Secular trends in ESKD incidence and prevalence in Canada over 27 Years: An Emerging Epidemic in the North

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Abstract

Introduction: End Stage Kidney Disease (ESKD) requiring dialysis is costly, and associated with disproportionately poor health outcomes and quality of life. It is therefore important to understand long-term secular trends in dialysis incidence and prevalence. As Canada is a large geographically diverse country, understanding regional dialysis trends will allow for the alignment of appropriate and efficient care delivery. The primary objective of this study was to describe long term secular and geographic trends in ESKD over 27 years in a single provider Canadian healthcare setting.

Methods: We used the Manitoba Renal Program ESKD registry to validate several administrative case definitions of ESKD in the universal provider Manitoba Health repository over a 7-year time horizon. Using the best performing case definition, we described the annual incidence and prevalence of ESKD in Manitoba from 1984-2010 stratified by age, sex and geographic location within the province.

Results: Over 1.2 million records within the repository were searched. We identified 9489 individuals in the Manitoba Health Physician Claims database with at least one claim for dialysis from April 1, 1984 through March 31, 2011. The most specific and least sensitive case definition was any two dialysis treatment claims >90 days apart with no gaps in treatments greater than 21 days (99.96% specific , 46 % sensitive). Over this time period, the total annual incidence of ESKD increased 2.5-fold from 15.8 to 40.2/100,000. Of note, the northern rural portions of the province saw a 12 fold unadjusted increase in ESKD from 8.12 in 1984 to 96.34/100,000 in 2009.

Conclusions: The incidence and prevalence of ESKD is increasing, most dramatically in the remote rural North. Innovative interventions such as primary screening and treatment initiatives should specially target Northern rural regions. Our case definitions of ESKD should be applied to other jurisdictions with long term administrative data to examine secular trends in this resource intense disease with devastating public health consequences.

Introduction

End Stage Kidney Disease (ESKD) requiring life sustaining kidney replacement therapy is a global public health problem(1) affecting over 2 million people worldwide and over 38,000 Canadians(2)(3). Manitoba has the highest incidence and prevalence of ESKD in Canada, in part due to its high burden of diabetes.(2). ESKD is associated with unacceptably high rates of morbidity and mortality (4), diminished quality of life (5) and disproportionately high costs to the health care system (6).

Worldwide secular trends of ESKD incidence and prevalence rates are challenging to illustrate due to variable population dynamics, the heterogeneous availability of dialysis services in certain countries, and differences in the generalizability of dialysis registries. (3)(7). Countries with well-developed registries and broad availability of dialysis services such as the United States and Canada have reported a relative slowing of the incidence of ESKD over the last decade(8)(2). There remains, however major variability across regions within these countries with regards to incidence, prevalence, modality choice and rates of treated ESKD. Canada, being geographically broad with a large rural Northern region, has unique challenges for health care delivery and disease surveillance. Unfortunately little data exists regarding secular trends in ESKD rate by geographic region.

Many comprehensive dialysis provider databases and registries within Canada are limited in their retrospective time horizon. Review of longitudinal administrative data remains an attractive option for analysis of secular trends in dialysis growth. If accurate, these data will aid in the creation of surveillance and prevention programs that may be applied to more efficiently address the burden of ESKD. The primary objective of this study was to examine the incidence, prevalence and geographic trends of ESKD over 27 years using novel and validated administrative case definitions. These long term trends may provide novel insights into the way contemporary CKD surveillance prevention efforts should be targeted.

Methods

Study Population

The setting of this study was Manitoba, Canada with a population of 1.2 million. Manitoba is a central Canadian province with a universal payor health care system (Manitoba Health) which processes and maintains all claims for health care utilization in the province in a secured, centralized repository(9).

Since 1984, all Manitoba residents have a unique personal health identification number which is attached to all health services claims submitted to Manitoba Health, who maintains computerized records of these claims.

Study Data Sources

Physician Claims Database

Each physician claim includes the patient's identification number, date of service, and three digit International Classification of Disease (ICD)-9-CM code for the physician-assigned diagnosis. Each hospitalization record includes the patient's identification number, dates of admission and discharge, and up to 25 diagnostic codes listed on the discharge abstract using ICD-10-CA codes after 2004. Prior to 2004, up to 16 diagnoses were recorded using five-digit ICD-9-CM codes. Manitoba Health also maintains a population registry, which is updated when an individual moves into or out of Manitoba, changes marital or family status, or dies.

To identify residents receiving dialysis in the Manitoba Health database, we searched all physician claims from April 1, 1984 through March 31, 2011 for procedures performed by physicians by Tariff codes for initial dialysis (9798, 9801, 9805, 9806), subsequent dialysis (9799, 9802, 9807, 9819) and home dialysis (9821).

Manitoba Renal Program Dialysis Registry

The Manitoba Renal Program (MRP) is the sole provider of dialysis and kidney health prevention services in the Province consisting of over 800 employees including 23 actively practicing nephrologists. The MRP has maintained a comprehensive database of all patients receiving chronic dialysis (>90 days on dialysis) including start and end dates in addition to detailed demographic and comorbidity data since January 2004. The quality of these data is adjudicated at formal interprofessional rounds on a weekly basis. The validation of this database has been described elsewhere and has been used extensively in published epidemiologic studies. {{2465 Sood, M.M. 2010;(10) }}

Administrative case definition for Dialysis

Definitions of disease states and diagnoses using administrative data sources must be validated using traditional sources of clinical data to verify accuracy and validity (patient charts, registries, electronic medical records, or self-report disease status diagnosed by doctors)(11).

We developed several administrative case definitions, varying the number of physician claims required to classify a person on dialysis. We based these candidate case definitions on previous validation studies using administrative data to define ESKD (12) including: at least one outpatient claim, at least two outpatient claims, at least two outpatient claims and at least ninety days apart and continuous outpatient claims at least ninety days apart with no gap in claims greater than twenty-one days. We compared the classifications of study cases according to the administrative case definitions and to records of MRP Dialysis Registry by computing sensitivity, specificity, and positive and negative predictive value.

Incidence and Prevalence

To estimate the incidence of chronic dialysis, we examined longitudinal records of medical claims for all individuals who met the administrative case definition for chronic dialysis. We considered the date of the first physician claim for a dialysis code to be the date of dialysis onset (incident case date). We calculate the incidence rates since 1989 to ensure identifying new dialysis cases by using a 5-year washout period (1984-1988). People on dialysis and alive in each year were counted as prevalent dialysis cases. Using the year of dialysis of incident and prevalent cases, we calculated the annual crude incidence/prevalence rates using the mid-year population figures from the Manitoba Health population registry for denominators in the crude rate calculations and 2001 Canadian population for the direct age- and sex-adjusted rates (13). Ninety-five percent confidence intervals were calculated assuming a Poisson distribution. Temporal trends were examined in the age-adjusted incidence and prevalence using a linear regression model. Using patient postal codes we reported home region of origin dividing the province into 4 regions by approximate distance from Winnipeg (the major tertiary care center): north rural (>300 km), mid rural (50-300 km North), south rural (50-300 km South) and urban (Winnipeg). We chose these geographic regions as surrogates for differential access to reliable, accessible primary and specialty care services mirrored by parameters such as population density and well-developed road access to communities. All programming and statistics were done using SAS (v9).

Standard Protocol Approval, Registration, and Patient Consents

This study received appropriate health research ethics board approvals from the University of Manitoba and the Winnipeg Regional Health Authority. Health Information Privacy Committee approval was obtained from Manitoba Health and data sharing agreements were signed between these institutions. Individual consents for patients to have their data included in the Manitoba Renal Program database were obtained.

Results

Using the administrative tariff codes for dialysis conducted by physicians, we identified 9489 individuals in the Manitoba Health Physician Claims database with at least one record for dialysis from April 1, 1984 through March 31, 2011.

We chose the study period of January 1st 2004 to December 31st 2010 based on the available, high quality data within the MRP for validation purposes. Within the MRP database we identified 2562 individuals on dialysis from January 1 2004 to December 31, 2010 and 10,236 as CKD non-dialysis patients. The age and sex distribution of the MRP chronic dialysis sample is shown in Table 1. The patients on dialysis were more likely to be men (54.06% versus 45.94 %, p<0.0001) and the mean age was 59.69 (SD = 15.93).

ESKD Case Definition Validation

We tested our administrative case definitions of chronic dialysis in our MRP cohort, all of whom had at least one physician claim for dialysis (Table 1). Based on these findings and to balance competing needs for sensitivity and specificity of the definition, our results are presented in Table 2 for the four case definitions we explored. Using MRP data of those on dialysis more than 90 days as the gold standard for a diagnosis of ESKD, the most sensitive case definition was any one dialysis treatment claim (65% sensitive, 94% specific). The most specific and least sensitive case definition was any two dialysis treatment claims >90 days apart with no gaps in treatments greater than 21 days (46 % sensitive, 99.96% specific).

As we increased the time interval during which dialysis claims were searched for by one year increments, the sensitivity of all case definitions improved considerably. Increasing the required days of chronic dialysis (i.e. >= 90 days) increased the specificity of the case definition, while decreasing the days on dialysis increased sensitivity. Accuracy and agreement (kappa) scores were highest for the case definition of any two outpatient dialysis claims (0.84, 0.63 respectively in calendar year 2004). These scores improved to 0.93 and 0.82 if we widened the time interval to include years 2004-2009. We therefore applied this case definition moving forward in our analysis of longitudinal secular trends of dialysis utilization over the entire repository of available administrative data in Manitoba from 1984 – 2011.

Incidence and prevalence

We applied our validated case definition of ESKD to the comprehensive administrative data set from 1984 to 2011. Figure 1 shows the age adjusted incidence and prevalence of ESKD in Manitoba (stratified by sex) over this 27 year time horizon demonstrating a slow increase in incidence over time, accompanied by a much more rapid rise in disease prevalence. In 1984, the provincial age adjusted incidence of ESKD was 16.88/100,000 rising to 37.78/100,000 in 2010. During the same time period, age adjusted prevalence went from 32.46/100,000 to 270.31/100,000; an 8-fold rise over the 27 year period. The age adjusted incidence and prevalence rates are higher in males over females, with prevalence rates of 3 % in males and 2.5 % in females by the end of 2010.

Prevalence by Age

Figure 2 shows prevalence rates stratified by age category. These findings demonstrate that the prevalence of ESKD has increased broadly, across every age category in the last 27 years. However, the overall increased prevalence rates of ESKD over time is now being largely driven by those in the three 55-85 age categories, with the largest relative increase in the 85+ category since the year 2000. Prevalence rates of ESKD appear again to be increasing with age with rates of 8 % in the 75-84 age deciles in comparison with rates of < 1 % in the same age group 27 years ago. Finally, the peak prevalence of ESKD by age has also shifted over the last two decades, with the peak now being 75-84, as compared with 65-74 in the 1980s.

Incidence and Prevalence by Region

Figures 3a and 3b show age-standardized incidence rates of ESKD in Manitoba stratified by geographic region. In the urban and southern/mid rural regions of Manitoba, incidence rates increased only 2-fold from 10-20/100,000 in the early 1980's to 30-40/100,000 in 2008-2010. In contrast ESKD incidence increased 12 fold from 10/100,000 in 1984 to 120/100,000 in 2010 in the rural remote north of Manitoba. Similar findings are seen with disease prevalence rates, with threefold higher disease prevalence in the rural remote north compared to other regions, and an approximately 50 fold higher prevalence in the 2010 northern population, when compared to the population from 1984.

Discussion

Employing a validated ESKD case definition over 27 years of data, we found an alarming, disproportionate increase in the rate of ESKD in the remote, rural North. The provincial age adjusted prevalence of ESKD has increased 8-fold over 3 decades of study. These findings suggest that despite a reported plateau in incidence and prevalence rates of ESKD in Canada, the population of patients with ESKD in Manitoba continues to rapidly increase. This increase is largely driven by elderly patients and those residing in rural remote Northern communities. These findings have significant public health implications for policy makers and health care providers. Urgent attention is needed to apply innovative public health interventions in surveillance and early, risk based prevention strategies in attenuating this trend.

The 12-fold increase in the age-adjusted rural, northern rate of ESRD is remarkable, especially in contrast with trends in southern regions of Manitoba and the rest of Canada, where growth appears to be leveling off. Several factors may contribute to this epidemic of ESKD. Canada's north faces unique challenges related to low population density, with many isolated communities having limited access to health care resources (14). Patients within the Northern, remote and rural regions of Manitoba are more likely to be Aboriginal and to have sociodemographic characteristics associated with poor health outcomes, including poverty, unemployment, and lower levels of formal education than their urban counterparts(14, 19, 20). Aboriginal people in Canada have a 2-3 fold increased prevalence of ESKD (15), are more likely to initiate renal-replacement therapy on hemodialysis, and are much less likely to receive a kidney transplant compared to non-Aboriginals (16). Canada's North also suffers a higher burden of other chronic diseases, including cardiovascular and respiratory diseases (e.g. tuberculosis), and certain types of cancer (notably cervical, breast, melanoma, and prostate), as well as shorter life expectancy(21) (18, 20). These phenomena are not unique to Canada; a higher incidence ESKD attributed to diabetes has been described in rural US populations with less access to primary care (17). The combination of demography, geography and climate all potentially contribute to the high rate of CKD and ESKD although there is likely a strong modifying effect of lower socioeconomic status on the increased incidence of preventable ESKD (18).

The Canadian Organ Replacement Registry has reported on the changing demographics of ESKD incidence and prevalence since 2001(2). Manitoba consistently has the highest incidence prevalence of

ESKD and dialysis utilization in Canada within this report. The Manitoba Renal Program, which has maintained detailed program level dialysis, demographic and comorbidity data since 2004 is the sole provider of dialysis services in the province. Manitoba therefore serves as an ideal province in which to validate case definitions of ESKD using administrative data over time. In addition, this province has a vested interest in examining detailed epidemiologic trends in ESKD incidence and prevalence to tailor surveillance and prevention efforts and perform detailed demand forecasting for optimal resource allocation.

The majority of patients on chronic facility based hemodialysis engage the health care system at least thrice weekly. Patients on home dialysis therapies are typically billed for by physicians on a weekly basis. These engagements are tracked with unique procedural codes for dialysis. This provides an ideal platform for administrative case definitions to be validated against program level clinical data. Manitoba has a relatively comprehensive dialysis registry which covers almost all the patients on dialysis. Linking administrative data and dialysis registry provide a unique opportunity of validating an administrative data-based algorithm for identifying ESKD patients through administrative database.

Our study demonstrates that valid, reliable case definitions for ESKD status can be derived from administrative claims data. Within a universal payor system such as Canada, health care claims data have several potential advantages over other databases such as hospital based electronic patient records, outpatient electronic medical records and disease specific registries as they are typically a more universal source of population level data (i.e. not specific to a certain health care setting) and they document every health care system interaction. These claims data may serve as a valuable tool to track the epidemiology of ESKD at a population level. A liberal time interval should be utilized in case finding for ESKD patients with administrative data sets, as accuracy and agreement scores are suboptimal when validated against gold standard program databases when only one calendar year is used. While others have published secular trends in ESKD using administrative data, these definitions were not internally validated against program level data for sensitivity and specificity over a long time horizon and should be interpreted with caution (15) given our experience in this study. Our case definitions were based on a previous Canadian study using Alberta data over a 1-year period finding kappa statistics for their four definitions ranging from 0.693 – 0.793(12). Our agreements were similar, although we discovered significant improvement in performance for case definitions as time horizons were broadened. The most likely explanations for this improvement in performance over a broader time horizon include delays in submitting claims on the provider side in addition to delays or disputes in processing claims on the payor side.

There are several clinical, research and policy implications to our findings. Firstly, our findings suggest that screening for diabetes, hypertension and kidney disease, as well as treatment for the prevention of kidney failure in patients with established CKD should be preferentially targeted at rural and remote Northern Regions. While there are challenges that exist in providing health services in these regions, the payoffs are likely to be larger. Secondly, research is needed to more accurately identify the biological determinants of a poor renal prognosis in patients who reside in these communities. Engagement of the aboriginal community in these research efforts is critical for success. Finally, we believe that kidney disease and its prevention and treatment should be considered a strategic priority in health care funding for aboriginal communities, and that present and future funding initiatives should be critically evaluated for their efficacy in reducing the incidence of kidney failure.

The strengths of this study include a single payor health care system with complete capture of all dialysis events within Manitoba on both the payor and provider side to develop valid administrative case definitions of ESKD. An extended time horizon is a major advantage of our study over other work done in this area to ensure full capture of all dialysis events. The examination of a 27 year time horizon is not possible with most current dialysis registries limiting the power of long term secular trend analyses.

Our study has some limitations. The MRP database is maintained and adjudicated for outcomes on a weekly basis, but there is a possibility of patients being omitted from the registry. We expect that this number is small. Our determination of patient region was by postal code derived from the Manitoba Health repository; however this may not always take into account actual location of patient residence and patient migration for work, other chronic conditions, etc. We did not explore our analysis within the Northern region of Manitoba stratified by specific community, road access, or proximity to a satellite hemodialysis facility due to limitations in collecting location data to this level of granularity using only postal code.

Conclusion

Urgent attention is needed to support well developed primary surveillance and prevention initiatives in rural and remote locations where dialysis growth remains disproportionately high. Despite the availability of well-developed reporting systems in Canada such as the Canadian Organ Replacement Register, there is additional value in examining long-term secular trends in dialysis derived from validated administrative case definitions of ESKD to explain regional variations in incidence and prevalence rates. Our case definitions are readily transferable to other jurisdictions with available longitudinal administrative data.

Further study is needed to examine the cost utility of investing in primary surveillance and prevention initiatives as opposed to the construction of dialysis facilities in locations of low population density.

Table 1. Age and sex distribution of the Manitoba Renal Program Dialysis Registry (2004-2010).

Age (years)	Men N (%)	Women N (%)	Men : Women	Women & Men N (%)
≤24	25 (0.98)	30 (1.17)	0.84	55 (2.15)
25-29	29 (1.13)	30 (1.17)	0.97	59 (2.3)
30-34	38 (1.48)	48 (1.87)	0.79	86 (3.36)
35-39	61 (2.38)	47 (1.83)	1.30	108 (4.22)
40-44	79 (3.08)	75 (2.93)	1.05	154 (6.01)
45-49	107 (4.18)	81 (3.16%)	1.32	188 (7.34)
50-54	140 (5.46)	93 (3.63)	1.50	233 (9.09)
55-59	183 (7.14)	130 (5.07)	1.41	313 (12.22)
60-64	165 (6.44)	152 (5.93)	1.09	317 (12.37)
65-74	558 (21.78)	491 (19.16)	1.14	1049 (40.94)
75-84	209 (8.16)	189 (7.38)	1.11	398 (15.53)
85+	55 (2.15)	51 (1.99)	1.18	106 (4.14)
Total	1385 (54.06) [a]	1177 (45.94) [b]	1.18	2562[c]

[a] Mean (SD) age 59.80 (15.48) y.
[b] Mean (SD) age 59.56 (16.45) y.
[c] Mean (SD) age 59.69 (15.93) y.

Table 2. Average Annual Incidence (AAI) of ESKD in Manitoba per 100,000 Population by Age and Sex, 1989 – 2010.

Age (years)	Women			Men			Women : Men	
	No. Cases 1989-2010	AAI	95% CI	No. Cases 1989-2010	AAI	95% CI	Rate ratio	95% CI
0-24	163	2.89	2.48-3.36	179	3.04	2.62-3.52	0.95	0.77-1.17
25-29	74	6.21	4.94-7.79	94	7.83	6.40-9.58	0.79	0.58-1.08
30-34	112	9.29	7.72-11.18	119	9.83	8.21-11.76	0.95	0.73-1.22
35-39	111	9.26	7.69-11.15	183	15.19	13.14	0.61	0.48-0.77
40-44	166	14.46	12.42-16.83	212	18.36	16.05-17.56	0.79	0.64-0.96
45-49	209	19.82	17.31-22.70	306	28.85	25.80-32.28	0.69	0.58-0.82
50-54	224	24.21	21.24-27.59	330	35.64	31.99-39.70	0.68	0.57-0.80
55-59	322	39.68	35.57-44.26	430	53.94	49.07-59.29	0.74	0.64-0.85
60-64	336	46.54	41.82-51.80	429	62.66	57.00-68.88	0.74	0.64-0.86
65-74	704	57.49	53.40-61.90	939	88.98	83.46-94.85	0.65	0.59-0.71
75-84	515	59.07	54.18-64.40	753	125.68	117.02-134.99	0.47	0.42-0.53
85+	120	32.66	27.31-39.06	150	89.38	76.17-104.90	0.37	0.29-0.46

Abbreviations: CI = confidence interval.

Appendix Table. Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), Accuracy and Kappa of Administrative Claims Case Definitions for Chronic Dialysis as Compared to Dialysis Registry (January 2004-December 2010)

Number of Physician Claims	Other conditions [a]	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	Accuracy	Kappa
≥ 1	1-year data	76.97 (74.74, 79.2)	93.81 (90.79, 92.94)	85.19 (83.21, 87.17)	89.8 (88.74, 90.87)	88.49 (87.36, 89.61)	0.73 (0.7, 0.75)
≥ 1	3-years data	74.04 (72.17, 75.91)	92.48 (91.79, 93.17)	78.62 (76.82, 80.42)	90.51 (89.76, 91.27)	87.47 (86.61, 88.32)	0.68 (0.66, 0.70)
≥ 1	5-years data	87.64 (86.34, 88.95)	91.33 (90.73, 91.93)	74.41 (72.82,76.00)	96.25 (95.84, 96.67)	90.51 (89.87, 91.15)	0.74 (0.73, 0.76)
≥ 1	7-years data	97.3 (96.68, 97.93)	89.67 (89.08, 90.26)	70.2 (68.69, 71.71)	99.25 (99.08, 99.43)	91.2 (90.62, 91.77)	0.76 (0.75, 0.77)
≥ 2	1-year data	74.63 72.33, 76.94)	94.39 (93.56, 95.22)	86.02 (84.04, 87.99)	88.94 (87.84, 90.04)	88.14 (87.01, 89.27)	0.72 (0.69, 0.74)
≥ 2	3-years data	72.71 (70.81, 74.61)	94.23 (93.63, 94.84)	82.48 (80.76, 84.21)	90.24 (89.49, 91.00)	88.38 (87.56, 89.20)	0.70 (0.68, 0.71)
≥ 2	5-years data	86.05 (84.58, 87.42)	93.38 (92.86, 93.91)	78.91 (77.36, 80.45)	95.88 (95.45, 96.31)	91.75 (91.15, 92.34)	0.82 (0.81, 0.83)
≥ 2	7-years data	95.55 (94.75, 96.34)	91.79 (91.26, 92.32)	74.43 (72.94, 75.92)	98.8 (98.58, 99.02)	92.54 (92.01, 93.07)	0.79 (0.78, 0.8)
≥ 2, at least 90 days apart	1-year data	64.77 (62.23, 67.30)	97.13 (96.52, 97.73)	91.25 (89.47, 93.02)	85.63 (84.44, 86.82)	86.89 (85.75, 88.03)	0.67 (0.65, 0.70)
≥ 2, at least 90 days apart	3-years data	60.87 (58.79, 62.95)	99.75 (99.62, 99.88)	98.92 (98.36, 99.48)	87.22 (86.41, 88.04)	89.18 (88.42, 89.94)	0.69 (0.67, 0.71)
≥ 2, at least 90 days apart	5-years data	72.02 (70.25, 73.80)	99.65 (99.52, 99.77)	98.33 (97.74, 98.92)	92.53 (91.99, 93.07)	93.48 (92.97, 93.98)	0.79 (0.78, 0.81)
≥ 2, at least 90 days apart	7-years data	**83.00 (81.55, 84.46)**	**98.65 (98.43, 98.87)**	**93.90 (92.91, 94.89)**	**95.87 (95.49, 96.25)**	**95.52 (95.12, 95.92)**	**0.85 (0.84, 0.87)**
≥ 2, lasted >90 days, no gaps > 21 days	1-year data	52.7 (50.06, 55.35)	97.5 (96.93, 98.06)	90.69 (88.67, 92.71)	81.67 (80.4, 82.95)	83.33 (82.1, 84.56)	0.57 (0.54, 0.59)
≥ 2, lasted >90 days, no gaps > 21 days	3-years data	45.19 (43.07, 47.31)	99.82 (99.71, 99.93)	98.96 (98.32, 99.60)	82.99 (82.09, 83.88)	84.97 (84.12, 85.52)	0.54 (0.52, 0.56)
≥ 2, lasted >90 days, no gaps > 21 days	5-years data	47.59 (45.62, 49.57)	99.77 (99.66, 99.87)	98.32 (97.58, 99.05)	86.87 (86.21, 87.54)	88.11 (87.47, 88.75)	0.58 (0.56, 0.60)
≥ 2, lasted >90 days, no gaps > 21 days	7-years data	50.64 (48.71, 52.58)	99 (98.81, 99.2)	92.7 (91.34, 94.07)	88.91 (88.34, 89.49)	89.93 (88.76, 89.89)	0.6 (0.58, 0.62)

Note: [a] *2010, 2004-2006, 2004-2008, and 2004-2010 Physician and MRP data were used for the I-year, 3-year, 5-year, and 7-year data agreement analysis, respectively*

Figure 1.

Age-standardized Incidence and Prevalence of ESKD in Manitoba per 100,000 population by Sex from 1989-2009

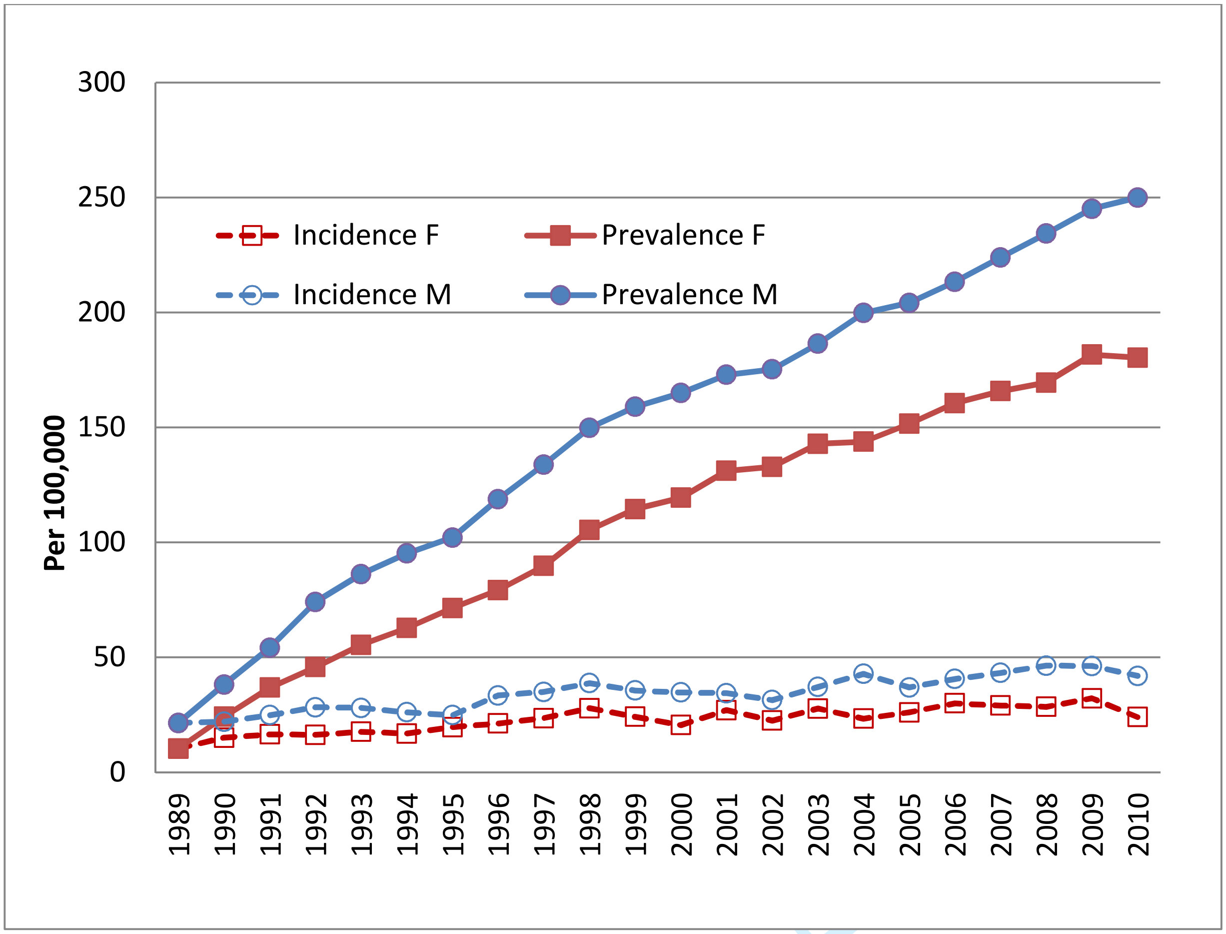


Figure 2. Age-specific prevalence of ESKD in Manitoba per 100,000 population by year between 1989 and 2010

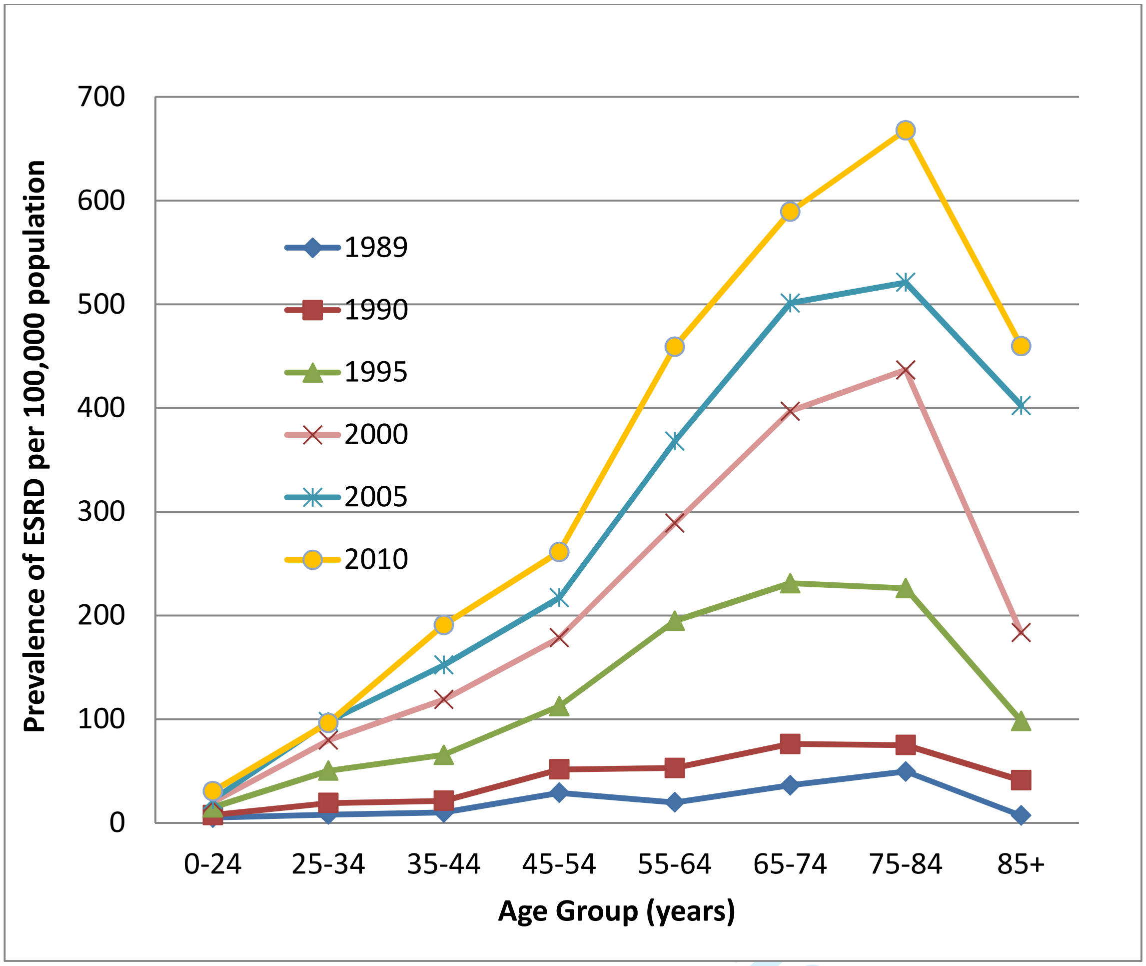
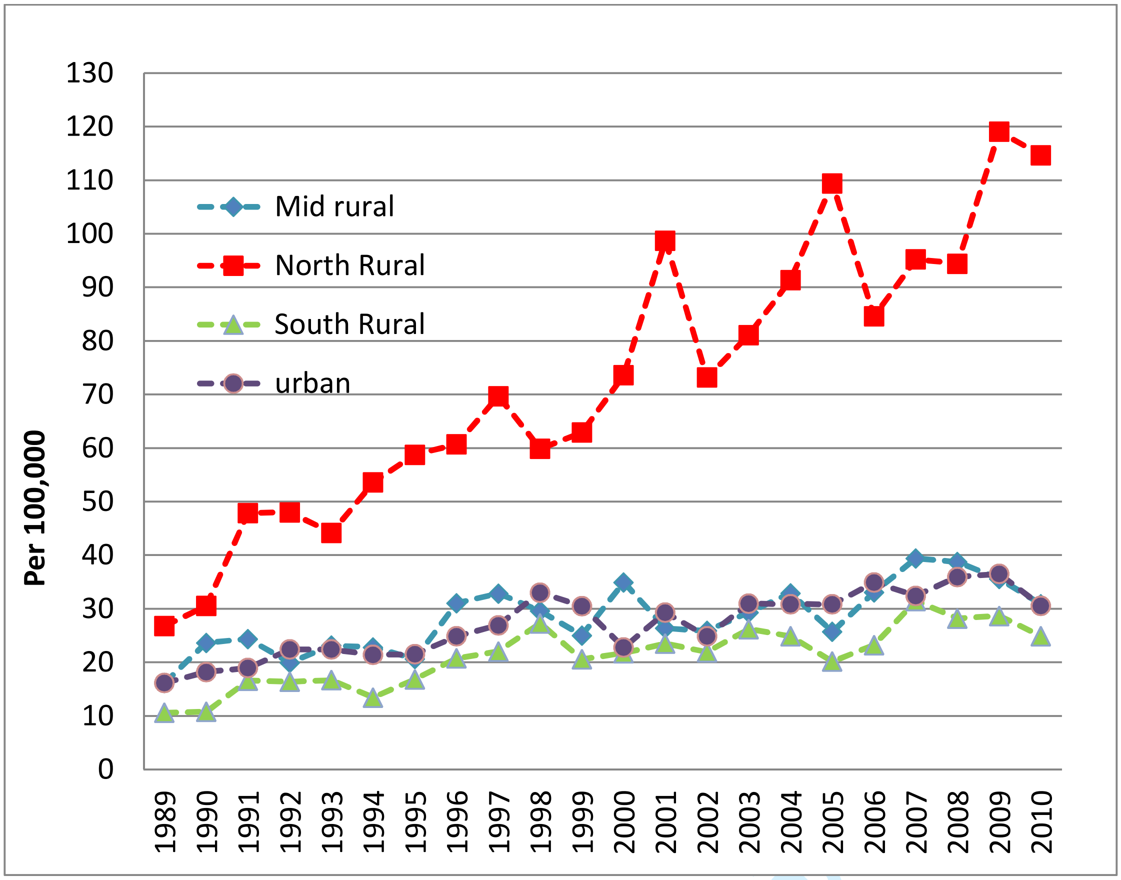
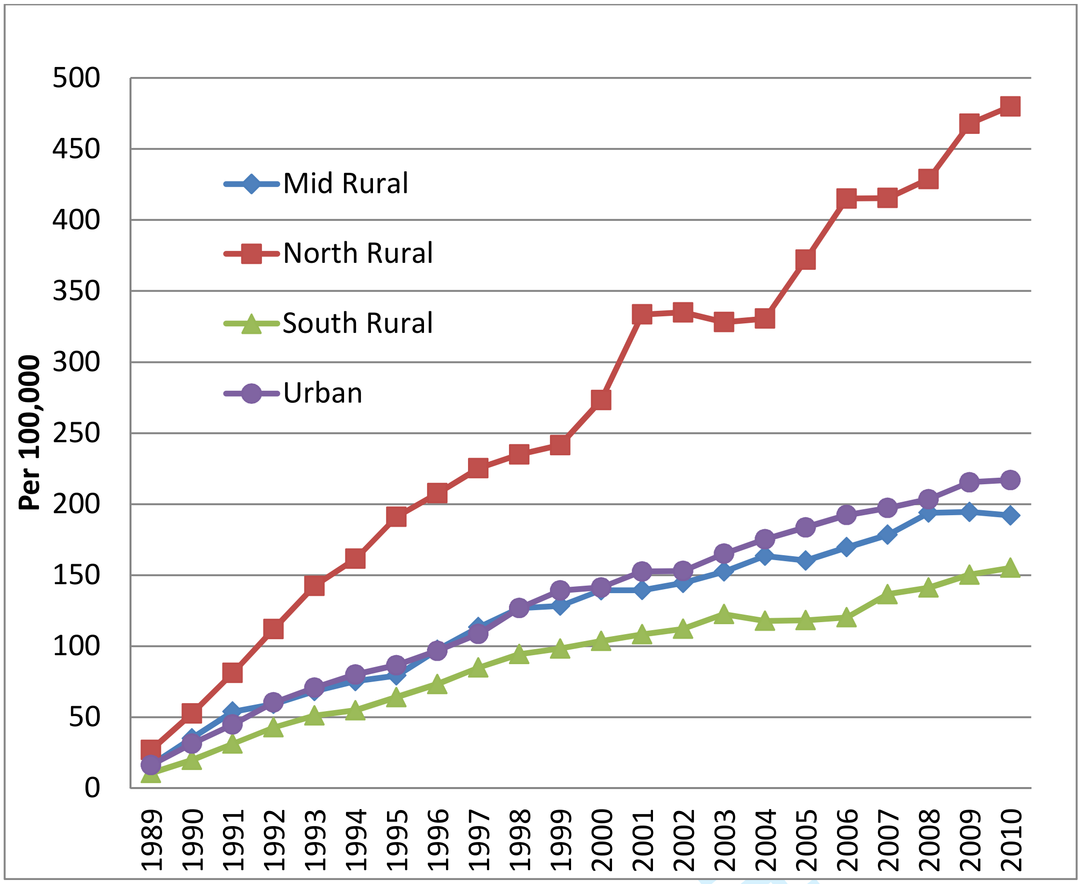


Figure 3a. Age-standardized Incidence of ESKD in Manitoba by regions per 100,000 populations from 1989 to 2010



Figures 3b. Age –standardized prevalence of chronic dialysis per 100,000 populations in Manitoba by region from 1989 to 2010



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