Canada, with specific attention paid to supporting the use of home dialysis. Existing models examined were those from British Columbia, Ontario, and the Centers for Medicare and Medicaid Services (CMMS) in the US.<sup>20</sup>

In British Columbia, funding for advanced CKD and ESRD is provided through the Ministry of Health to the BC Provincial Renal Agency (BCPRA), where it is then allotted to regional health authorities based on patient volumes. The BCPRA developed a CKD-specific activity-based funding (ABF) model that calculates full-time equivalent requirements and corresponding labour costs for each element of care included within a defined care bundle. The model then allocates funding based on volume and acuity projections. This program has been shown to reduce spending growth and result in improved mortality rates, reduced use of renal replacement therapy, and increased home-based care.<sup>20</sup>

In Ontario, the Ministry of Health and Long-Term Care created the Ontario Renal Network (ORN) in 2010, which is now responsible for delivery of kidney services in that province. As part of Ontario's Quality-Based Procedures initiative, which is an experiment with activity-based funding-for-care bundles for specific health conditions, ORN created the CKD quality-based procedure aimed at incentivizing home dialysis. This funding model is thought to have enhanced team-based care in CKD and has resulted in an increase of 1.5% in the percentage of patients using home dialysis.<sup>20</sup>

The CMMS, which is responsible for delivery of publicly funded health services for older adults and social assistance recipients in the US, implemented a bundled care model for all non-physician components of ESRD care. Physicians in this system are reimbursed using a monthly capitation model. This model was also shown to increase uptake of home dialysis, particularly PD.<sup>20</sup>

The IHE roundtable concluded that funding for CKD care is best administered within a stable and predictable funding envelope. Although an ABF model is a way of achieving this stability, the group acknowledged that this was not the only way of doing so. ABF models were also thought to be an effective means of creating financial incentives toward higher value care, and to allow for the collection of high-quality data that could be used to refine funding models for future planning purposes. The IHE roundtable further recommended that, regardless of the funding model, operating room allotments be realigned to prioritize operations such as PD catheter insertion that support high-quality and lower cost kidney care.<sup>20</sup>

## Lessons From a Comparable Chronic Disease Model: Congestive Heart Failure

Other chronic diseases that drive significant health system spending pose similar challenges as CKD to the Canadian health system. To investigate the extent to which fiscal sustainability has been addressed in other chronic care models, we conducted a search using the same keywords about sustainability substituting a comparable chronic disease, CHF. CHF was deemed to be comparable to CKD because it is also a condition that individuals may live with for many years, it drives significant health system costs, and it can be well-managed in early stages with high-quality, evidence-based care.<sup>30</sup>

Little evidence was found that dealt with sustainability throughout the continuum of CHF care. Most search results about CHF dealt with single interventions (e.g., remote monitoring) or interventions with specific sub-populations (long-term care residents). Based on the limited evidence found, it is challenging to draw specific comparisons between sustainability efforts in CHF care and CKD care. However, an issue that seems to be relevant for both conditions and patient populations is the desire for better uptake of high-quality home and community-based care options. Although the needs of these patient populations differ, there would seem to be important parallels about aligning financial incentives for remote monitoring for CHF that are also relevant to increasing uptake of home dialysis, for example.

## Conclusions

Ensuring CKD care in Canada is sustainable to support the future demand growth is multifactorial and should occur across the care continuum. For those at risk of CKD or in early stages of the disease, public health interventions to support healthy behaviours and ensure access to primary health care seem crucial to preventing or delaying disease progression. For later-stage patients requiring RRT, enhancing access to transplantation and home-based dialysis have the potential to reduce costs while also improving outcomes and quality of life. Those with ESRD who are not good candidates for RRT or who prefer a less-invasive care option, could benefit from a CM approach. Ensuring that patients who prefer to forgo dialysis in favour of CM can access the supports they need could reduce total health system costs and free up scarce dialysis resources.

From a health system policy perspective, funding reform may be warranted to enhance team-based CKD care with good continuity. Policy-makers should also consider the ways in which improving financial supports for caregivers, providing travel and expense reimbursement for home dialysis patients and living organ donors, and providing support for utility and ancillary costs of home dialysis could incentivize sustainable CKD care.

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