



Prevalence of Severe Kidney Disease and Use of Dialysis and Transplantation Across Alberta from 2004 – 2013

*Alberta Annual Kidney Care Report
Kidney - Strategic Clinical Network*

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Executive Summary

Background

The Kidney Strategic Clinical Network (K-SCN) in partnership with the Northern and Southern Alberta Renal Programs (NARP & SARP), the Interdisciplinary Chronic Disease Collaboration (ICDC), and the Alberta Kidney Disease Network (AKDN) is releasing its first annual kidney care report. This report informs long-term program planning for Alberta's renal programs, identifies variations in care and outcomes across the province, and highlights areas for quality improvement.

Methods

Routine laboratory data for all Albertans was obtained through the unique AKDN database. This data was linked to Alberta Health administrative data and detailed clinical information from the Southern and Northern Alberta Renal Programs to define the incidence and prevalence of Chronic Kidney Disease (CKD) and the use of renal replacement therapy (dialysis and kidney transplantation).

Key findings

- Although the number of patients with severe CKD and kidney failure is increasing, across all age groups and zones, the incidence and prevalence rates of severe CKD and kidney failure are stable suggesting the increase is related to population growth.
- There are nearly 4,500 patients across Alberta with kidney failure (defined by having an $eGFR < 15 \text{ mL/min/m}^2$) who are not on renal replacement therapy. This number far exceeds the number of patients managed in multidisciplinary CKD clinics in Alberta. Nearly 30% of such patients have not been seen by a Nephrologist. Consideration should be given to creating a provincial registry for such patients.
- The use of peritoneal dialysis (PD) varies substantially across age groups (expected) and across Alberta zones (not expected). The use of PD appears to be decreasing over time across all zones. Since patients on PD experience similar survival to in-center hemodialysis and PD is associated with better quality of life and lower costs (~\$25,000/year less expensive than in-center hemodialysis), it is important to understand and address the barriers to use of PD.
- The number of people receiving kidney transplants over the past 10 years has been stable despite a 40% increase in the number of people with end stage renal disease (ESRD) and the introduction of transplants being done within the paired exchange program. While the number of living donor transplants is similar across the Northern and Southern Alberta Renal Programs, fewer deceased donor kidney transplants are performed in Southern Alberta.

Conclusions

This report has identified consistent growth in the numbers of adults with severe kidney disease and kidney failure. Furthermore, there is significant variation in timing of dialysis initiation, use of peritoneal dialysis and kidney transplantation across Alberta Health Services (AHS) zones. Despite the substantial increase in the number of patients on dialysis, the number of kidney transplants performed over the past ten years has remained stable.

Given these findings, initiatives aimed at optimizing the timing of dialysis initiation, increasing appropriate use of home dialysis and increasing the number of transplants performed are urgently required. The information in this report should assist Alberta Kidney Health decision makers with future planning for dialysis and transplantation services.

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Chapter 1: Background and Methods

BACKGROUND

Chronic Kidney Disease

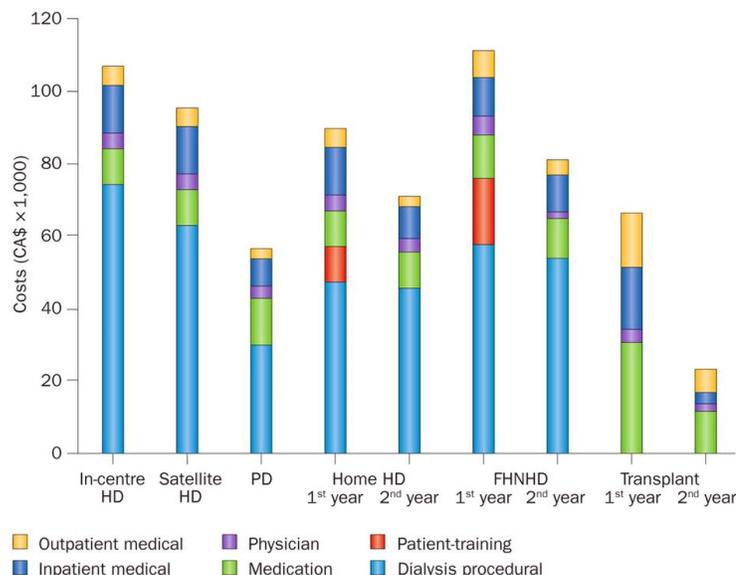
Kidney disease is a common complex chronic condition, which may lead to kidney failure. It increases the risk of cardiovascular complications, and when severe, is associated with debilitating symptoms, which impact a patient's quality of life. Kidney disease encompasses a variety of disorders and represents a major public health burden, affecting nearly four million Canadians, with particular relevance to vulnerable populations such as Aboriginal people and the elderly.

Chronic kidney disease (CKD) is defined by an estimated glomerular filtration rate [eGFR; an estimate of kidney function] < 60 mL/min/1.73m² that is persistent for at least three months. Other simple laboratory tests, such as measurement of urinary protein using a urinalysis or other measure of proteinuria, can provide important prognostic information and indicate that a patient is at high risk for cardiovascular events and progression to kidney failure. When the eGFR falls below 15mL/min/1.73m², patients are considered to have kidney failure. When patients have kidney failure, and they develop symptoms of kidney failure (typically when the eGFR falls below 10mL/min/1.73m²), including nausea, vomiting, poor energy and itching, then they require treatment with kidney transplantation (for appropriate candidates), dialysis (either in-center or home-based hemodialysis, or peritoneal dialysis), or non-dialysis supportive care.

Dialysis and transplantation are forms of renal replacement therapy. Costs vary by dialysis modality and transplantation. Canadian micro-costing studies have noted that total health care costs of treating dialysis patients per year are as follows (all costs in Can 2013 \$)¹⁻³:

- in-center hemodialysis (in a hospital or clinic setting) \$95,000 to \$107,000
- home hemodialysis \$71,000 to 90,000
- peritoneal dialysis \$56,000

Figure 1. Annual health care costs of dialysis by modality (2012 CAD)⁴.



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1. Lee H, Manns B, Taub K, et al. Cost analysis of ongoing care of patients with end-stage renal disease: the impact of dialysis modality and dialysis access. *American Journal of Kidney Diseases*. 2002;40(3):611-622.
2. Klarenbach S, Tonelli M, Pauly R, et al. Economic evaluation of frequent home nocturnal hemodialysis based on a randomized controlled trial. *J Am Soc Nephrol*. Mar 2014;25(3):587-594.
3. Chui BK, Manns B, Pannu N, et al. Health care costs of peritoneal dialysis technique failure and dialysis modality switching. *American Journal of Kidney Diseases: The official Journal of the National Kidney Foundation*. Jan 2013;61(1):104-111.0
4. Klarenbach SW, Tonelli M, Chui B, Manns BJ. Economic evaluation of dialysis therapies. *Nat Rev Nephrol*. 2014 Nov;10(11):644-652

Alternatively, the cost of transplantation, including donor costs (both deceased and living donors) is about \$100,000 in year one, and \$20,000 in year two with costs declining annually for most patients thereafter¹.

The Need for an Alberta Kidney Care Annual Report

The Alberta Health Services Kidney - Strategic Clinical Network (K-SCN), works in close partnership with the Alberta Kidney Care Coordinating Council and the Northern and Southern Alberta Renal Programs (NARP, SARP), and brings together clinicians, researchers, and other stakeholders dedicated to improving health for people with kidney disease. The Kidney-SCN will transform the care provided to patients with kidney disease across Alberta and aims to ensure quality, safety, and sustainability of services.

The Kidney Strategic Clinical Network (K-SCN) in partnership with the Northern and Southern Alberta Renal Programs (NARP & SARP), the Interdisciplinary Chronic Disease Collaboration (ICDC), and the Alberta Kidney Disease Network (AKDN) is releasing its first annual kidney care report. This report informs long-term program planning for Alberta's renal programs, identifies variations in care and outcomes across the province, and highlights areas for quality improvement.

The report provides, for the first time a true picture of the burden of kidney disease in Alberta. It identifies areas of rapid demand growth, supports future capacity decision making, assesses current care, including use of home dialysis and transplantation, and evaluates future needs for dialysis and transplantation services. This study is based in part on data provided by Alberta Health and Alberta Health Services. The interpretation and conclusions contained herein are those of the researchers and do not necessarily represent the views of the Government of Alberta or Alberta Health Services. Neither the Government of Alberta nor, Alberta Health or Alberta Health Services express any opinion in relation to this study.

Methods

This work was done by the Interdisciplinary Chronic Disease Collaboration and the Alberta Kidney Disease Network. Routine laboratory data for all outpatients and inpatients in Alberta was obtained through the unique AKDN database. This data was linked to Alberta Health administrative data and detailed clinical information from the Southern and Northern Alberta Renal Programs to define the incidence and prevalence of Chronic Kidney Disease (CKD) and the use of renal replacement therapy (dialysis and kidney transplantation).

Throughout this report, **severe CKD** is defined as:

- 1) eGFR < 30 ml/min/1.73m² not on renal replacement therapy (i.e. excluding dialysis and prior transplants), or
- 2) eGFR < 60 ml/min/1.73m² with *proteinuria* (Protein to Creatinine ratio (PCR) > 100mg/mmol) or albuminuria (albumin to creatinine ratio (ACR) > 60 mg/mmol or dipstick proteinuria=heavy) not on renal replacement therapy (i.e. excluding dialysis and prior transplants);

Kidney failure is defined as

eGFR < 15 ml/min/1.73m² not on renal replacement therapy or treatment with renal replacement therapy (hemodialysis, peritoneal dialysis or kidney transplantation). In order to interpret the results in this report, it is important to understand the terms *incidence* and *prevalence*. Incidence is a measure of new cases of severe CKD (or kidney failure) arising within a particular timeframe in a population. Therefore, incidence is the number (referred to as "incidence") or the rate (referred to as incidence rate) of new cases of

severe CKD each year in Alberta. Alternatively, prevalence is the number (referred to as “prevalence”) or the rate (referred to as prevalence rate) of cases of severe CKD existing within a population during a particular time period (or on a particular date). Of note, the incidence and prevalence rates that are reported herein are not age or sex standardized – where relevant, analyses that stratify by age are presented.

After discussion with operational leads from the Northern and Southern Alberta Renal Programs, the following objectives were established for this initial report:

- 1) To determine the number of incident cases of severe CKD and kidney failure not receiving renal replacement therapy (and the incidence rate) overall, and stratified by age, in each of the AHS zones for two year periods between January 1, 2006 and December 31, 2013.
- 2) To determine the number of incident cases of kidney failure treated with renal replacement therapy (dialysis or pre-emptive transplant) overall and stratified by age, in each of the AHS zones for two year periods between January 1, 2006 and December 31, 2013.
- 3) To determine the number of prevalent cases of severe CKD and kidney failure not receiving renal replacement therapy (and the prevalence rate), stratified by age and AHS zone for two year periods between January 1, 2004 and December 31, 2013. The proportion of patients who have seen a nephrologist is also presented, where available.
- 4) To determine the number of prevalent cases of kidney failure on dialysis (and the prevalence rate) stratified by dialysis modality, age and AHS zone on December 31 of each year from 2009 to 2013, inclusive.
- 5) To determine the proportion of patients receiving peritoneal dialysis at ninety days after dialysis initiation, by AHS zone and age, between January 1, 2009 and December 31, 2013.
- 6) To determine the number of adults who received kidney transplants each year between January 1, 2004 and December 31, 2013 by age, AHS zone and donor type.
- 7) To determine the number of people who received kidney transplants, per one thousand dialysis patients aged <75 years at the end of the preceding year, by age and AHS zone from January 1, 2009 to December 31, 2013.

In the next iteration of this report we will map the residence location of Albertans with kidney failure (eGFR < 15 ml/min/1.73m² or treatment with hemodialysis or peritoneal dialysis) in relation to existing, proposed and potential satellite dialysis units between January 1, 2012 and December 31, 2013, and comparing two five year time periods (January 1, 2004 - December 31, 2008 with January 1, 2009 – December 31, 2013). We will also report on specific quality indicators including: 1) the proportion of CKD patients with diabetes or proteinuria who filled a prescription for an angiotensin converting enzyme receptor inhibitor or angiotensin receptor antagonist over one year, 2) the proportion of CKD patients filling a prescription for a statin treatment over one year, and 3) the proportion of CKD patients with a measurement of urine protein, blood lipids, and A1C (in patients with diabetes) in the prior year. Other future reports will consider outcomes such as all-cause mortality, hospitalization, and health care costs.

DATA SOURCES

Data from the following sources was used for this report: the AKDN repository of laboratory data; the Northern and Southern Alberta Renal Programs (NARP and SARP); and Alberta Health (AH). The data sources were linked via each patient's unique provincial health number (PHN).

AKDN / ICDC

The AKDN/ICDC has established a computerized repository of laboratory data from labs throughout Alberta, which was used to define the study cohorts. The AKDN/ICDC contains all serum creatinine measurements as well as other relevant laboratory tests obtained in hospital as well as outpatient settings for all Alberta residents. Data is available from May 1, 2002 for seven of the nine geographically based provincial health regions that existed before Alberta Health Services and from July 1, 2003 and January 1, 2005 for the other two regions.

NARP and SARP

The NARP and SARP databases were used to identify patients who have started renal replacement, including the date of initiation. Together the NARP and SARP provide care to all identified patients with kidney failure in Alberta, and maintain computerized databases identifying all hemodialysis, and peritoneal dialysis patients within the province.

Alberta Health (AH)

AH maintains administrative data for Alberta. These data were used to obtain information on three domains of interest: demographic data including date of death for patients who have died; hospitalizations and emergency department visits; and physician claims.

Transplant Data

Although AH administrative data can accurately identify patients who undergo kidney transplantation in Alberta, it does not identify the type of transplant that was received (deceased donor, living related or unrelated donor, paired exchange). Therefore, for figures reporting the number and type of transplants done across Alberta, this data was taken from aggregate statistics provided by the Southern and Northern Alberta Transplant Programs. For future reports, we aim to obtain individual patient level data from the transplant programs to more accurately describe transplant services.

Identification of Study Population

Laboratory data from the AKDN database was used to identify all Albertans age eighteen and older with *at least one outpatient serum creatinine measurement who were identified as having severe CKD or kidney failure in the province of Alberta*. Based on availability of laboratory data, the cohort entry date was May 1, 2002 for seven of the nine geographically based provincial health regions that existed prior to the current Alberta Health Services, and July 1, 2003 and January 1, 2005 respectively for the other two regions. Kidney failure requiring dialysis was defined using SARP and NARP data, verified using Alberta Health administrative data where required to ensure accuracy. Accrual into all of the patient cohorts ended December 31, 2013 (the latest date for which Alberta Health administrative data are available within the AKDN).

DATA PREPARATION

Assessment of kidney failure

We used individual-level data obtained from the NARP and SARP programs to determine cases of kidney failure on renal replacement therapy. Data from these programs included the start and end dates of dialysis, the modality (pre-dialysis care, hemodialysis, and peritoneal dialysis), and the dates of any changes in modality. A rigorous process of data verification and cleaning was undertaken to ensure accuracy of results. For the SARP data, obtained from the PARIS database, this process was required due to missing start dates or end dates, contradictory dates, and gaps in data where they may have been receiving dialysis. We addressed these issues by applying various logical rules, by gleaning information from text data in PARIS, by comparing the SARP data to Alberta Health physician claims for dialysis and transplants, and by detailed individual review of several hundred cases within the data captured in physician and nursing records in PARIS.

There were also records in the SARP data consistent with episodes of acute hemodialysis secondary to acute kidney injury. Since it was our intent to include patients with kidney failure requiring chronic dialysis or transplantation (and to exclude patients with acute kidney failure requiring acute dialysis – since this resolves within weeks for the majority of survivors), these cases were removed. We defined kidney failure requiring chronic disease as periods of dialysis of at least ninety days duration, but also including people known to have severe CKD followed within pre-dialysis clinics who died or received a kidney transplant before ninety days. For the purpose of this report we defined acute dialysis as:

- Hemodialysis initiated within fourteen days of death, not preceded by peritoneal dialysis or pre-dialysis care, and which continued until within one day of death (*suggesting death in the setting of acute kidney failure*); or,
- A period of less than ninety days of hemodialysis not immediately preceded by pre-dialysis care or peritoneal dialysis, and not immediately followed by peritoneal dialysis or a kidney transplant (*suggesting recovery from acute kidney failure*).

As noted above, for cases which were unclear, we carried out detailed individual review within the data captured in physician and nursing records through Paris, and removed cases of acute dialysis for acute kidney failure. Using this process and the above definitions, we identified and excluded approximately one thousand three hundred acute dialysis records from the SARP data. Of note, people who started on acute dialysis for acute or chronic kidney failure which became chronic were not excluded using these definitions, nor were people who were followed within the pre-dialysis clinics who started on chronic dialysis but survived less than ninety days.

The NARP data was obtained from NIS (Nephrology Information System) to create a dataset similar to that derived from SARP. As with the SARP data, logical rules were applied, and many cases were reviewed manually to obtain missing data or clarify contradictory information. Approximately two hundred cases of acute dialysis were identified and removed from the NARP data using the above rules.

Once the NARP and SARP data were combined, we excluded three hundred and ninety-seven individuals who were not present in the Alberta Health registry to March 31, 2013 – mainly out-of-province residents with nine digit PHNs which were otherwise indistinguishable from Alberta PHNs. The combined NARP/SARP database covers the period January 1, 2001 to December 31, 2013.

Assessment of severe chronic kidney disease

The definitions of severe CKD and kidney failure not requiring dialysis were based on eGFR estimates and measurements of urinary protein. We first calculated eGFR for each outpatient serum creatinine measurement, using the CKD-EPI equation¹, with age determined on the date of the measurement. For the definition of severe CKD that included proteinuria, we considered all proteinuria measurements in the two years prior to and up to the date of any serum creatinine measurement which met the threshold for the eGFR cut-off. The definition of proteinuria required either an ACR >60 mg/mmol, a PCR >100 mg/mmol, or a urinalysis proteinuria result of “heavy”². We considered only the most recent measurement, but used any ACR measurement in the prior two years in preference to any PCR measurement, and any PCR measurement in preference to any urinalysis result.

Incident cases of severe CKD were defined by the first eGFR in the period that fell below the threshold level, with no prior eGFR measurement below the threshold in the previous two years. Prevalent cases were also defined by the first eGFR measurement that fell below the threshold in a period. Age and zone of residence were assessed at the date of this measurement. For both incident and prevalent severe CKD and kidney failure, we excluded people who were on dialysis at any point in the ninety days on or after the qualifying eGFR measurement, and people who had had a kidney transplant between April 1, 1994 and the date of the measurement.

For the calculation of incidence and prevalence rates per million people, we used population data obtained from Alberta Health (http://www.ahw.gov.ab.ca/IHDA_Retrieval/) for the appropriate age group, AHS zone, and year. We assigned people to each of the five AHS Zones each year by linking their postal code of residence for the closest matching fiscal year in the Alberta Health registry to the Alberta Health Postal Code Translator File³.

Information on home hemodialysis is available in NARP and SARP data from approximately 2007 on. For logistical reasons, it was not extracted for this report, and all patients treated with home hemodialysis are categorized as being treated with hemodialysis for this report. In future reports, we will endeavor to report home hemodialysis as a separate modality.

Late referral is defined by patients who were not seen by a nephrologist until ninety days or less before the initiation of chronic renal replacement. This could include patients who developed acute kidney injury that failed to resolve and led to chronic dialysis. For people who had been followed by a Nephrologist for more than ninety days, we calculated their last eGFR prior to dialysis initiation by using the most recent serum creatinine measurement (outpatient, inpatient or ER) up until the day of dialysis initiation. If there was more than one measurement on the same day, then we used the highest serum creatinine measurement on that day. This was considered the estimate of kidney function prior to initiating dialysis. Guidelines recommend that initiation of dialysis in patients with progressive chronic kidney disease should only occur when the eGFR is below 10.5 ml/min/1.73m² and patients have symptoms from their kidney failure⁴. A proxy of potentially inappropriate early initiation of chronic dialysis is assessing the proportion of patients who initiate dialysis with an eGFR >10.5 ml/min/1.73m² (irrespective of symptoms), and this proportion is reported across age and AHS zones.

Page References:

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1. Levey AS, Stevens LA, Schmid CH, et al, for the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration). A new equation to estimate glomerular filtration rate. *Ann Intern Med.* 2009; 150: 604–12
2. Hemmelgarn BR, Clement F, Manns BJ, Klarenbach S, James MT, Ravani P, Pannu N, Ahmed SB, MacRae J, Scott-Douglas N, Jindal K, Quinn R, Culleton BF, Wiebe N, Krause R, Thorlacius L, Tonelli M. Overview of the Alberta Kidney Disease Network. *BMC Nephrol.* 2009 Oct 19;10:30.
3. Alberta Health: Postal Code Translator File (PCTF); June, 2013.
4. Nesrallah GE, Mustafa RA, Clark WF, et al; Canadian Society of Nephrology. CSN clinical practice guideline for timing the initiation of chronic dialysis. *CMAJ.* 2014 Feb 4;186(2):112-7.

COVARIATES AND OTHER VARIABLE DEFINITIONS

Demographic data including age, sex, and First Nations status were determined from the AH registry file. We used validated algorithms to define diabetes from the AH physician claims and hospitalization databases¹.

ETHICS AND PRIVACY

We are secondary users of the data, as defined by the Alberta Health Information Act. Ethics approval was obtained from the Universities of Calgary and Alberta for ongoing ICDC / AKDN data collection (Ethics ID: E-22590), and for the purposes of this report (Ethics ID: REB 14-0884). Data is housed within the Citrix Research Data Haven within the IT department of the University of Calgary (UC), which has been approved for storage of patient level data.

BASELINE CHARACTERISTICS:

Tables 1 and 2 outline the characteristics of adults who started dialysis between 2009 and 2013, stratified by modality (hemodialysis and peritoneal dialysis) and AHS zone (Calgary, Central, Edmonton, North, South), and First Nations status. Of note, patients starting dialysis from the North zone are in general younger, and First Nations patients are more common outside of the Calgary and Edmonton zones. First Nations patients are less likely to start dialysis with peritoneal dialysis, and are also substantially younger than non-First Nations patients starting dialysis.

Table 1. Selected characteristics for adult incident dialysis patients, by two year period and dialysis modality at initiation.

	Dialysis modality at initiation					
	Overall		HD		PD	
	Jan 1, 2009 to Dec 31, 2010	Jan 1, 2012 – Dec 31, 2013	Jan 1, 2009 to Dec 31, 2010	Jan 1, 2012 – Dec 31, 2013	Jan 1, 2009 to Dec 31, 2010	Jan 1, 2012 – Dec 31, 2013
N	1060	1194	850	984	210	210
Mean age	62.0	61.4	63.2	62.3	57.3	57.3
Age 65+ (%)	45.1	42.7	48.5	44.9	31.4	32.4
Male (%)	58.8	62.7	57.3	63.8	64.8	57.6
First Nations (%)	6.2	6.6	7.3	7.6	1.9	1.9
Diabetes, %	55.0	61.7*	57.1	63.2*	46.7	54.4*
Late referral, % (no nephrologist visit > 90 days before dialysis)	22.3	21.4**	25.4	24.8**	9.9	5.3**
Last eGFR before dialysis among early referrals:						
Mean (mL/min/1.73m²)	8.38	7.72	8.33	7.62	8.57	8.10
Proportion > 10.5 mL/min/1.73m²	18.9%	14.6%	18.1%	15.0%	21.4%	13.4%

* excludes people who started dialysis after March 31, 2013

** excludes people who started dialysis after June 30, 2013

Late referral calculation excludes dialysis re-initiation after failed transplant

Table 2. Selected characteristics for adult incident dialysis patients, by zone of residence and First Nations status (January 1, 2009 to December 31, 2013)

	Overall	Calgary	Central	Edmonton	North	South	First Nations
N	2846	1058	379	906	264	227	182
Mean age	61.3	61.2	62.5	61.6	58.8	63.0	54.4
Age ≥65 (%)	43.3	43.1	45.9	44.4	34.1	47.6	24.2
Male (%)	61.8	62.2	59.6	61.4	63.6	62.6	50.0
First Nations (%)	6.4	4.0	9.0	4.3	16.3	10.1	---
Diabetes (%)*	57.1	54.8	59.9	57.1	60.1	60.4	73.4
Late referral, %**	22.4	25.4	24.4	16.8	23.2	25.1	24.7
Last eGFR before dialysis among early referrals:							
Mean (mL/min/1.73m²)	8.1	8.5	7.9	8.0	7.6	7.6	7.7
Proportion > 10.5 mL/min/1.73m²	17.0%	20.4%	15.5%	15.6%	12.6%	15.5%	11.8%

* excludes people who started dialysis after March 31, 2013

** excludes people who started dialysis after June 30, 2013.

Late referral calculation excludes dialysis re-initiation after failed transplant.

The proportion of patients with “late referral” was similar across AHS zones, except in Edmonton where late referral was less common. Initiating dialysis with a eGFR >10.5 ml/min/1.73 m² among patients followed by a Nephrologist for at least ninety days may be inappropriate (when patients do not have symptoms related to kidney failure). Over 20% of such patients starting dialysis in the Calgary zone between 2009 and 2013 started dialysis with an eGFR >10.5 ml/min/1.73 m², compared with ~15% across the other AHS zones.

Number of Incident Cases of Severe Chronic Kidney Disease across Alberta, 2006-2013:

Tables 3 and 4, and Tables 9 through 12 outline the number of incident cases of severe CKD overall, and stratified by age, or by AHS zone from 2006 to 2013. Table 4 notes a higher incidence rate of kidney failure (eGFR <15 ml/min/1.73 m² not on renal replacement therapy) in the South zone while Table 3 also notes a higher incidence rate of severe CKD (eGFR<30 ml/min/1.73m²). This in part relates to the older age on average in the South zone. Of note, the Chinook region (part of the South zone) is the only health region that does not calibrate their serum creatinine measurements using isotope dilution mass spectrometry, which may contribute to the differences observed.

Table 3. Number of incident cases of severe CKD (and incidence rate), defined as eGFR < 30 mL/min/1.73m², by AHS zone and two year period (excluding those on dialysis or with a transplant, but including all adults).

2 year period	Calgary			Central			Edmonton			North			South			Alberta		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	3574	3617	30.4	1661	5077	14.1	3712	4392	31.6	1386	4587	11.8	1407	6828	12.0	11740	4399	100
2008-2009	3922	3731	31.9	1679	4930	13.7	4024	4493	32.8	1191	3732	9.7	1465	6817	11.9	12281	4353	100
2010-2011	3817	3482	30.4	1836	5302	14.6	4090	4391	32.5	1336	4021	10.6	1495	6795	11.9	12574	4297	100
2012-2013	4357	3733	31.8	1843	5141	13.4	4428	4488	32.3	1561	4431	11.4	1517	6724	11.1	13706	4435	100

RPMP = rate per million population per two year period.

Table 4. Number of incident cases of kidney failure (eGFR < 15 mL/min/1.73m²) not requiring renal replacement therapy (and incidence rate), by AHS zone and two year period (including all adults).

2 year period	Calgary			Central			Edmonton			North			South			Alberta		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	860	870	30.7	361	1103	12.9	931	1101	33.2	344	1139	12.3	305	1480	10.9	2801	1050	100
2008-2009	986	938	32.2	395	1160	12.9	1044	1166	34.1	320	1003	10.5	314	1461	10.3	3059	1084	100
2010-2011	960	876	31.6	415	1198	13.7	1011	1085	33.3	335	1008	11.0	314	1427	10.3	3035	1037	100
2012-2013	1027	880	31.8	422	1177	13.1	1057	1071	32.7	367	1042	11.4	360	1596	11.1	3233	1046	100

RPMP = rate per million population per two year period.

Number of Incident Cases of Kidney Failure requiring renal replacement therapy across Alberta, 2006-2013:

Tables 5, 6, and Table 13 outline the number of incident cases of kidney failure requiring renal replacement therapy, stratified by age and/or AHS zone. The populations with the largest growth in new cases of kidney failure requiring renal replacement therapy are among patients under seventy-five, and those within the Edmonton and Calgary zones (Table 5, 6). The prevalence rate of kidney failure requiring renal replacement therapy, even within these groups, is stable, suggesting that the increased number of new cases of kidney failure relates to in-migration (and the resultant larger population size) and the changing demographic of the three age groups, due to aging baby boomers. For example, the Alberta population aged sixty to seventy-four years has been growing at over twice the rate of the other two age groups (average annual growth from 2009 to 2013 was 5.0% for this age group, compared to 2.6% for those aged older than seventy-five years and 2.0% for those aged eighteen to fifty-nine years).

Of note, the vast majority of patients initiating renal replacement therapy across all AHS zones, and age groups started dialysis rather than having a transplant. In 2012-13, only 3.7% of ESRD patients overall received a preemptive transplant, including 5.9% of patients under age sixty, and 2.9% of patients aged sixty to seventy-four.

Table 5. Number of incident cases of kidney failure requiring renal replacement therapy (dialysis and pre-emptive transplantation) (and incidence rate) by age group and two year period, across Alberta.*

	18-59			60-74			75+			All adults		
	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP
2006-2007	430	30	212	373	9	1144	263	1	1587	1,066	40	414
2008-2009	452	21	207	361	7	1009	257	0	1473	1,070	28	389
2010-2011	504	25	225	397	8	1019	214	0	1171	1,115	33	392
2012-2013	497	31	215	434	13	1015	263	2	1376	1,194	46	401

RPMP = rate per million population per two year period. PT = pre-emptive transplant

*Includes resumption of dialysis after a failed transplant

Table 6. Number of incident cases of kidney failure requiring renal replacement therapy (dialysis and pre-emptive transplantation) (and incidence rate) by age group and two year period, across Alberta.**

	Calgary			Central			Edmonton			North			South			Alberta*		
	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP	Dial	PT	Total RPMP
2006-2007	388	8	401	155	9	501	324	16	402	101	5	351	90	2	446	1,066	40	414
2008-2009	381	9	371	145	8	449	364	7	414	93	3	301	81	1	382	1,070	28	389
2010-2011	409	10	382	155	5	462	346	12	384	112	2	343	86	1	395	1,115	33	392
2012-2013	449	19	401	152	4	435	376	18	399	111	1	318	101	4	465	1,194	46	401

RPMP = rate per million population per two year period. PT = pre-emptive transplant

* Totals may not add across zones because a small number of people (<1%) could not be assigned to a zone, but are included in the Alberta total.

**Includes resumption of dialysis after a failed transplant

Prevalence of Severe Chronic Kidney Disease across Alberta, 2004-2013:

Table 7, Tables 14 through 18 and Figures 2 and 3 outline the number of prevalent cases of severe CKD and kidney failure not requiring renal replacement therapy, overall and stratified by age or AHS zone from 2004 to 2013. In general, the prevalence rate of severe CKD (across all definitions) is stable, but the number of adults with severe CKD is increasing. Similar to the incidence rate, the prevalence rate of severe CKD (defined as eGFR <30 ml/min/1.73 m²) or kidney failure (eGFR <15 ml/min/1.73 m² not requiring renal replacement therapy) appears highest in the South zone, which is partly due to older age. When the prevalence rates are stratified by age and zone (Figures 10 and 11), the differences are less pronounced, though still apparent, particularly in the age group over seventy-five.

Table 7. Number of prevalent cases of severe CKD (and prevalence rate), defined as eGFR < 30 mL/min/1.73m², by AHS zone and two year period, excluding those on dialysis or with a transplant, including the proportion of patients seen by a Nephrologist (all adults)

2 year period	Calgary			Central			Edmonton			North			South			Alberta		
	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*
2004-2005	5661	6158	43.3	2554	8244	36.5	6332	7985	38.0	1826	6420	26.1	2387	12130	39.5	18760	7494	38.4
2006-2007	6028	6100	44.0	2513	7681	41.8	6393	7564	43.7	2044	6765	30.8	2384	11570	43.4	19362	7254	42.1
2008-2009	6517	6200	44.1	2735	8030	43.2	6738	7523	45.4	2038	6385	34.2	2503	11647	44.0	20531	7276	43.4
2010-2011	6495	5924	48.2	2999	8661	41.7	7149	7675	47.3	2169	6528	37.2	2662	12099	43.2	21474	7338	45.2
2012-2013	7250	6211	--	3146	8776	--	7574	7677	--	2491	7071	--	2753	12203	--	23214	7512	--

* % with a nephrologist visit in the year prior to or after the qualifying eGFR; could not be assessed for 2012-13. RPMP = rate per million population per two year period

Figure 2. Prevalence rate (per million) of kidney failure (eGFR < 15 mL/min/1.73m²) not on renal replacement therapy (and number of prevalent cases, on top of bars), by age and two year period, across Alberta.

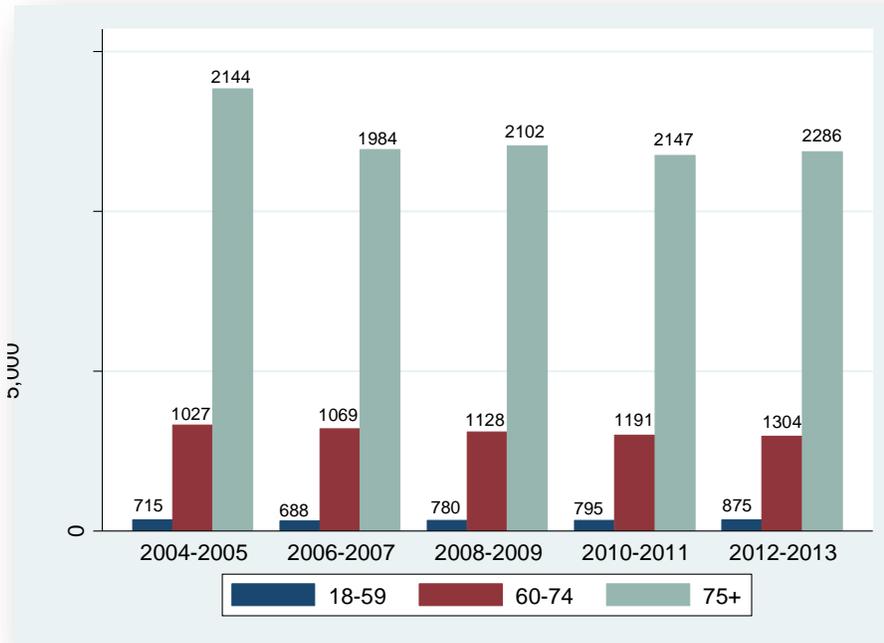
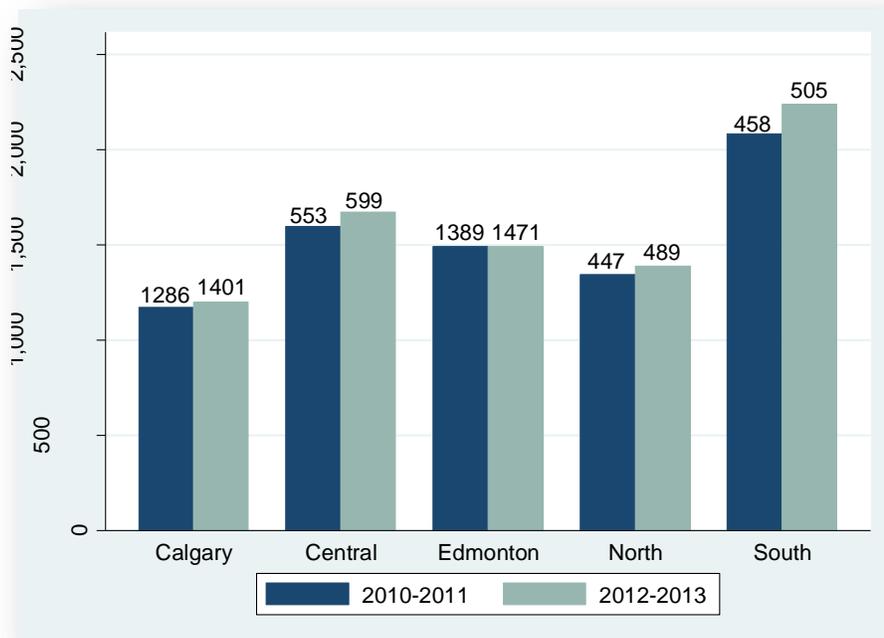


Figure 3. Prevalence rate (per million) of kidney failure (eGFR < 15 mL/min/1.73m²) not on renal replacement therapy (and number of prevalent cases, on top of bars), by AHS zone and two year period (all ages).



While not all adults with severe CKD (defined by eGFR <30 ml/min/1.73 m²) are being followed by a Nephrologist (Table 14), ~70%, 60% and 30% of patients aged under sixty, sixty to seventy-four and seventy-five or older, respectively, have been seen by a Nephrologist within a two year period. Similarly, for patients with kidney failure (eGFR <15 ml/min/1.73 m² not requiring renal replacement therapy), ~90%, 80% and 60% of patients aged under sixty, sixty to seventy-four and seventy-five or older, respectively have been seen by a Nephrologist within a two year period. Given that guidelines recommend all such patients should be assessed by Nephrology, further work is required to understand the characteristics of patients that are not being referred, and whether there are barriers to appropriate referral.

Figures 2 and 3 highlight that while the prevalence rate of kidney failure (eGFR < 15 ml/min/1.73 m² not on renal replacement therapy), is stable across zones over the past ten years, the number of cases of kidney failure is increasing substantially among adults under age seventy-five. As above, the increased number of new cases of kidney failure likely relates to in-migration (and the resultant larger population size) and the changing demographic of the three age groups, due to aging baby boomers.

Number of Cases of Kidney Failure requiring dialysis across Alberta, 2009-2013:

Tables 8 and Table 19 outline the number of prevalent cases of kidney failure requiring dialysis (and prevalence rate), stratified by age or AHS zone. The populations with the largest growth in cases of kidney failure on dialysis are patients under age seventy-five, and the Edmonton and Calgary zones. While the prevalence rate for kidney failure requiring dialysis has been relatively stable between 2011 and 2013, the total number of cases of kidney failure requiring dialysis has increased by 4.5% per year since 2008. Across Alberta, the number of cases has been fairly stable in patients over age seventy-five, but increasing significantly by 5.4% and 6.6% per year for adults under age sixty and age sixty to seventy-four, respectively. Since the prevalence of kidney failure is increasing more quickly than its incidence, this suggests that life expectancy on dialysis may have increased or that exit from dialysis to transplantation has gone down.

Table 8. Number of prevalent cases of kidney failure requiring dialysis at year end (and prevalence rate), by AHS zone, modality and year (all adults).

Year	Calgary			Central			Edmonton			North			South			Alberta*		
	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP
Dec 31, 2009	547	172	674	218	28	718	462	88	605	115	39	477	136	20	720	1481	351	641
Dec 31, 2010	558	173	673	227	33	754	494	86	628	128	42	517	133	16	680	1546	354	655
Dec 31, 2011	590	192	706	230	34	759	523	89	652	134	45	534	135	26	729	1621	392	682
Dec 31, 2012	637	187	721	241	30	765	568	96	687	139	43	526	132	26	707	1726	388	697
Dec 31, 2013	660	190	713	251	30	774	574	100	670	154	38	535	147	23	747	1801	384	694

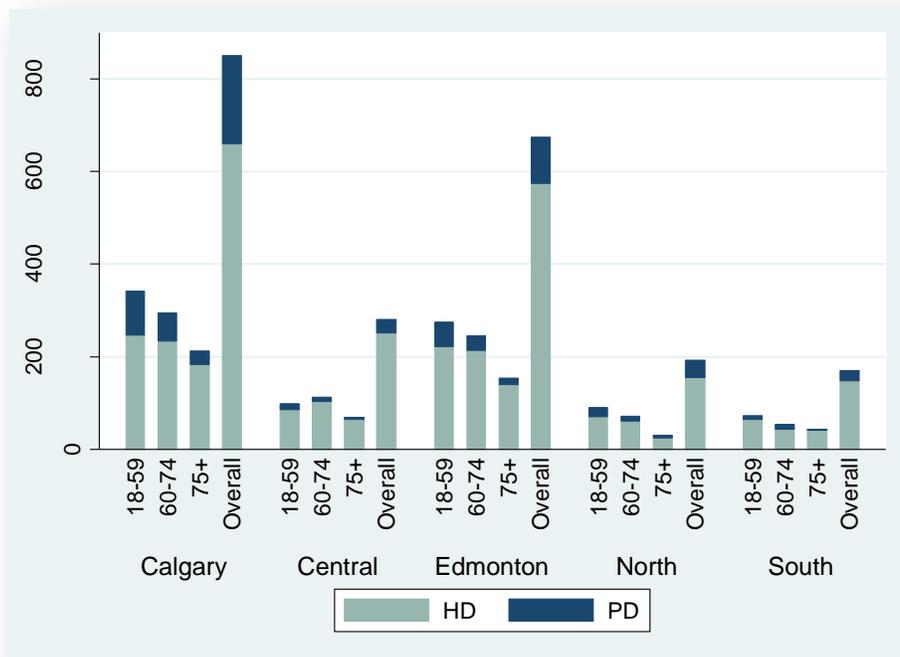
*Totals do not add across zones because a small number of people (<1%) could not be assigned to a zone, but are included in the Alberta total.

HD = hemodialysis, PD = peritoneal dialysis, RPMP= rate per million population

Use of Hemodialysis and Peritoneal Dialysis across AHS Zones, 2009-2013

Figure 4 shows the number of prevalent cases of kidney failure requiring hemodialysis or peritoneal dialysis by AHS zone on December 31, 2013, stratified by age. Of note, there is substantial variation in the proportion of patients receiving peritoneal dialysis across the five AHS zones, and across all age groups, with substantially higher use of peritoneal dialysis in the Calgary zone. The proportion of patients receiving peritoneal dialysis varies by zone from 11% in the Central zone to 22% in the Calgary zone overall, and from 11% in the Central zone to 25% in the Calgary zone for patients aged under seventy-five.

Figure 4. Number of prevalent cases of kidney failure requiring hemodialysis or peritoneal dialysis by age and AHS zone, as of December 31, 2013.



The proportion of patients using peritoneal dialysis at ninety days after starting dialysis is a better marker of a program's approach to use of peritoneal dialysis since it is less impacted by patients exiting the therapy due to death, conversion to hemodialysis or transplantation. The proportion of patients receiving peritoneal dialysis after ninety days is highest in the Calgary zone and the North zone (Figures 5, 6). Figures 5 and 6 also suggest that the use of peritoneal dialysis is decreasing across all AHS zones and ages comparing 2009/10 and 2012/13.

Figure 5. Proportion of patients receiving peritoneal dialysis at ninety days after dialysis initiation, by AHS zone and age, January 1, 2009 to December 31, 2010.

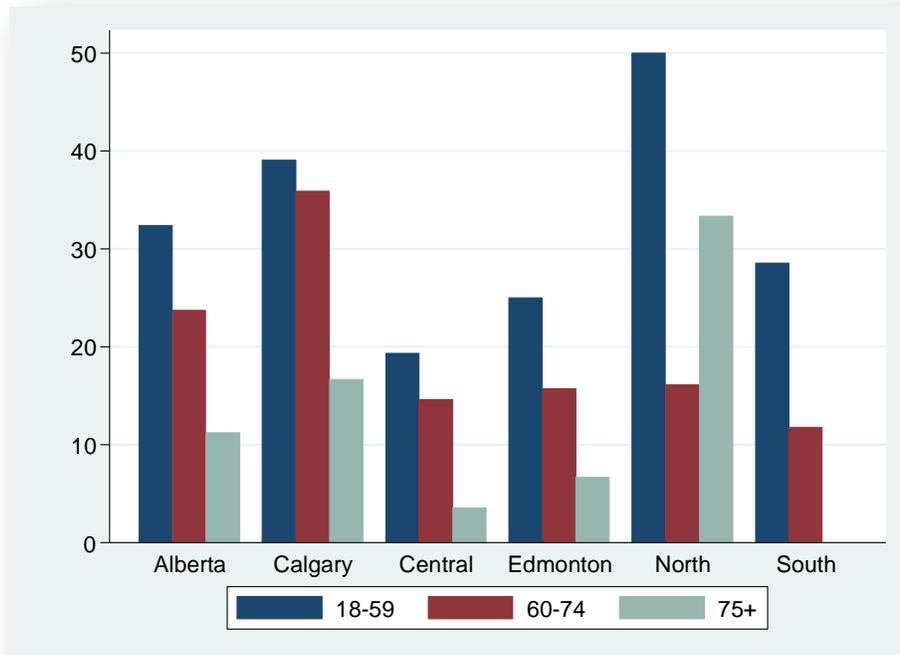
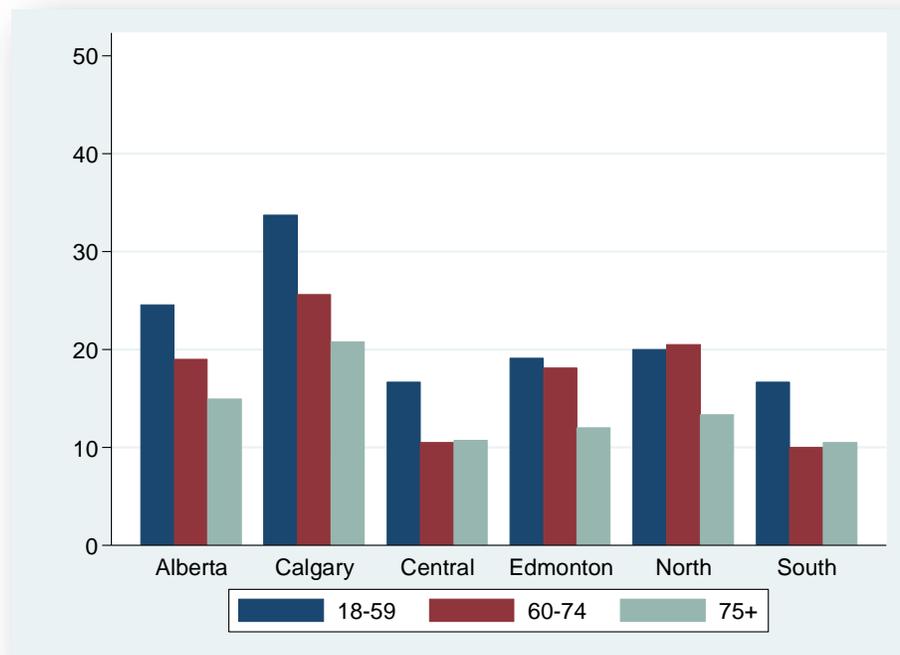


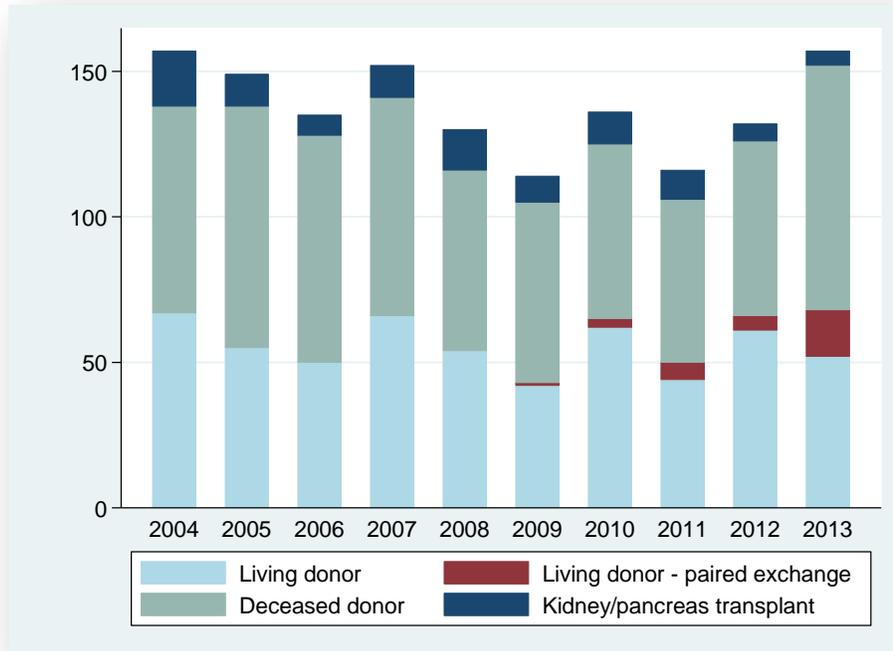
Figure 6. Proportion of patients receiving peritoneal dialysis at ninety days after dialysis initiation, by AHS zone and age, January 1, 2012 to December 31, 2013.



Kidney transplantation in Alberta, 2004-2013

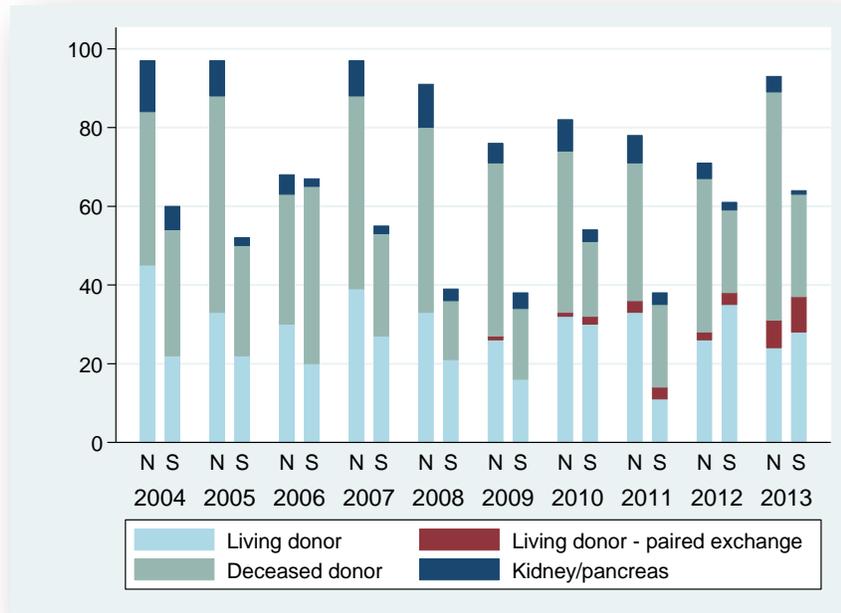
The overall number of kidney transplants (in children and adults) has been relatively stable over the past ten years, including the number of living donor transplants (Figure 7), despite the increase in the number of people with ESRD over this time period. Of note, since 2011, living donor paired exchange transplants represent about ~10% of transplants occurring each year.

Figure 7. Number of transplants performed across Alberta by donor type, 2004 to 2013, (all ages).*



Approximately 30-40% fewer transplants are performed annually in Southern Alberta compared with Northern Alberta, largely due to fewer deceased donor transplants (Figure 8). This difference persists even after taking into account the size of the program by assessing the number of transplants per one thousand dialysis patients aged under seventy-five (Figure 9). Figure 9 also highlights variation in the likelihood of transplantation across AHS zones, after accounting for the number of dialysis patients who might be candidates for transplantation.

Figure 8. Number of transplants performed in the Northern and Southern Alberta Renal programs, by donor type, 2004 to 2013 (all ages).

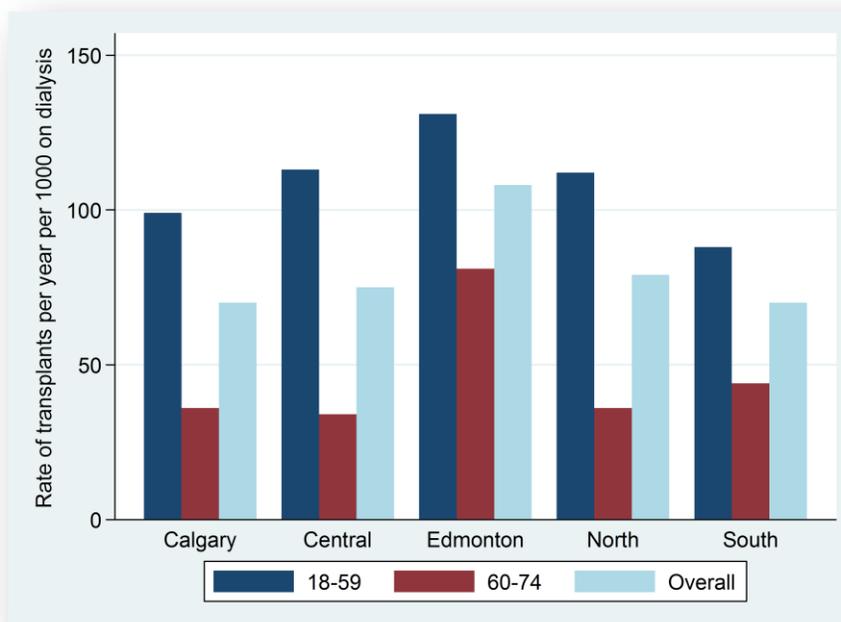


N=Northern Alberta Renal Program

S=Southern Alberta Renal Program

* based on aggregate data reported by SARP and NARP (excludes out-of-province residents)

Figure 9. Rate of transplants per year per one thousand patients on dialysis, by AHS zone of residence and age group, 2009 to 2013 (aged eighteen to seventy-four years).



KEY FINDINGS

In this report, there are several key findings. The crude incidence and prevalence of known severe CKD is increasing in Alberta, across all age groups, and Alberta zones. The incidence and prevalence rates of known severe CKD is stable suggesting that the increased number of adults with CKD is related to Alberta's increasing population, and possibly the aging baby boomer population. The overall incidence and prevalence (absolute numbers) of kidney failure requiring dialysis has also increased by 2.8% and 4.5% per year, respectively over the past four years, though the incidence and prevalence rates have remained stable.

Although we have not assessed mortality rates over time, the increase in prevalence in kidney failure requiring dialysis is presumably due to the increasing number of new cases which is not offset by those dying or leaving dialysis on the basis of receiving a transplant. Regardless of the explanation, the increase in the total number of incident and prevalent adults with kidney failure will continue to place additional demands on kidney services. These data and associated projections are essential for program planning.

With respect to program planning, this report points to upcoming capacity issues in several AHS zones, including Calgary and Edmonton. As examples of the current pressure, in the Calgary zone, there are only an additional twenty-four hemodialysis spots available across the entire zone. Looking at the rate of increase in the number of people receiving hemodialysis year upon year, it would be expected that Calgary hemodialysis facilities will be over-capacity by October 2015. In Edmonton, given the rate of increase in the number of adults receiving hemodialysis, full capacity will also be reached in the fall of 2015. Even with expansion to a seven day hemodialysis rotation (which is not currently funded), this would only delay reaching capacity until the fall of 2016. Moreover, there would be no capacity left in the system to deal with a crisis resulting in the temporary closure of a dialysis unit.

While it may be possible to increase the number of people who start dialysis with peritoneal dialysis or transplantation, easing pressure from in-center hemodialysis units in the future, in general it is very difficult to get patients who have been on hemodialysis for a substantial period of time to switch to peritoneal dialysis, and increasing transplantation cannot likely be achieved in a short time period.

As is noted in nearly all of the figures assessing the frequency of kidney disease by zone, the incidence and prevalence rates of kidney disease appear highest in the South zone – though the rate of end-stage renal disease requiring dialysis is similar in the South zone compared with other zones. As noted in Figures 10 and 11, this may be related to a number of factors including an older population in the South zone, a higher risk of diabetes in the South zone (6.2%) compared to the provincial average (5.7%)¹, and the fact that the former Chinook health region in the South Zone is the only health region which does not currently calibrate their serum creatinine measurements using isotope dilution mass spectrometry (resulting in a slightly higher serum creatinine measurement and lower eGFR), and a higher prevalence of diabetes in the South Zone. These differences held after age stratification and considering the frequency of First Nations population, and therefore it seems unlikely that the apparent higher rate relates only to differences in serum creatinine measurement. Of note, the Chinook region is planning to implement isotope dilution mass spectrometry calibration of serum creatinine measurements in the near future which should make eGFR measurements comparable across all AHS zones. It is important to note that this is an important issue since clinicians in the Chinook area are responding to the creatinine and eGFR measurement delivered to their office.

Given that patients with kidney failure (eGFR<15mls/min/m²) are at high risk of adverse outcomes, understanding their characteristics and current management is critical. Consideration should be given to a provincial registry for such patients.

Of note, there are nearly four thousand five hundred patients across Alberta with kidney failure, defined by having an eGFR<15mls/min/m² not on renal replacement therapy. This number far exceeds the number of patients managed in multidisciplinary CKD clinics in Alberta. Moreover, about 30% of adults with kidney failure (eGFR<15mls/min/m² not on renal replacement therapy) overall have not been seen by a Nephrologist within a two year period, which is particularly concerning given that they are likely to either require renal replacement therapy, or conservative support to manage uremic symptoms within a short timeframe. A current initiative, supported by the Kidney-SCN, is currently underway to increase appropriate referral through use of a comprehensive CKD clinical pathway in primary care.

Use of home dialysis

The use of home dialysis varies substantially across age groups, as expected, and across Alberta zones, which is not expected. It is possible that a small amount of the variation in use of peritoneal dialysis relates to the variable use of transplantation across zones. Zones with higher use of transplantation might be expected to have slightly lower use of peritoneal dialysis (since patients who are candidates for transplantation are usually good candidates for peritoneal dialysis), though this should have less impact on use of peritoneal dialysis at ninety days. Regardless, the use of peritoneal dialysis appears to be decreasing over time across all programs (Figures 5 and 6). While the proportion of patients initiating dialysis who have diabetes has also increased slightly, age is similar across the two time periods, and it is not possible to explain these differences without further investigation. Given that patients on peritoneal dialysis experience similar survival to in-center hemodialysis, and PD is associated with better quality of life, and lower costs (~\$25,000/yr less expensive than in-center hemodialysis), understanding and addressing barriers to use of peritoneal dialysis is important.

As noted, peritoneal dialysis costs approximately \$25,000 per patient less per year than hemodialysis and is similarly effective. The average person starting peritoneal dialysis therapy will stay on peritoneal dialysis for two years before dying, switching to hemodialysis, or getting a transplant. If an intervention were to increase peritoneal dialysis use by 5% across Alberta for the six hundred adults starting dialysis each year, and considering only a three year time horizon, we could estimate that \$4.5 million dollars could be reallocated within SARP and NARP. The Dialysis Measurement, Analysis, and Reporting (DMAR) System is such an intervention that has been used in eleven centers across Canada. DMAR facilitates the collection of high-quality data about local practice using methods derived from clinical trials, but adapted to be feasible for implementation in routine care. Data collection is structured around well-developed conceptual frameworks for understanding clinical problems and guided by the Translating Evidence into Practice Model developed by the Johns Hopkins Quality and Safety Research Group for large-scale collaborative projects. DMAR data collection is combined with a multidisciplinary meeting to review all new dialysis starts to assess barriers to peritoneal dialysis use, educational interventions that are currently being rolled out across Alberta, and audit and feedback. DMAR data collection is currently ongoing in Calgary, and planned for expansion within the Southern zone over the coming year. The Kidney-SCN is seeking funding for this initiative through the Strategic Clinical Networks to enable expansion across Alberta but this funding has not yet been allocated.

Use of kidney transplantation

The number of people receiving kidney transplants over the past ten years has been stable, despite a 40% increase in the number of people with ESRD and the fact that 10% of transplants are done within the paired exchange program, which was not operational ten years ago. Fewer transplants are performed in

the Southern half of Alberta, largely due to fewer deceased donor transplants (Figure 9). This difference persists after taking into account the size of the program.

Differences in the the rate of transplantation are also noted across the zones, with the highest rate observed in the Edmonton zone. The reasons for these observed differences are not clear from this data. Since transplantation is the most effective treatment for people with kidney failure, and since it costs less compared with ongoing dialysis, further work is urgently needed to understand barriers to transplantation that might explain these differences across zones, and to determine strategies to increase the number of transplants being performed in Alberta.

CONCLUSION:

The report provides a real-time picture of the burden of kidney failure in Alberta. It has identified ongoing growth in the numbers of adults with severe kidney disease, and with kidney failure. It has identified areas, including the South zone, where kidney disease and kidney failure appear more common. These numbers can be used by AHS zones and Alberta renal programs to support future decision-making. There is significant variation in timing of dialysis initiation, use of peritoneal dialysis, and kidney transplantation across AHS zones, and the number of kidney transplants performed over the past ten years is stable despite a substantial increase in the number of patients on dialysis. Given these findings, initiatives aimed at optimizing timing of dialysis initiation, increasing appropriate use of home dialysis, and increasing the number of transplants performed are urgently required.

ACKNOWLEDGEMENTS:

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This study is based in part on data provided by Alberta Health and Alberta Health Services. The interpretation and conclusions contained herein are those of the researchers and do not necessarily represent the views of the Government of Alberta or Alberta Health Services. Neither the Government of Alberta nor, Alberta Health or Alberta Health Services express any opinion in relation to this study.

Further information about this report is available from Braden Manns, Interim Scientific Director, Kidney – Strategic Clinical Network and Svare Professor in Health Economics, University of Calgary, Braden.Manns@albertahealthservices.ca. 1403 – 29th St N.W., Calgary, AB, T2N 2T9.

Supplementary Tables and Figures

Table 9. Number of incident cases of severe CKD (and incidence rate), defined as eGFR < 30 mL/min/1.73m², by age and two year period, excluding those on dialysis or with a transplant, across Alberta.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	1465	676	12.5	3034	9089	25.8	7241	43539	61.7	11740	4399	100
2008-2009	1630	714	13.3	3170	8694	25.8	7481	42874	60.9	12281	4353	100
2010-2011	1561	665	12.4	3347	8418	26.6	7666	41961	61.0	12574	4297	100
2012-2013	1745	710	12.7	3666	8326	26.7	8295	43086	60.5	13706	4435	100

RPMP = rate per million population (per 2-year period)

Table 10. Number of incident cases of severe CKD (and incidence rate), defined as eGFR < 60 mL/min/1.73m² with proteinuria, by age and period, excluding those on dialysis or with a transplant, across Alberta.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	1070	493	32.2	1147	3436	34.5	1106	6650	33.3	3323	1245	100
2008-2009	1158	507	31.9	1277	3502	35.2	1191	6826	32.8	3626	1285	100
2010-2011	1161	495	32.6	1227	3086	34.4	1178	6448	33.0	3566	1219	100
2012-2013	1348	549	32.1	1498	3402	35.7	1353	7028	32.2	4199	1359	100

RPMP = rate per million population (per 2-year period)

Table 11. Number of incident cases of severe CKD (and incidence rate), defined as eGFR < 60 mL/min/1.73m² with proteinuria, by AHS zone and two year period (excluding those on dialysis or with a transplant, but including all adults).

2 year period	Calgary			Central			Edmonton			North			South *			Alberta		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	953	964	28.7	554	1693	16.7	1069	1265	32.2	532	1761	16.0	215	1043	6.5	3323	1245	100
2008-2009	1098	1045	30.3	576	1691	15.9	1189	1328	32.8	502	1573	13.8	261	1215	7.2	3626	1285	100
2010-2011	1087	992	30.5	689	1990	19.3	1044	1121	29.3	524	1577	14.7	222	1009	6.2	3566	1219	100
2012-2013	1514	1297	36.1	598	1668	14.2	1332	1350	31.7	519	1473	12.4	236	1046	5.6	4199	1359	100

RPMP = rate per million population (per 2-year period)

Table 12. Number of incident cases of kidney failure (eGFR < 15 mL/min/1.73m²) not requiring renal replacement therapy (and incidence rate), by age and two year period, across Alberta.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	525	242	18.7	797	2388	28.5	1479	8893	52.8	2801	1050	100
2008-2009	614	269	20.1	842	2309	27.5	1603	9187	52.4	3059	1084	100
2010-2011	592	252	19.5	887	2231	29.2	1556	8517	51.3	3035	1037	100
2012-2013	658	268	20.4	919	2087	28.4	1656	8602	51.2	3233	1046	100

RPMP = rate per million population (per 2-year period)

Table 13. Number of incident cases of kidney failure requiring renal replacement therapy (dialysis and pre-emptive transplantation combined) (and incidence rate) by AHS zone and age group (January 1, 2010 to December 31, 2013 only).*

Zone of residence	18-59		60-74		75+		All adults	
	Dial & PT (N)	RPMP						
Calgary	413	224	291	978	183	1462	887	392
Central	128	239	117	1033	71	1270	316	448
Edmonton	316	207	289	1070	147	1187	752	392
North	111	196	82	961	33	1010	226	330
South	79	235	69	962	44	1168	192	431

PT = preemptive transplantation

*Includes resumption of dialysis after a failed transplant

RPMP = rate per million per two year period

Table 14. Number of prevalent cases of severe CKD (and prevalence rate), defined as eGFR < 30 mL/min/1.73m², by age and two year period, excluding those on dialysis or with a transplant, across Alberta, including the proportion of patients seen by a Nephrologist.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*
2004-2005	2158	1059	70.3	4766	15390	54.2	11836	76407	26.3	18760	7494	38.4
2006-2007	2277	1050	72.2	4908	14704	57.5	12177	73219	30.3	19362	7254	42.1
2008-2009	2497	1094	72.3	5199	14258	58.6	12835	73558	31.7	20531	7276	43.4
2010-2011	2554	1089	74.1	5484	13793	59.5	13436	73544	34.0	21474	7338	45.2
2012-2013	2766	1126	--	6006	13640	--	14442	75015	--	23214	7512	--

*% with a nephrologist visit in the year prior to or after the qualifying eGFR; could not be assessed for 2012-2013. RPMP = rate per million population per two year period

Table 15. Number of prevalent cases of severe CKD (and prevalence rate), defined as eGFR < 60 mL/min/1.73m² with proteinuria, by age and time period, excluding those on dialysis or with a transplant, across Alberta.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	2665	1229	22.3	3841	11507	32.2	5429	32644	45.5	11935	4472	100
2008-2009	2977	1304	22.1	4292	11771	31.9	6192	35487	46.0	13461	4771	100
2010-2011	3173	1353	21.9	4673	11753	32.3	6640	36345	45.8	14486	4950	100
2012-2013	3459	1408	21.9	5241	11903	33.1	7112	36941	45.0	15812	5117	100

RPMP = rate per million per two year period

Table 16. Number of prevalent cases of severe CKD (and prevalence rate), defined as eGFR < 60 mL/min/1.73m² with proteinuria, by AHS zone and time period, excluding those on dialysis or with a transplant (all adults).

2 year period	Calgary			Central			Edmonton			North			South			Alberta		
	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%	N	RPMP	%
2006-2007	3715	3759	31.1	1634	4994	13.7	4265	5046	35.7	1338	4429	11.2	983	4771	8.2	11935	4472	100
2008-2009	4150	3948	30.8	2033	5969	15.1	4542	5071	33.7	1685	5279	12.5	1051	4891	7.8	13461	4771	100
2010-2011	4532	4134	31.3	2380	6873	16.4	4690	5035	32.4	1826	5496	12.6	1058	4809	7.3	14486	4950	100
2012-2013	5317	4555	33.6	2318	6466	14.7	5221	5292	33.0	1908	5416	12.1	1048	4645	6.6	15812	5117	100

RPMP = rate per million per two year period

Table 17. Number of prevalent cases of kidney failure (and prevalence rate), defined as eGFR < 15 mL/min/1.73m², by age and two year period, excluding those on dialysis or with a transplant, across Alberta, including the proportion of patients seen by a Nephrologist.

2 year period	18-59			60-74			75+			All adults		
	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*
2004-2005	715	351	82.9	1027	3316	77.7	2144	13840	48.8	3886	1552	62.7
2006-2007	688	317	85.9	1069	3203	80.8	1984	11930	55.6	3741	1402	68.4
2008-2009	780	342	87.6	1128	3094	79.5	2102	12047	56.9	4010	1421	69.2
2010-2011	795	339	89.7	1191	2996	81.1	2147	11752	61.3	4133	1412	72.5
2012-2013	875	356	--	1304	2962	--	2286	11874	--	4465	1445	--

*% with a nephrologist visit in the year prior to or after the qualifying eGFR (could not be assessed for 2012-2013). RPMP = rate per million population per two year period

Table 18. Number of prevalent cases of kidney failure (and prevalence rate), defined as eGFR < 15 mL/min/1.73m², by AHS zone and two year period, excluding those on dialysis or with a transplant, including the proportion of patients seen by a Nephrologist (all adults).

2 year period	Calgary			Central			Edmonton			North			South			Alberta		
	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*	N	RPMP	NV*
2004-2005	1124	1223	66.5	597	1927	62.3	1273	1605	63.7	474	1667	45.8	418	2124	69.1	3886	1552	62.7
2006-2007	1165	1179	70.7	479	1464	74.3	1238	1465	67.5	436	1443	54.6	423	2053	72.1	3741	1401	68.4
2008-2009	1274	1212	67.5	511	1500	76.7	1371	1531	69.9	439	1375	61.0	415	1931	71.6	4010	1421	69.2
2010-2011	1286	1173	74.1	553	1597	76.5	1389	1491	72.4	447	1345	65.8	458	2082	70.1	4133	1412	72.5
2012-2013	1401	1200	--	599	1671	--	1471	1491	--	489	1388	--	505	2238	--	4465	1444	--

*% with a nephrologist visit in the year prior to or after the qualifying eGFR (could not be assessed for 2012-2013). RPMP = rate per million population per two year period

Table 19. Number of prevalent cases of kidney failure requiring dialysis at year end (and prevalence rate), by age, modality and year, across Alberta.

Year	18-59			60-74			75+			All adults		
	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP	HD	PD	Total RPMP
Dec 31, 2009	548	176	314	485	123	1633	448	52	2835	1481	351	641
Dec 31, 2010	586	171	324	531	127	1693	429	56	2688	1546	354	655
Dec 31, 2011	637	191	351	559	138	1715	425	63	2638	1621	392	682
Dec 31, 2012	682	195	363	604	127	1710	440	66	2666	1726	388	697
Dec 31, 2013	697	194	357	656	128	1730	448	62	2612	1801	384	694

HD=hemodialysis, PD=peritoneal dialysis, RPMP = rate per million population per two year period

Figure 10. Prevalence rate (per thousand) of severe CKD, defined by eGFR < 30 ml/min/1.73m², by period, AHS zone and age, excluding patients on dialysis or with a transplant.

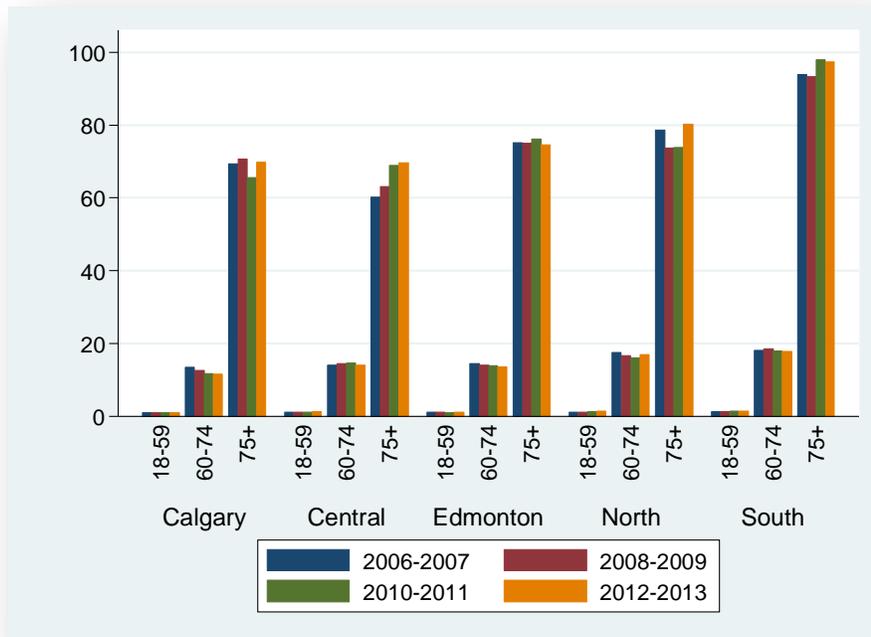


Figure 11. Prevalence rate (per million) of kidney failure (eGFR < 15 ml/min/1.73m²) not on renal replacement therapy, by two year period, AHS zone and age.

