

**HEALTH CARE UTILIZATION AND
DIRECT HEALTH CARE COSTS OF
DIABETES IN URBAN AND RURAL
SASKATCHEWAN, 1991 - 2001**
Working Paper #06-04

Sheri L. Pohar¹
Sumit R. Majumdar^{1,2}
Philip Jacobs^{1,3}
Jeffrey A. Johnson^{1,3}

¹Institute of Health Economics, Edmonton, Canada

²Department of Medicine, University of Alberta, Edmonton, Canada

³Department of Public Health Sciences, University of Alberta, Edmonton, Canada

TABLE OF CONTENTS

ACKNOWLEDGEMENT	vi
SUMMARY	1
Objective	1
Methods.....	1
Results.....	1
Conclusions.....	2
INTRODUCTION	3
RESEARCH DESIGN AND METHODS	5
Data Sources	5
Study Population.....	5
Diabetes Cohorts.....	5
Estimation of Health Care Resource Utilization and Costs	6
Physician Visits.....	6
Prescriptions.....	7
Hospitalizations and Day Surgeries	7
Dialysis	8
Mortality	9
Analysis.....	9
RESULTS	10
Utilization and Costs.....	10
Physician Services	11
Prescription Drug Plan Services	11
Hospital Services	12
Day Surgeries.....	13
Dialysis	13
Overall Health Care Costs	14
Mortality	14
DISCUSSION.....	14
Physician Visits.....	15
Prescriptions.....	16
Hospitalizations.....	17
Dialysis	17
Overall Costs.....	18
Mortality	18
Limitations	19
CONCLUSION.....	21
REFERENCE LIST	23

APPENDICES	27
APPENDIX A.....	28
Saskatchewan Health Data Dictionaries	
APPENDIX B	39
Consumer Price Index	
APPENDIX C	40
Imputation of Resource Intensity Weights (RIW's) Based Upon Length of Stay (LOS)	
APPENDIX D.....	41
Imputation of Missing Day Survery Day Procedure Group Weights	
APPENDIX E	42
Dialysis Cost Estimation	

LIST OF TABLES

TABLE 1.....	43
Comparison of Diabetes Cohort by Urban or Rural Residence at Index	
TABLE 2.....	43
Diabetes Cases (1991 - 2001)	
TABLE 3.....	44
Pharmacologic Management of Diabetes and Related Comorbidities by Urban or Rural Residence, 2001	
TABLE 4.....	45
Utilization of Antidiabetic Agents by Urban or Rural Residence, 2001	
TABLE 5.....	46
Top Five Most Responsible Reasons for Hospitalizations by Urban or Rural Residence, 1991 to 2001	
TABLE 6.....	48
Annual Hospitalizations by Type of Facility and Urban or Rural Residence, 1991 to 2001	
TABLE 7.....	50
Overall Per Capital Health Care Costs by Urban or Rural Residence	

LIST OF FIGURES

FIGURE 1	51
Total Physician Visits Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 2A	52
General Practitioner Visits Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 2B	52
Specialist Visits Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 3A	53
Crude Physician Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 3B	53
Age Standardized Physician Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 4	54
Average Annual Per Capita Prescription Dispensagions, 1991 - 2001, by Urban or Rural Residence	
FIGURE 5A	55
Crude Annual Average Prescription Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 5B	55
Age Standardized Annual Average Prescription Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 6	56
Hospital Discharges Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 7	57
Average Length of Stay, 1991 - 2001, by Urban or Rural Residence	
FIGURE 8A	58
Crude Hospital Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 8B	59
Age-Standardized Hospital Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 9	60
Day Surgery Utilization Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 10A	61
Day Surgery Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	

FIGURE 10B	61
Age-Standardized Day Surgery Costs Per Capita, 1991, 2001, by Urban or Rural Residence	
FIGURE 11	62
Average Annual Number of Days on Haemodialysis Per Dialysis Recipient, 1991 - 2001, by Urban or Rural Residence	
FIGURE 12	63
Annual Number of Days on Peritoneal Dialysis Per Dialysis Recipient, 1991 - 2001, by Urban or Rural Residence	
FIGURE 13	64
Haemodialysis Utilization (Alone or in Combination with Peritoneal Dialysis), 1991 - 2001, by Urban or Rural Residence	
FIGURE 14	65
Percent of Dialysis Population who Received Any Haemodialysis Alone or in Combination with Peritoneal Dialysis, 1991 - 2001, by Urban or Rural Residence	
FIGURE 15	66
Dialysis Costs Per Capita, 1991 - 2001, by Urban or Rural Residence	
FIGURE 16A	67
Crude Per Capita Total Health Services Costs, 1991 - 2001, by Urban or Rural Residence	
FIGURE 16B	67
Age-Standardized Per Capita Total Health Services Costs, 1991 - 2001, by Urban or Rural Residence	
FIGURE 17A	68
Per Capita Total Health Care Costs for the Large Urban Population with Diabetes, 2001	
FIGURE 17B	68
Per Capita Total Health Care Costs for the Small Urban Population with Diabetes, 2001	
FIGURE 17C	68
Per Capita Total Health Care Costs for the Rural Population with Diabetes, 2001	
FIGURE 18A	69
Crude Mortality Rate, 1991 - 2001, by Urban or Rural Residence	
FIGURE 18B	69
Age-Standardized Mortality Rate, 1991 - 2001, by Urban or Rural Residence	

ACKNOWLEDGEMENT

Dr Johnson is a Health Scholar with the Alberta Heritage Foundation for Medical Research (AHFMR) and is a Canada Research Chair in Diabetes Health Outcomes. Dr Johnson is Chair of a New Emerging Team (NET) grant to the Alliance for Canadian Health Outcomes Research in Diabetes (ACHORD). The ACHORD NET grant is sponsored by the Canadian Diabetes Association, the Heart and Stroke Foundation of Canada, The Kidney Foundation of Canada, the CIHR – Institute of Nutrition, Metabolism and Diabetes and the CIHR – Institute of Circulatory and Respiratory Health. Dr Majumdar is an ACHORD Investigator, a Population Health Investigator with the Alberta Heritage Foundation for Medical Research and a New Investigator of the Canadian Institutes of Health Research.

We would like to acknowledge Scot Simpson, William Osei, Mary Rose Stang, and Winanne Downey for their contributions to this project.

This study is based in part on de-identified data provided by the Saskatchewan Department of Health. The interpretation and conclusions contained herein do not necessarily represent those of the Government of Saskatchewan or the Saskatchewan Department of Health.

Corresponding Author & Reprints: Jeffrey A. Johnson, Ph.D.
Institute of Health Economics
#1200 – 10405 Jasper Avenue
Edmonton, Alberta
CANADA T5J 3N4
Phone: (780) 448-4881; Fax: (780) 448-0018
email: jeff.johnson@ualberta.ca

SUMMARY

Objective

The purpose of this analysis was to compare health care utilization as well as costs and mortality of individuals with diabetes in the province of Saskatchewan from 1991 to 2001, according to residential location.

Methods

The National Diabetes Surveillance System (NDSS) criteria were applied to Saskatchewan Health's administrative databases to identify individuals with diabetes between 1991 and 2001. The analysis included health care resource utilization and cost data across five categories of health care services (physician visits, prescription medications, hospitalizations, day surgeries and dialysis) for these individuals, grouped by calendar year (1991-2001). Crude and directly age-standardized (to the 2001 Canadian population) cost comparisons were made between individuals who resided in large urban, small urban or rural areas. All costs are expressed in 2001 dollars. Crude and directly age-standardized mortality rates were also assessed for the three locations of residence. Registered Indians were excluded from all analyses because prescription drug utilization was unavailable for this portion of the population.

Results

Between 1991 and 2001, 57,774 individuals were identified as having diabetes (from the Saskatchewan Health-covered population less registered Indians), of whom approximately 46% (n=26656) resided in rural areas. In 2001 those who resided in large urban centres had 15.2 ± 15.9 physician visits on average, while those in small urban and rural areas had 14.5 ± 14.5 and 14.2 ± 14.0 visits, respectively (P value < 0.01 compared to large urban). While the number of visits to general practitioners was similar across the three locations of residence, individuals who resided in large urban centres had more specialist visits on average: in 2001, individuals in large urban centres had 3.1 visits compared to 1.5 visits for those in rural areas. The average number of prescriptions dispensed each year was lowest for those living in large urban centres and highest for those living in small urban centres, yet prescription costs were highest for large urban

centre dwellers. While the average number of hospitalizations for rural area residents was highest, the average length of stay for these residents was shorter than for those in small and large urban centres. Age-standardized hospital costs were similar for all subjects.

Haemodialysis was the dialytic modality more commonly used for residents of large urban centres and was associated with higher costs. In 2001 dialysis costs for large urban centre residents were more than double the average dialysis costs for rural area residents (\$291 vs \$119, P value < 0.001). Despite differences in costs and utilization in the individual cost categories, overall health care costs were similar regardless of residential location. Age-standardized mortality rates rose significantly over the follow-up period, but did not differ by residential region.

Conclusions

From 1991 to 2001, we observed systematic differences in health care utilization and costs for physician services, prescriptions, hospitalizations, day surgeries, and dialysis according to residential location. Overall direct health care costs and mortality, however, were similar for those living in rural or urban centres. Thus, differences in the mix of services received by residents living in different locations did not appear to affect either economic or clinical outcomes.

INTRODUCTION

Approximately 22% to 38% of the Canadian population reside in rural areas (Mitura 2003). Recent reports have suggested that the health status of individuals who reside in rural areas may be inferior to those who live in urban centres. For example, rural dwelling Canadians experience shorter life expectancies and disability-free life expectancies and are more likely to rate their health as fair to poor (Mitura 2003; Shields 2002).

A number of factors may relate to the comparatively poor health of individuals in rural areas. Those who live in rural areas tend to be older than those who live in urban centres (Natural Resources Canada 2004c; Mitura 2003) and, as such, are more likely to experience chronic illnesses such as diabetes, arthritis and heart disease (Mitura 2003; Health Canada 2003; Statistics Canada 2000; Center for Chronic Disease Prevention and Control 2002). Further, individuals who live in Canada's rural areas are more likely to engage in poor health practices such as smoking (32% of adults in rural areas compared to 22% in major metropolitan areas) and are more likely to be overweight (40% of adults compared to 27% in major metropolitan areas) (Mitura 2003). In the rural Prairie Regions specifically, obesity, smoking and heavy drinking rates are higher than the national average (Shields 2002).

Rural health regions provide care for an older, less healthy population that tend to have more risk factors for chronic diseases such as diabetes and heart disease. Poor health status and chronic conditions have been associated with increased utilization of health services (Maddigan 2005; Brown 1994; Walter-Ginzburg 2001; Wyke 2003; Jordan 2003; Parkerson, Jr. 2000; Pearson 1999; Kennedy 2001). Thus, individuals who reside in rural areas may be expected to have higher utilization rates of health care resources than those residing in urban areas.

Rural health care delivery, however, can pose unique challenges compared to health care delivery in urban centres. Shortages of medical resources and personnel and a lack of specialized services in rural areas may threaten quality of care and the ability of the rural population to access needed services (Touati 2004). The result can be inequities in access to services and, hence, decreased utilization (Touati 2004). Previous research has found increased utilization of some resource categories, but decreased utilization of others in rural regions of

Canada and the United States (Bay 1997; Booth 2003; Veugelers 2003; Blazer 1995). Decreased utilization has been ascribed, in part, to difficulties with health care delivery in rural areas and other barriers to access in these areas (Mathews 2004). With regards to physician services, for example, there are four-fold differences between physician to patient ratios in rural areas (1:797) and urban areas (1:193) in Canada (Hutten-Czapski 1998). Further, individuals who reside in rural areas are less likely to have a regular medical doctor than are those who reside in urban areas (Mathews 2004) and have longer distances to travel to see physicians, particularly specialists, compared to their urban counterparts (Natural Resources Canada 2004a; Natural Resources Canada 2004b). Long distance to a health care provider has been shown to be a barrier to utilization (Nemet 2000).

Diabetes is an example of a chronic condition that requires quality care in order to ensure that the impact of the condition itself and its associated complications and comorbidities are limited (Canadian Diabetes Association 2003). The common comorbidities of cardiovascular and kidney disease require attention to multiple risk factors. Unfortunately, care for both rural and urban dwelling individuals with diabetes appears to be somewhat substandard compared to recognized treatment guidelines (Rosenblatt 2001; Supina 2004; Klinke 2004; Toth 2003; Glasgow 2000; Andrus 2004). Further, it has been shown that individuals in rural areas with diabetes are less likely than urban dwelling individuals to receive preventive therapies and appropriate monitoring (Rosenblatt 2001; Klinke 2004; Andrus 2004).

Utilization and access to health care services are important issues to consider in treating diabetes given that a large component of diabetes care is preventive and requires access to health care providers to receive this care (Canadian Diabetes Association 2003). Further, access issues may decrease the utilization of some categories of health care services in rural areas, while the age and health of the rural population may demand greater consumption of resources in other categories where access is less problematic. If differential utilization exists across multiple categories of health care resources, overall health care costs and clinical outcomes could be quite different for rural and urban area residents. This would have important policy implications. Finally, as health care reform attempts to improve the efficiency of health care delivery, it is important to explore trends in both utilization and costs over time.

In 2001, Saskatchewan had the highest proportion of rural dwellers among Canada's western provinces with approximately 36% of the population residing in rural areas (i.e. areas with populations of less than 1000 or fewer than 400 persons per square kilometre) (Statistics Canada 2002). This makes the rural and urban differences in health care utilization and associated costs among diabetes patients within Saskatchewan particularly relevant to consider. Thus, our objective was to explore health care utilization, costs and mortality rates of individuals with diabetes in the province of Saskatchewan according to their location of residence from 1991 to 2001.

RESEARCH DESIGN AND METHODS

Data Sources

Administrative databases from Saskatchewan Health were used in the analyses (Downey 2000). These databases contain information on prescription drug use, hospitalizations, physician services and dialysis for all eligible residents of Saskatchewan and have been used in numerous epidemiologic studies (Downey 2000). Data pertaining to the age, sex and registered Indian distribution of all Saskatchewan Health beneficiaries from 1991 to 2001 were obtained from Saskatchewan Health (Saskatchewan Health 2005a).

Study Population

Diabetes Cohorts

The National Diabetes Surveillance System (NDSS) criteria (Health Canada 2003) were applied to Saskatchewan Health's administrative databases to identify individuals with diabetes in the covered population between 1991 and 2001. Individuals are considered to have diabetes if they have two physician visits with a diagnosis of diabetes (ICD-9 code of 250) on two different days within any contiguous 730-day period or one hospitalization with a discharge diagnosis of diabetes (ICD-9 code of 250 from the first three diagnostic fields) (Health Canada 2003). Although the NDSS case definition is typically applied for individuals aged 20 years and older, we have included those less than 20 years old as well so that the entire covered population with diabetes (both type 1 and type 2) could be included. The diabetes cohort for each year was comprised of incident or prevalent diabetes cases with active Saskatchewan Health coverage.

Individuals who met the NDSS criteria for diabetes in the years 1989 or 1990 were identified as prevalent diabetes cases in 1991.

The subject's diabetes index date was the date of hospital discharge for diabetes or the date of the first physician visit that qualified the subject. Location of residence was determined at index and classified as either large urban, small urban or rural. Large urban centres had populations that exceeded 100,000 (Saskatoon and Regina), small urban centres had populations between 5000 and 99,999 (Estevan, Humboldt, Lloydminster, Meadow Lake, Melfort, Moose Jaw, Nipawin, North Battleford, Prince Albert, Swift Current, Weyburn and Yorkton), and rural areas had populations of less than 5000.

Estimation of Health Care Resource Utilization and Costs

Health care resource use was identified from service records in the linkable administrative databases of Saskatchewan Health. These data were collected for each individual and grouped according to calendar year.

Physician Visits

Physician service records were used to estimate utilization and costs of physician services. The information available in this database included date of services, ICD-9 diagnostic code associated with the claim, type of physician and fee paid (Appendix A). Fee for service claims were collapsed to create physician visits. A physician visit is defined as a single record for services received by a patient from a single physician for the same diagnosis on the same day at the same clinic and same location. Physician visits included visits to general practitioners, specialists, and out-of-province physicians, as well as visits to other practitioners who provided insured services, such as optometrists. Capture of visits to salaried and contract physicians was incomplete. Visits to Saskatchewan Cancer Agency salaried physicians were not captured. The amount paid for each visit was used to determine the cost for physician services. These values were then converted to 2001 dollars using the Consumer Price Index for Health Care Services basket, which was obtained from Statistics Canada (See Appendix B).

Prescriptions

The number of prescriptions per year was determined from the Saskatchewan Drug Plan (DP) database. The database contains out-of-hospital medication claims for all beneficiaries eligible for DP benefits. Prescriptions for beneficiaries whose prescription drug benefits are provided by a federal government agency (e.g. First Nations & Inuit Health, Health Canada) are not included in the database (Saskatchewan Health 2005). With these exclusions, the study captured prescriptions for approximately 90% of the covered population (Downey 2000).

Prescription drug costs were compiled from the same database. This database contains the total approved, total submitted and program portions of the prescription cost. The total amount approved was used to estimate prescription costs for active diabetes cases for each year. The total for each year was then converted to 2001 dollars using the Consumer Price Index Prescribed Medicines basket (Appendix B).

Hospitalizations and Day Surgeries

The number of hospital and day surgery discharges each year was obtained from Saskatchewan Health's hospital services file which includes data on all hospital discharges for Saskatchewan Health beneficiaries (including out-of-province hospital discharges). As the database captures hospital discharges, an individual who is transferred between two institutions would have separate records for each discharge. Each inpatient discharge record contained a resource intensity weight (RIW) calculated by the Canadian Institute of Health Information, admission and discharge dates, diagnostics codes, discharge type (alive, dead or other) and hospital type (provincial, regional, community - including district, community and northern hospitals- or out-of-province) (Appendix A). Provincial hospitals were those located in Regina and Saskatoon. Regional hospitals included those in Moose Jaw, Prince Albert, North Battleford, Swift Current and Yorkton. Lloydminster Hospital was also included as a regional hospital after January 1, 2001. The discharge date was used to determine the calendar year in which a hospital discharge occurred.

The cost per hospitalization in 2001 dollars was determined by multiplying the RIW by the funding per weighted case for 2001 (Johnson 2002) and was estimated to be (\$3369.77) (M. R. Stang, personal communication, March 4, 2004). Missing RIWs and day procedure group

(DPG) weights were estimated using an algorithm provided by Saskatchewan Health (based, in part, on length of stay) and mean imputation, respectively (Appendix C).

Hospital discharge records for day surgery procedures were identified from the hospital services file as well. A cost per day surgery was assigned based on the DPG weight multiplied by the estimated funding per weighted case for 2001 (\$3369.77). Actual DPG weights were unavailable for the three fiscal years 1991/92 through 1993/94. Although 1993/94 was the introductory year for DPGs and DPG weights, the reported values for this fiscal year were considered unreliable. Therefore, we used the respective fiscal annual average DPG weight calculated and provided by Saskatchewan Health (W. Downey, personal communication, October 11, 2001) for all day surgery records for the calendar years 1991 through 1993. The annual average DPG weight for the 1991/92 fiscal year, for example, was used for all day surgery records in 1991. For the 1994 to 1998 calendar years, a mean imputation method was used to estimate missing DPG weights. Using this approach, missing weights were replaced with the mean DPG weight within each calendar year (1994 to 1998). After 1998 there were no records with missing DPG weights (Appendix D).

Dialysis

The physician services file was used to identify individuals who were on dialysis, based on fee-for-service billing codes (FSCs). Duration, frequency and patterns of dialysis were used to estimate the duration of time each year that individuals were on haemodialysis or peritoneal dialysis. Duration of haemodialysis was determined for each year by subtracting the date of the earliest haemodialysis code from the date of the last haemodialysis code within a given year. The duration of time between the last haemodialysis code in one year and the first haemodialysis code in the subsequent year was determined. If this period of time was less than 14 days, individuals were assumed to be on haemodialysis until the end of the calendar year and from the beginning of the next calendar year. We then assessed the average number of days between haemodialysis codes within a calendar year. If the average number of days between haemodialysis codes within a year was less than or equal to 14 days, we assumed that haemodialysis was ongoing. If the duration of time between haemodialysis codes exceeded 14 days on average, the duration of haemodialysis within a given year was estimated from the time between individual dialysis codes. In this case, haemodialysis was considered to be ongoing

during a particular segment of the year if the duration of time between codes was less than 14 days for that segment. When the duration of time between codes was more than 14 days, haemodialysis was not considered ongoing during such segments of the calendar year. The same algorithm was used to determine the duration of peritoneal dialysis. For peritoneal dialysis patients who received haemodialysis on occasion, the duration of haemodialysis each year was estimated as previously described for haemodialysis.

Annual dialysis costs were calculated by multiplying the proportion of each calendar year on either haemodialysis or peritoneal dialysis by the estimated annual cost of each dialysis modality. The cost estimate from a prospective observational study of patients attending dialysis clinics in Calgary, Alberta was used (Lee 2002). We used the annual cost of either haemodialysis or peritoneal dialysis excluding physician services (as these costs were captured in the physician visits costs), but prescription costs were included. This value was converted to 2001 Canadian dollars (1 US dollar = 1.45 Canadian dollars) (estimated from the Consumer Price Index Health Services basket (Appendix B) and was found to be \$52,719 dollars per year of haemodialysis or \$37,431 dollars per year of peritoneal dialysis (Appendix E).

Mortality

Mortality rates were determined for each calendar year. For each mortality calculation, the numerator was the annual number of deaths in the active diabetes cohort and the denominator was the number of individuals with active diabetes for that year. Mortality was expressed as a rate of deaths per 1000 population with diabetes.

Analysis

Health care resource utilization and costs (in 2001 dollars) were determined per calendar year according to location of residence: large urban centres, small urban centres and rural areas. Registered Indians were excluded from the analysis because the Saskatchewan Health databases do not capture their prescription drug use. For each category of health care resource utilization (other than dialysis) the average number of encounters was determined. Physician visits were assessed for all general practitioners and specialists both separately and as a total. For those individuals on dialysis, the average number of days each year on each dialysis modality was

determined. The number of individuals per 1000 on each dialysis modality was also determined. Utilization patterns of relevant medication categories (angiotensin converting enzyme (ACE) inhibitors, HMG-CoA reductase inhibitors (statins), acetylsalicylic acid (ASA), antidiabetic agents and diabetes-related diagnostic agents) were assessed for 2001. Individuals were categorized as having either no prescription or one or more prescriptions for each medication class in 2001. The primary or most responsible reason for hospitalization and type of hospital at which an encounter occurred was compared across the locations of residence.

Crude average health care costs per individual were determined for each cost category and overall. Directly age-standardized (to the 2001 Canadian population) costs were also determined, with the exception of dialysis costs where sample size did not permit age standardization. Non-parametric tests of statistical significance (Chi-Square and Kruskal-Wallis, as appropriate) were used for comparisons of crude utilization and costs across locations of residence for 2001.

To explore rural versus urban differences in outcomes, crude and directly age-standardized (to the 2001 Canadian population) mortality rates were determined for the three locations of residence.

RESULTS

Utilization and Costs

From 1991 to 2001, a total of 57,774 individuals from the general population (i.e. covered population less registered Indians) were identified as having diabetes (Tables 1 and 2). Approximately 46% (n=26,656) of these individuals resided in rural areas. Individuals residing in rural areas (63.1 ± 16.2 years) and small urban centres (62.5 ± 16.9 years) were significantly older than those who resided in large urban centres (59.3 ± 17.3 , $p < 0.001$) (Table 1). Without considering differences in age, overall mortality during the follow-up period in large urban areas was lower compared to rural and small urban centres (Table 1). During the follow-up period the number of active diabetes cases increased from 23,069 in 1991 to 41,630 in 2001 (Table 2), representing 4.5% of Saskatchewan's covered population that year, (excluding the Registered Indian population).

Physician Services

For most years, the average number of physician visits was higher for individuals with diabetes who resided in large urban centres than in small urban or rural areas. In 2001, those who resided in large urban centres had 15.2 ± 15.9 physician visits on average, while those in small urban and rural areas had 14.5 ± 14.5 and 14.2 ± 14.0 visits, respectively ($p < 0.01$ compared to large urban) (Figure 1). While the number of visits to general practitioners was similar across the three locations of residence, individuals who resided in large urban centres had more specialist visits on average (Figures 2a and 2b). Crude physician costs were similar for small urban and rural areas, both being considerably lower than physician costs in large urban centres (Figure 3a). Physician costs in large urban centres were $\$784 \pm \823 , compared to $\$679 \pm \724 in small urban and $\$674 \pm \705 in rural areas ($p < 0.001$ for both comparisons) in 2001. Age standardization reduced the magnitude of the differences in costs according to location of residence, although the differences persisted (Figure 3b).

Prescription Drug Plan Services

Over the 11-year follow-up period, the average number of prescriptions dispensed each year was lowest for those in large urban centres and highest for those living in small urban centres. In 2001, individuals who resided in large urban centres had approximately 2.2 fewer prescriptions dispensed than individuals who resided in large urban centres ($p < 0.001$ for the difference) (Figure 4).

In 2001, the use of an ACE inhibitor or ASA was highest in rural areas while statin use was highest in large urban centres (Table 3). In large urban centres, however, the use of an ACE inhibitor in combination with a statin was highest, with 11.6% of individuals receiving one or more prescriptions for each agent in 2001. The use of the three agents together was low (1.7 to 2.0%) in all locations of residence, with no significant differences among areas (Table 3). Metformin was the most commonly used anti-diabetic agent in all three locations of residence (Table 3), and its use was significantly higher in large urban and rural areas than in small urban areas. More than one-half of individuals had one or more prescriptions for diabetes monitoring supplies (Table 3).

Closer examination of treatment patterns with anti-diabetic agents revealed that over one-third of individuals with diabetes were managed without medication in 2001. Small urban centres had a larger proportion of individuals managed without medication (37.5%, $p < 0.001$) compared to large urban (33.3%) and rural regions (33.0%). Insulin use, alone or in combination with oral agents, was highest in large urban centres (Table 4). For those managed with an oral agent without insulin (45.4% of the study population), metformin was the most common treatment, alone or in combination with sulphonylurea (Table 4).

In contrast to utilization, crude prescription costs were higher in large urban centres than in small urban or rural areas ($p < 0.001$ for both comparisons in 2001) (Figure 5a). Age-standardized differences in prescription costs were larger than crude differences (Figure 5b).

Hospital Services

The average number of hospitalizations for residents of large urban centres was considerably lower than for small urban and rural residents, with the magnitude of differences among residential locations decreasing from 1991 to 2001 (Figure 6). While the average number of hospitalizations was highest for individuals residing in rural areas, the average length of stay was shorter for residents of small and large urban centres (Figure 7). From 1991 to 2001 the average length of stay decreased for all location categories. The primary or most responsible reasons for hospitalization were similar in the three locations of residence, with cardiovascular disease being the single most common reason in all regions each year (Table 5). Individuals residing in large urban centres tended to be hospitalized locally (Table 6), but a significant proportion of individuals residing in small urban and rural areas were hospitalized in provincial hospitals.

Crude hospital costs decreased dramatically over the follow-up period with the differences in costs by residential location decreasing as well (Figure 8a). In 2001 the average cost per hospitalization was $\$1967 \pm \7019 in large urban centres, $\$2272 \pm \8475 in small urban and $\$2175 \pm \7580 in rural areas ($p < 0.001$ for small urban and rural compared to large urban) (Figure 8a). After age standardization, hospital costs were similar in all locations of residence (Figure 8b).

Day Surgeries

The number of day surgeries per diabetes case each year was higher among those residing in large and small urban centres at index compared to those living in rural areas (Figure 9). In 2001 the average number of day surgeries for the cohort residing in large urban centres (0.26 ± 0.78) was significantly higher than those observed for the cohorts residing in small urban (0.23 ± 0.82) and rural areas (0.20 ± 0.71) ($p < 0.01$ for both comparisons) (Figure 9). Similar to utilization, day surgery costs were higher in large and small urban areas compared to rural areas, before and after age standardization (Figures 10a and 10b).

Dialysis

Each year, the estimated duration of haemodialysis for individuals who resided in rural areas at index was shorter than for individuals who resided in large or small urban centres (Figure 11). While the patterns of peritoneal dialysis were less clear, it did appear that, for the most part, dialysis recipients who resided in large urban centres had shorter durations of peritoneal dialysis (Figure 12). A greater proportion of the total population who resided in large urban centres was on haemodialysis (either alone or in combination with peritoneal dialysis) than in either small urban centres or rural areas during each year of follow-up (Figure 13). The proportion of the total population on haemodialysis who resided in small urban centres increased considerably in 2000 and 2001 compared to previous years (Figure 13). The proportion of dialysis recipients residing in large or small urban centres who were on haemodialysis, alone or in combination, was also higher compared to rural areas in most years (Figure 14). The average per capita annual dialysis costs increased from 1991 to 2001 for all subjects and were much higher in large urban centres than in small urban centres and rural areas (Figure 15). In 2001 costs for large urban centre residents were more than double the average dialysis costs for those in rural areas (\$291 vs \$119, $p < 0.001$). Dialysis costs were similar for small urban centre residents and rural residents from 1991 to 1999, but in 2000 and 2001, costs for small urban residents rose considerably (Figure 15).

Overall Health Care Costs

In the early years of the follow-up period, there appears to be a gradient in overall health care costs with rural areas having the highest per capita costs and large urban areas having the lowest (Figure 16a and Table 7). By 2001 overall per capita health care costs were similar in all regions and differences were not statistically significant. Age-standardized overall costs were similar in all locations of residence for the 11-year study period (Figure 16b and Table 7). Hospitalizations represented the largest component of health care costs regardless of the location of residence, ranging from 44% in large urban centres to 49% in rural areas (Figures 17a, 17b and 17c). In large and small urban centres, dialysis and medication costs accounted for a larger proportion of health care costs than in rural areas.

Mortality

The crude mortality rate was lowest in large urban centres from 1991 to 2001 (Figure 18a). The highest crude mortality rate was found in small urban centres in 2001, a rate of 50 per thousand. In large urban centres, the crude mortality rate reached a maximum of 18 per thousand in 1998 before decreasing to 16 per thousand in 2001. Age-standardized mortality rates did not differ across regions; however, in all regions the age standardized mortality rate significantly increased over the follow-up period (Figure 18b).

DISCUSSION

We explored differences in health care utilization and costs in Saskatchewan among individuals with diabetes over an 11-year period according to urban-rural residence at index. Health care utilization varied across locations of residence for the specific health care service categories. Utilization of physician services, haemodialysis and day surgeries were higher for individuals residing in large urban centres, but these individuals had fewer prescription dispensations and hospitalizations. As would be expected, utilization differences across locations of residence translated into higher costs for physician care, dialysis and day surgeries in large urban areas, and lower costs for hospitalizations. Interestingly, prescription costs were highest in the large urban centres even though fewer prescriptions were dispensed on average, indicating increased utilization of more expensive prescription medications in large urban centres.

Despite different utilization patterns across the five categories of health care services, overall crude and age-standardized costs were similar across large urban, small urban and rural areas. For all locations of residence, average crude and age-standardized overall health care costs decreased from 1991 to 2001, a trend that was mainly influenced by decreasing hospital costs. Differences in utilization patterns do not appear to have impacted mortality in diabetes, however, as age-standardized mortality rates were similar in all areas from 1991 to 2001.

Physician Visits

Individuals who resided in large urban centres made more physician visits on average than did those who resided in small urban or rural areas. We observed a higher number of specialist visits by individuals in large urban centres compared to small urban or rural areas, but the average number of general practitioner visits did not differ. Previous research has also found a similar number of family physician visits between rural and urban areas, but more frequent specialist visits in urban areas (Veugelers 2003). In our present study, it appears that realized access to general practitioners was similar in urban and rural areas for individuals with diabetes, but access to specialists in rural areas may be a concern. It is not possible, however, to comment on the appropriateness of the rates of specialist visits, as there may be some degree of over-utilization of specialists as a result of easier access for individuals residing in large urban centres. Further, given that care received from general practitioners may be comparable to specialist care, it would be inappropriate to infer that the quality of care received in rural areas was inferior simply because it was delivered by general practitioners.

We could not determine if more frequent specialist care was associated with better outcomes for individuals with diabetes. As would be expected with more frequent specialist visits, the costs of physician care for individuals in large urban centres exceeded those for individuals in rural areas. It does not appear that the more frequent specialist care led to better pharmacologic management of diabetes overall, as the use of ACE inhibitors, statins and ASA in combination was comparable in all locations of residence. Individuals residing in large urban centres were more likely to be on both a statin and ACE inhibitor in combination. Hospital discharge rates and costs were lower for those in large urban centres, but we could not establish a causal relationship between specialist care and hospitalizations from these data. Regardless, mortality was similar

in all locations of residence after differences in age distribution of the populations were considered. Thus, from these results, the overall benefit of more frequent specialist care remains unclear.

Prescriptions

Despite having fewer prescription dispensations on average, prescription medication costs were higher in large urban centres than in small urban or rural areas. Decreased utilization with increased costs suggested that medications used by individuals in large urban centres were more expensive than those used in small urban or rural areas. A number of relatively expensive medications are recommended for vascular protection in diabetes, including ACE inhibitors and statins (Canadian Diabetes Association 2003). Thus, we examined use of these agents in the three locations of residence to determine if this explained the observed cost differences.

Compared to rural areas, a larger proportion of individuals who resided in large urban centres had one or more statin prescriptions, but fewer were dispensed an ACE inhibitor. As well, the use of statins, ACE inhibitors and ASA in combination was similar in all areas. Patterns of use of antidiabetic agents and testing supplies do not explain differences in costs between rural and large urban areas. Insulin use was higher in large urban centres, but the proportion of individuals on at least one medication for diabetes was similar in rural areas and large urban centres. Thus, from the utilization patterns of these medications, it appears that statins may have accounted for some of the higher prescription costs for individuals residing in large urban centres.

Current guidelines for the management of diabetes in Canada suggest the use of lipid-lowering therapies, ACE inhibitors and antiplatelet agents (e.g. ASA) for vascular protection in diabetes (Canadian Diabetes Association 2003). Patterns of utilization of these agents individually suggest that those who resided in rural areas were the most likely to be treated with either an ACE inhibitor or ASA, with 40.0% and 8.3%, respectively, having one or more prescriptions in 2001. The use of ACE inhibitors, statins and ASA in combination, however, was not significantly different for individuals residing in large urban, small urban or rural areas.

Overall, in 2001 only 1.9% of individuals with diabetes were dispensed this combination of medications, despite the 1998 CDA guidelines recommending their use (Meltzer 1998). Thus, adherence to the recommended treatment guidelines was exceedingly low, regardless of the place

of residence. It might be expected that adherence to treatment guidelines would be higher in large urban areas where more specialist care was received, but this was not the case. It is not clear if there were differences in the prescribing of agents for vascular protection between general practitioners or specialists or whether specialists recommended treatment according to the guidelines, but these recommendations were not followed up.

Hospitalizations

Hospitalization was the largest cost category of the five analysed, and varied as a proportion of overall costs across the three locations of residence. Residents in large urban centres had the lowest rates and cost of hospitalization, yet tended to have longer lengths of stay than did individuals from rural areas. Thus, higher costs for rural area residents were not related to length of stay but to more frequent hospital discharges, which could relate to transfers between hospitals. If, for example, an individual who resided in a rural area were hospitalized first locally, then transferred to a large urban centre and then back to a local rural hospital, this would appear as three hospital discharges with shorter lengths of stay. Age-standardized costs of hospitalizations did not differ across the three locations of residence; thus, more frequent hospitalizations in rural areas could also be an age-related phenomenon.

Dialysis

Average dialysis costs were considerably higher for individuals who resided in large urban centres compared to rural areas. Due to the small number of individuals who received dialysis, we were unable to age-standardize dialysis costs to adjust for differences across areas. It did appear, however, that higher dialysis costs for individuals living in large urban were related both to the larger proportion of the cohort on haemodialysis and to a longer average duration of haemodialysis each year for dialysis recipients. Haemodialysis is considerably more expensive than peritoneal dialysis (\$52,719 dollars per year compared to \$37,431 dollars per year) (Lee 2002). Previous research has found that dialysis modality, rather than geographic location of the dialysis unit in itself, explained a significant amount of cost variation in dialysis (Hirth 2001). The observed cost differences are to be expected due to the differential utilization of haemodialysis according to location of residence. However, the reasons for the differential utilization of haemodialysis are not clear. It is possible that individuals who resided in urban

areas had closer access to haemodialysis centres. As well, it is possible that rural residents choose peritoneal dialysis over haemodialysis in order to avoid the travel that might be associated with haemodialysis.

Overall Costs

Despite difference in the patterns of health care utilization, no regional differences were observed in age-adjusted overall costs for the 11-year follow-up period. In the later years of follow-up, crude costs were similar as well. Thus, it appears that rural location, in itself, was not associated with higher per capita health care costs overall, despite the unique challenges of rural health care delivery. Importantly, the overall average cost of care per individual with diabetes decreased from 1991 to 2001 for all locations of residence. Of course, the overall cost of care for the population increased due to an increasing prevalence of the condition over time. Hospital costs were the largest cost category (44 to 49% in 2001) and, as such, strongly influenced the observed trends in overall costs. Dialysis, day surgery and prescription costs tended to increase from 1991 to 2001, but were offset by larger decreases in hospital costs.

Mortality

Age-standardized mortality rates increased slightly over the follow-up period for all locations of residence, with no differences according to rural versus urban residence. Previous research in the general Canadian population found that individuals who live in metropolitan and urban centres have longer life-expectancies (Shields 2002). Therefore, it is somewhat surprising that we did not observe any urban versus rural mortality gradients. Individuals in rural areas more frequently report poor health practices (Shields 2002; Mitura 2003) and diabetes self-care involves healthy eating, exercise and weight management (Canadian Diabetes Association 2003). In the case of diabetes, it may be that the impact the disease itself has on mortality (Health Canada 2003) is more important than the influence of location of residence. The rising mortality rates over the follow-up period are somewhat surprising given the availability of medications for preventing complications and of evidence-based treatment guidelines in the later years of follow-up. At the same time, it is apparent that in 2001, the use of some of the preventive medications (e.g., ASA) was quite low. In contrast, Booth and colleagues recently reported declining all-cause mortality between 1992 and 1999 among the Ontario population with and without

diabetes, due in large part to a substantial decline in the rates of heart attack and stroke (Booth 2006). They note, however, that despite the declining rate of events, the absolute number of cardiovascular events and deaths is actually increasing due to an increase in the prevalence of type 2 diabetes.

Limitations

The observed differences in cost and utilization of health care services according to location of residence should be considered in light of a number of limitations. First, while there is good evidence of the validity of the NDSS criteria for identifying diabetes cases, some cases might still be missed (Hux 2002). Individuals whose physicians do not bill fee-for-service and do not shadow bill, for example, may not meet the NDSS criteria for diabetes unless they are hospitalized for diabetes. Further, some settlements in Saskatchewan's rural and northern health regions are served by nurse practitioners (NPs). Although some NPs shadow bill, the records are kept on a separate file and were not included in the compilation of the dataset for this project. Thus, utilization and cost are underestimated, particularly for Saskatchewan's rural population with diabetes. It is possible that visits to primary care providers in some rural regions of Saskatchewan were higher than in the large urban centres, but our analyses were unable to observe this.

Categorization of residential location (large urban, small urban or rural area) was available only at baseline. It is possible that some individuals moved between locations of residence during the 11-year period. Resource utilization and costs would be attributed to the incorrect category of residential location for individuals who moved from one category to another. The movement between rural and urban is unlikely to balance to zero, with the shift from rural to urban likely being larger. Thus, misclassification bias in this respect could be differential.

Overall cost estimates were limited to the direct costs of medical care, of which five cost categories were included. We were unable to capture resource utilization and costs managed under the global budgets of the health regions in Saskatchewan. This would include resources such as diabetes educators, dietitians, podiatrists and auxiliary costs of transplants (e.g. transplant coordinators and costs for living donors). As well, we were unable to capture other costs such as emergency department services that were not subject to fee-for-service billing. By

excluding some outpatient costs and emergency department services, average direct medical costs of care would be underestimated for all regions. However, if location of residence were associated with the use cost categories that were not included, rural versus urban comparisons of overall costs could be biased. Further, we did not include indirect or direct non-medical costs in this analysis. Travel costs to receive care, for example, are generally greater for individuals who live in rural areas (Asthana 2003). Distances to travel to see a specialist, for example, may be approximately 30 times higher in rural areas than in urban areas (Natural Resources Canada 2004b).

Data were not directly available from Saskatchewan Health for some cost categories, and external sources were used to generate cost estimates. For example, dialysis costs were based on costs estimated in an Alberta study (Lee 2002). It is not clear to what extent dialysis costs in Alberta are generalizable to Saskatchewan. As well, hospital and day surgery costs were based on resource intensity or DPG weights and the estimated funding per weighted case for the year 2001. We would have preferred to use the estimated funding per weighted case for each year inflated to 2001 dollars, but an estimated funding per weighted case was not available for 1991 to 1994. Thus, costs in the early years may have been overestimated. Further, weights were not calculated in the early years and some were missing in later years. Since April 1, 1998, however, weights were missing only if the hospitalization was in an out-of-province hospital that does not report to the Canadian Institute for Health Information (CIHI). Consequently, we had to use imputation methods to estimate missing weights.

We reported patterns of drug use based on drugs covered by the Drug Plan, but recognize that this may not reflect all drug use. As ASA is an inexpensive non-prescription medication, it is possible that some individuals chose to purchase this medication without having a claim submitted to Saskatchewan Health on their behalf. This drug use would not be captured in the database, leading to an underestimate of ASA use in all locations of residence. In a sample of rural Albertans with diabetes, reported ASA use was considerably higher than what was observed in this study, with 22% of individuals in the study self-reporting its use, alone or in combination (Klinke 2004). Thus, it is quite likely that some ASA use was indeed missed in all areas.

Health policy changes in the province of Saskatchewan from 1991 to 2001 have implications for the interpretation of health care utilization and cost trends. For example, a number of changes in co-payments and deductibles for the Saskatchewan Drug Plan occurred during the study period which resulted in increased out-of-pocket costs for certain beneficiaries (Johnson 2002). As well, funding of some services, such as laboratory services, changed over the study period and were no longer reflected in fee-for-service physician billings after 1993 (Johnson 2002). Thus, estimates of costs and utilization of physician services may appear higher in the earlier years of the follow-up period simply due to this change in policy. The expansion of dialysis services available in rural areas in the late 1990s and early 2000's may have affected utilization of haemodialysis. More sites were added and some existing sites expanded their services by increasing the days per week from three to six and adding haemodialysis machines. Observed trends should be considered in light of these policy changes.

Changes in reporting and recording financial information for administrative records also changed over time. For day surgeries, the calculation of DPG weights was inconsistent in the early 1990s and this could impact the cost estimates (Johnson 2002). There have also been several changes to the definition of day surgery over time and the application of the definition was not standardized. As well, a number of RIWs and DPG weights were missing during the early 1990s, requiring imputation. There have also been changes in the intensity weight methodology over time.

CONCLUSION

From 1991 to 2001, we observed differences in the patterns of health care utilization and costs for physician services, prescriptions, hospitalizations, day surgeries and dialysis according to the location of residence. Individuals in large urban areas generated higher physician, prescription medication, dialysis and day surgery costs than did their rural counter parts, but hospital costs were lower. Overall direct health care costs and mortality, however, were similar for individuals residing in rural and urban centres. It seems that outcomes, both economic and clinical, were similar across location of residence even though there were differences in service utilization across the five categories. Thus, differences in the mix of services received by individuals who

resided in rural versus urban areas does not appear to have affected either economic or clinical outcomes.

REFERENCE LIST

1. Andrus, MR, Kelley, KW, Murphey, LM, Herndon, KC (2004). A comparison of diabetes care in rural and urban medical clinics in Alabama. *Journal of Community Health*, 29, 29-44.
2. Asthana, S, Gibson, A, Moon, G, Brigham, P (2003). Allocating resources for health and social care: the significance of rurality. *Health and SocialCare Community*, 11, 486-493.
3. Bay, KS, Long, MJ, Ross Kerr, JC (1997). Utilization of hospital services by the elderly: geriatric crisis in one Canadian single payer system. *Health Services Management Research*, 10, 42-57.
4. Blazer, DG, Landerman, LR, Fillenbaum, G, Horner, R (1995). Health services access and use among older adults in North Carolina: urban vs rural residents. *American Journal of Public Health*, 85, 1384-1390.
5. Booth, GL, Hux, JE (2003). Relationship between avoidable hospitalizations for diabetes mellitus and income level. *Archives of Internal Medicine*, 63, 101-106.
6. Booth, GL, Kapral, MK, Fung, K, Tu, JV (2006). Recent trends in cardiovascular complications among men and women with and without diabetes. *Diabetes Care*, 29, 32-37.
7. Brown, EM, Goel, V (1994). Factors related to emergency department use: results from the Ontario Health Survey 1990. *Annals of Emergency Medicine*, 24, 1083-1091.
8. Canadian Diabetes Association (2003). Canadian Diabetes Association 2003 clinical practice guidelines for the prevention and management of diabetes in Canada. *Canadian Journal of Diabetes*, 27S1-S152.
9. Centre for Chronic Disease Prevention and Control (2002). *Diabetes in Canada, Second Edition*. Health Canada.
10. Downey, W, Beck P, McNutt M, Stang M, Osei W, & Nichol J (2000). Health databases in Saskatchewan. In B. Strom (ed.), *Pharmacoepidemiology*, 325-345. Wiley: Chinchester.
11. Glasgow, RE, Strycker, LA (2000). Preventive care practices for diabetes management in two primary care samples. *American Journal of Preventive Medicine*, 19, 9-14.
12. Health Canada (2003). *Responding to the challenge of diabetes in Canada. First report of the National Diabetes Surveillance System (NDSS)*. Ottawa: Health Canada.

13. Hirth, RA, Tedeschi, PJ, Wheeler, JR (2001). Extent and sources of geographic variation in Medicare end-stage renal disease expenditures. *American Journal of Kidney Disease*, 8, 824-31.
14. Hutten-Czapski, P (1998). Rural incentive programs: a failing report card. *Canadian Journal of Rural Medicine*, 3, 242-247.
15. Hux, JE, Ivis, F, Flintoft, V, Bica, A (2002). Diabetes in Ontario: determination of prevalence and incidence using a validated administrative data algorithm. *Diabetes Care*, 25, 512-516.
16. Johnson, JA, Simpson, SH, Jacobs, P, Downey, W, Beck, P, Osei, W (2002). Cost of health care for people with diabetes mellitus in Saskatchewan 1991 to 1996 (Rep. No. Working Paper 02-02).
17. Jordan, K, Ong, BN, Croft, P (2003). Previous consultation and self reported health status as predictors of future demand for primary care. *Journal of Epidemiology Community Health*, 57, 109-113.
18. Kennedy, BS, Kasl, SV, Vaccarino, V (2001). Repeated hospitalizations and self-rated health among the elderly: a multivariate failure time analysis. *American Journal of Epidemiology*, 153, 232-241.
19. Klinke, JA, Johnson, JA, Guirguis, LM, Toth, EL, Lee, TK, Lewanczuk, RZ, et al. (2004). Underuse of aspirin in type 2 diabetes mellitus: prevalence and correlates of therapy in rural Canada. *Clinical Therapy*, 26, 439-446.
20. Lee, H, Manns, B, Taub, K, Ghali, WA, Dean, S, Johnson, D, et al. (2002). Cost analysis of ongoing care of patients with end-stage renal disease: the impact of dialysis modality and dialysis access. *American Journal of Kidney Disease*, 40, 611-622.
21. Maddigan, SL, Feeny, DH, Majumdar, SR, Farris, KB, Johnson, JA (2005). Health Utilities Index Mark 3 demonstrated construct validity in a population-based sample with type-2 diabetes. *Journal of Clinical Epidemiology*, submitted, April 2005.
22. Mathews, M, Edwards, AC (2004). Having a regular doctor: rural, semi-urban and urban differences in Newfoundland. *Canadian Journal of Rural Medicine*, 9, 166-172.
23. Meltzer, S, Leiter, L, Daneman, D, Gerstein, HC, Lau, D, Ludwig, S, et al. (1998). 1998 clinical practice guidelines for the management of diabetes in Canada. Canadian Diabetes Association. *Canadian Medical Association Journal*, 159 Suppl 8, S1-29.
24. Mitura, V, Bollman, RD (2003). The health of rural Canadians: A rural-urban comparison of health indicators. *Rural and Small Town Canada Analysis Bulletin*, 4, 1-23.

25. Natural Resources Canada (2004a). Average distance to the nearest family physician, 1998. Available at:
<http://atlas.gc.ca/site/english/maps/health/ruralhealth/distancephysicians/distancefamilyphysician/1>.
26. Natural Resources Canada (2004b). Average distance to the nearest physician specialist, 1998. Available at:
<http://atlas.gc.ca/site/english/maps/health/ruralhealth/distancephysicians/distancephysicianspecialist/1>.
27. Natural Resources Canada (1-1-2004c). Old-age dependency ratios, 2000. Available at:
<http://atlas.gc.ca/site/english/maps/health/ruralhealth/agingpop/dependencyratios2000/1>.
28. Nemet, GF, Bailey, AJ (2000). Distance and health care utilization among the rural elderly. *Social Science and Medicine*, 50, 1197-1208.
29. Parkerson, GR, Jr, Gutman, RA (2000). Health-related quality of life predictors of survival and hospital utilization. *Health Care Financial Reviews*, 21, 171-184.
30. Pearson, S, Stewart, S, Rubenach, S (1999). Is health-related quality of life among older, chronically ill patients associated with unplanned readmission to hospital? *Australia New Zealand Journal of Medicine*. *New Zealand Journal of Medicine*, 29, 701-706.
31. Rosenblatt, RA, Baldwin, LM, Chan, L, Fordyce, MA, Hirsch, IB, Palmer, JP, et al. (2001). Improving the quality of outpatient care for older patients with diabetes: lessons from a comparison of rural and urban communities. *Journal of Family Practice*, 50, 676-680.
32. Saskatchewan Health. (2005). The Saskatchewan Drug Plan. Available at:
www.health.gov.sk.ca/ps_drug_plan.html. Accessed May 3, 2005.
33. Shields, M, Tremblay, S (2002). The health of Canada's communities. *Health Reports*, 13, S1-S24.
34. Statistics Canada (2000). How healthy are Canadians? *Health Reports*, 12, 9-51.
35. Statistics Canada. (2002). 2001 Census. Available at:
www12.statcan.ca/english/census01/products/standard. Statistics Canada .
36. Supina, AL, Guirguis, LM, Majumdar, SR, Lewanczuk, RZ, Lee, TK, Toth, EL, et al. (2004). Treatment gaps for hypertension management in rural Canadian patients with type 2 diabetes mellitus. *Clinical Therapies*, 26, 598-606.
37. Toth, EL, Majumdar, SR, Guirguis, LM, Lewanczuk, RZ, Lee, TK, Johnson, JA (2003). Compliance with clinical practice guidelines for type 2 diabetes in rural patients: treatment gaps and opportunities for improvement. *Pharmacotherapy*, 23, 659-665.

38. Touati, N, Contandriopoulos, AP, Denis, JL, Rodriguez, C, Sicotte, C (2004). Care access in rural areas: what leverage mechanisms do regulatory agencies have in a public system? *Health Care Management Reviews*, 29, 249-257.
39. Veugelers, PJ, Yip, AM, Elliott, DC (2003). Geographic variation in health services use in Nova Scotia. *Chronic Diseases of Canada*, 24, 116-123.
40. Walter-Ginzburg, A, Chetrit, A, Medina, C, Blumstein, T, Gindin, J, Modan, B (2001). Physician visits, emergency room utilization, and overnight hospitalization in the old-old in Israel: the cross-sectional and longitudinal aging study (CALAS). *Journal of the American Geriatric Society*, 49, 549-556.
41. Wyke, S, Hunt, K, Walker, J, Wilson, P (2003). Frequent attendance, socioeconomic status and burden of ill health. An investigation in the west of Scotland. *European Journal of General Practice*, 9, 48-55.

APPENDICES

Appendix A: Saskatchewan Health Data Dictionaries

Saskatchewan Health

Population Health Branch

Research Services

Subject File : RSCHSUBJ.ASC (192,237 records)

Variable	Description	Position	Length	Type
STUDYID	study identification number	1	7	categorical
CASEID	case identification number for cases CASEID=STUDYID for controls CASEID=matching case's STUDYID	8	7	categorical
DIABCASE	diabetes case control indicator 0 = diabetes case 1 = control 1 2 = control 2	15	1	categorical
SEX	sex 1 = male 2 = female	16	1	categorical
YOB	year of birth	17	4	continuous
INDEX	index date Reported as a perpetual date.	21	5	continuous
SOURCE	data source of index diabetes event 0 = control 1 = hospital services file 2 = physician services file	26	1	categorical
ENROL	study enrolment date Reported as a perpetual date.	27	5	continuous
EXIT	study exit date Reported as a perpetual date.	32	5	continuous
COVEXIT	coverage at exit date 00 = active coverage 01 = deceased 02 = inactive coverage	37	2	categorical
REGIND	registered Indian status N = never registered Y = ever registered	39	1	categorical
PREVFLAG	prevalent diabetes flag 0 = subject did not meet diabetes definition in 1989 or 1990 1 = subject met diabetes definition in 1989 or 1990	40	1	categorical
URB_RUR	urban rural indicator 0 = large urban centre 1 = small urban centre 3 = rural 4 = unknown	41	1	categorical

Diabetes study SR 02-012
Johnson et al., IHE

Page 1 of 12

layout.xls; subject
2004-03-09

RHA1	regional health authority 1 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	42	2	categorical
RHA1P	proportion of subject's RM allocated to RHA1	44	4.2 explicit two-place decimal	continuous
RHA2	regional health authority 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	48	2	categorical
RHA2P	proportion of subject's RM allocated to RHA2	50	4.2 explicit two-place decimal	continuous
RHA3	regional health authority 0 = unknown 1 = Sun Country 2 = Five Hills 3 = Cypress 4 = Regina Qu'Appelle 5 = Sunrise 6 = Saskatoon 7 = Heartland 8 = Kelsey Trail 9 = Prince Albert Parkland 10 = Prairie North 11 = Mamawetan Churchill River 12 = Keewatin Yatthe 13 = Athabasca Health Authority	54	2	categorical
RHA3P	proportion of subject's RM allocated to RHA3	56	4.2 explicit two-place decimal	continuous

Notes:

1. The study identification number is unique to an individual.
2. Case identification number: for diabetes cases the CASEID is the same as the STUDYID and for controls the CASEID identifies to which case the control is matched.
3. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.
4. The year of birth for subjects born before 1906 is set to 1906.
5. The index date of diabetes case subjects is the earliest date between January 1, 1991 and December 31, 2001 that an individual meets the diabetes definition criteria. This date is set to 0 for controls.
6. The enrol date is the later of January 1, 1989 or actual coverage initiation.
7. Exit date is the earliest of death, coverage termination, or study end (December 31, 2001).
8. For subjects where the COVEXIT variable is reported as 01, study exit is due to death and the exit date is the date of death as reported on the person registry system. If COVEXIT is IA, study exit is due to coverage termination; the most likely reason for coverage termination is leaving the province.
9. Registered Indians are not eligible for Saskatchewan prescription drug benefits because they receive these benefits from the federal government.
10. Urban rural indicator: large urban centres with populations of 100,000 or larger include Saskatoon and Regina; small urban centres with populations between 5,000 and 99,999 include Estevan, Humboldt, Lloydminster, Meadow Lake, Melfort, Moose Jaw, Nipawin, North Battleford, Prince Albert, Swift Current, Weyburn, and Yorkton.
11. A rural municipality (RM) may be cross more than one regional health authority (RHA). In these cases, a proportion of each RM's population is assigned to each of the RHAs it crosses. If a subject's RM crosses more than one RHA, each RHA and its assigned proportion is reported. No RM is split among more than three RHAs.

Hospital Services File : RSCHHOSP.ASC (632,253 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
ADMT_DT	admission date Reported as a perpetual date.	8	5	continuous
DISC_DT	discharge date Reported as a perpetual date.	13	5	continuous
DAYSSTAY	length of stay in days	18	4	continuous
DCTYPE	discharge type A = alive D = deceased O = other	22	1	categorical
DAY_SX	day surgery flag 0 = inpatient stay 1 = day surgery record	23	1	categorical
HOSPTYPE	type of hospital B = base C = community R = regional U = out of province	24	1	categorical
DX1	diagnosis one	25	5	categorical
DX1TYPE	diagnosis one type M = most responsible	30	1	categorical
DX2	diagnosis two	31	5	categorical
DXTYPE	diagnosis two type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	36	1	categorical
DX3	diagnosis three	37	5	categorical
DX3TYPE	diagnosis three type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	42	1	categorical
DX4	diagnosis four	43	5	categorical

DX4TYPE	diagnosis four type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	48	1	categorical
DX5	diagnosis five	49	5	categorical
DX5TYPE	diagnosis five type 1 = pre-admit comorbidity 2 = post-admit comorbidity 3 = secondary	54	1	categorical
RIW	resource intensity weight	55	10.4 (implicit 4-place decimal)	continuous

Notes:

1. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.

2. Diagnoses are reported using ICD-9 codes 001 through 999.9 and V01 through V99.9 up to four digits, as specified in Table 1: Diagnoses of interest.

3. Diagnosis type: Prior to April 1, 1999 diagnoses were labelled primary, secondary, and other and are reported in that order on this file. Beginning April 1, 1999 each diagnosis was also assigned a type and the most responsible is always reported first but the other diagnoses are not reported in a hierarchical order. For these other diagnoses, the associated diagnosis type may be used to assess the relevance of the other diagnoses.

Most responsible: the one diagnosis which describes the most significant condition of the patient during hospitalization.

Pre-admit comorbidity: the diagnosis which has a significant influence on the patient hospitalization; sometimes described as primary.

Post-admit comorbidity: the diagnosis which describes a condition arising during the patient hospitalization; sometimes described as complication.

Secondary: the diagnosis which did not significantly contribute to the patient hospitalization.

4. The day surgery flag differentiates inpatient stays from day surgery admissions. The working definitions for day surgery have changed over time:

The first definition came into effect around 1989 and is a patient:

- who is not admitted as an inpatient to an inpatient bed, and
- undergoes an elective surgical, diagnostic or treatment procedure, and
- who is released on the same day, and
- who meets the criteria for category (1) or (2) day surgery patients.

A category (1) day surgery patient requires:

- a pre-admission work-up (history and physical exam), and
- a general anaesthetic or regional block, and
- post-operative observation in a recovery room or distinct observation unit with dedicated registered nursing care.

Examples of category (1) procedures include: dilation and curettage, arthroscopy, partial osteotomy, etc.

A category (2) day surgery patient requires:

- hospital treatment facilities (staff support and equipment not normally available in a physician's office), and
- local anaesthesia or sedative (e.g., IV diazepam) and or nursing support during administration of the treatment or procedure, and
- post-procedural assessment prior to release.

Examples of category (2) procedures include: biopsies, invasive diagnostic procedures of uterus, vasectomy, etc.

The second definition came into effect around 1997 or 1998 and was not meant to replace the above; it was an attempt to standardize the definition across the country. It reads as follows:

A service provided to a patient who is pre-booked and admitted to a formally organized unit of the hospital. This service requires an operating or procedure room and a post-anaesthetic or recovery room. Pre-operative, post-operative and discharge care, and follow-up instruction are provided. Such patients do no require admission to an inpatient bed and are usually discharged within a few hours following surgery.

For reporting purposes, the following two criteria must be met before submitting a day surgery claim:

- the patient must meet the day surgery definition and
- the procedure must appear on the Appendix H of the CIHI (Canadian Institute for Health Information) Directory for Use with Complexity.

These definitions are not applied consistently across facilities or even within facilities over time. This is not a validated field.

The most current definition came into effect April 1, 2002 but is not described here because it is outside the study period.

5. The discharge type is NOT a validated field.

6. Type of hospital: base includes St. Paul's, Royal University, Saskatoon City, Pasqua, Plains, and Regina General Hospitals and Wascana Rehabilitation Centre; regional includes Moose Jaw Union, Providence Place, Victoria, Holy Family, North Battleford Union, Swift Current Union, and Yorkton Regional Hospitals and after January 1, 2001 Lloydminster Hospital.

7. Resource intensity weight (RIW) is calculated by CIHI. An explanation of RIW and how it is calculated can be found at the following web site:

http://secure.cihi.ca/cihiweb/dispPage.jsp?cw_page=casemix_riw_e

All acute care hospitals in Saskatchewan (SK) have been reporting to CIHI since the 1998/99 fiscal year. Prior to that, about 80% of SK hospital separations were processed by CIHI. RIWs are therefore reported only on records from facilities reporting to CIHI.

RIWs have been used to calculate the cost of a hospital stay by multiplying the RIW by the cost per weighted case for that fiscal year (e.g., based on SK 1996/97 hospital services utilization and funding, the cost per weighted case was \$2,166.00 for 1996/97). See below Table I: cost per weighted case by fiscal year. This information is available since 1995/96 only.

For those records where no RIW is reported, an estimated RIW based on length of stay may be used. These are available upon request.

Table I: cost per weighted case by fiscal year

fiscal year	cost/weighted case
1995/96	\$2,031.47
1996/97	\$2,165.63
1997/98	\$2,249.09
1998/99	\$2,439.18
1999/00	\$2,840.05
2000/01	\$2,992.82
2001/02	\$3,369.77

Physician Services File : RSCHDRSV.ASC (340,052 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	date of service Reported as a perpetual date.	8	5	continuous
DOCSPEC	physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	13	1	categorical
DIAG_CAT	diagnosis	14	4	categorical
FSC	physician fee-for-service code	18	5	categorical
AMTPAID	amount paid	23	7.2 (implicit two-place decimal)	continuous

Notes

1. This is a service record file. It contains only those records with a fee-for-service code (FSC) of interest (see Table 2: Fee-for-service codes of interest). See the medical visit file for a comprehensive capture of all physician services, albeit collapsed to visits.

2. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.

3. Diagnosis is reported using ICD-9 codes 001 through 999 and V01 through V99 up to three digits and Medical Services Plan (MSP) codes Z01 through Z99 and C01 through C99, as specified in category Table 1: Diagnoses of interest.

4. Fee-for-service codes are listed in the *Payment schedule for insured services provided by a physician* see www.health.gov.sk.ca/info_center_publications_mshr.html.

5. Services delivered by physicians in salaried or contractual arrangements may or may not be captured (e.g., those on alternate payment contracts, some ER physicians, salaried Northern Medical Services physicians, etc).

Physician Visit File : RSCHVIST.ASC (15,236,278 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	date of visit Reported as a perpetual date.	8	5	continuous
DOCSPEC	prescribing physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	13	1	categorical
DIAG_CAT	diagnosis	14	4	categorical
AMTPD	amount paid	18	9.2 (implicit two-place decimal)	continuous

Notes

1. This is a visit-based file. Visits were collapsed from service-based records on the following variables: unique identifier, diagnosis, date of service, practitioner number, clinic number, and location of service. That is, all services delivered to a single person by a single physician for the same diagnosis on the same day at the same clinic and same location of service are reduced to a single visit record. The amount paid is calculated by summing the amount paid for each service record.

2. The perpetual date is based on a calendar with Day 1 = January 1, 1960.
SAS uses a perpetual calendar with Day 0 = January 1, 1960.

3. Diagnosis is reported using ICD-9 codes 001 through 999 and V01 through V99 up to three digits and Medical Services Plan (MSP) codes Z01 through Z99 and C01 through C99, as specified in category Table 1: Diagnoses of interest.

4. Services and therefore visits delivered by physicians in salaried or contractual arrangements may or may not be captured (e.g., those on alternate payment contracts, some ER physicians, salaried Northern Medical Services physicians, etc).

Prescription Drug File: RSCHDRUG.ASC (19,772,257 records)

Variable	Description	Position	Length	Type
STUDYID	study ID number	1	7	categorical
DATE	dispensing date	8	5	continuous
RX_CAT	drug category	13	3	categorical
DOCSPEC	prescribing physician speciality 1 = general practitioner 2 = pediatrician 3 = general internist, nephrologist or endocrinologist 4 = cardiologist 5 = all other internists 6 = psychiatrist 7 = other SK physicians 8 = out of province physician	16	1	categorical
QUANTITY	quantity dispensed	17	5	continuous
STRENGTH	strength	22	8.4 (implicit four-place decimal)	continuous
FORM	dosage form CAP = oral capsule CHT = chewable tablet CRT = controlled release tablet ECC = enteric coated capsule ECT = enteric coated tablet INJ = injection IRR = liquid irrigation LAC = long acting capsule LIQ = oral liquid ODT = oral disintegrating tablet PWD = powder RCT = rectal SKL = sprinkle capsule SLT = sublingual tablet SRT = sustained release tablet SUP = rectal suppository TAB = oral tablet XRC = extended release capsule	30	3	categorical
TOTLSUBM	total submitted cost	33	7.2 (implicit two-place decimal)	continuous

Saskatchewan Health		Population Health Branch		Research Services
PLANCOST	government share of cost	40	7.2 (implicit two-place decimal)	continuous
TOTLAPPR	total approved cost	47	7.2 (implicit two-place decimal)	continuous

Notes

1. The perpetual date is based on a calendar with Day 1 = January 1, 1960. SAS uses a perpetual calendar with Day 0 = January 1, 1960.
2. For drug category key see Table 3: Drug categories.
3. Strength is reported for categories 77, 79, and 200 through 349 otherwise zero filled. Strength is typically reported as number of mg per tablet, capsule or mL..
4. Dosage form is reported for categories 77, 79, and 200 through 349 only, otherwise blank.
5. Quantity is reported for categories 77, 79, and 200 through 349 only, otherwise zero filled. Quantity is typically reported as number of units (e.g., tablets, mL) dispensed.
6. Total submitted cost is the total cost submitted by the dispensing pharmacist.
7. Total approved cost is the total cost approved for payment by the Drug Plan.
8. Patient share of cost may be calculated by subtracting the government share of cost from the submitted or the approved cost.
9. There are 12 records on this file with a quantity dispensed of zero. There are several possible explanations:
 - a) although system will give a warning if 0 is entered for quantity, it can be overridden,
 - b) pharmacist dispensed sample medication, and therefore claimed only the dispensing fee
 - c) a paper claim which was manually processed and quantity not reported or not entered.

Appendix B: Consumer Price Index



Statistika
Canada Statistiquo
Canada

Canada



Fransais	Contact Us	Help	Search	Canada Site
The Daily	Canadian	Community	Our products	Home
Census	Statistics	Profiles	and services	Other links

CANSIM (\$)

Find it

Newsflash

Communiqué

CANSIM Help

Table 326-0002^{1,2,3,4,5,17} - Consumer price index (CPI), 2001 basket content, annual (Index, 1992=100)

Survey or program details:
Consumer Price Index - 2301

Geography⁶ - Saskatchewan

Commodities and commodity groups ⁹	Medicinal and pharmaceutical products	Prescribed medicines	Health care services
1991	97.6	96.1	95.6
1992	100.0	100.0	100.0
1993	105.3	106.4	102.7
1994	106.2	107.1	104.2
1995	107.2	108.1	105.5
1996	106.0	106.0	107.6
1997	99.2	97.2	108.4
1998	101.5	99.4	111.3
1999	99.9	97.1	113.9
2000	101.8	97.6	116.3
2001	105.5	101.6	119.8
2002	106.1	102.1	121.8
2003	107.1	102.9	124.3
2004	105.9	100.4	128.5

Source: Statistics Canada

Appendix C: Imputation of Resource Intensity Weights (RIW's) Based Upon Length of Stay (LOS)

# of days length of stay	Fiscal year				
	1991/92	1992/93	1993/94	1994/95	1995/96
0	0.4249	0.4514	0.455	0.5281	0.5303
1	0.5554	0.5481	0.5612	0.6655	0.5996
2	0.6653	0.6656	0.6622	0.679	0.6908
3	0.7188	0.727	0.7472	0.7101	0.7166
4	0.7619	0.8161	0.8028	0.8923	0.8422
5	0.8653	0.8967	0.8835	0.9169	0.9504
6	0.989	0.9681	0.984	1.0572	1.1399
7	1.1711	1.0131	1.0916	1.0996	1.1202
8	1.108	1.128	1.1649	1.1693	1.2385
9	1.2774	1.1945	1.268	1.4224	1.3376
10	1.3593	1.3541	1.2908	1.4115	1.4139
>10	$0.1445*los+0.0022$	$0.1423*los+0.0018$	$0.1438*los+0.0023$	$0.1539*los+0.0029$	$0.1578*los+0.0024$

# of days length of stay	Fiscal year					
	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02
0	0.4914	0.5032	0.4799	0.4518	0.4422	0.4294
1	0.6408	0.6054	0.5719	0.5191	0.5173	0.4984
2	0.6477	0.6446	0.6478	0.6037	0.6034	0.5841
3	0.6989	0.7288	0.7098	0.6722	0.6809	0.6570
4	0.8172	0.8315	0.783	0.7525	0.7736	0.7537
5	0.9157	0.9136	0.8837	0.8384	0.8562	0.8225
6	1.0661	1.0167	0.947	0.9061	0.9226	0.8834
7	1.0935	1.0779	1.0102	0.9851	0.9891	0.9584
8	1.2222	1.1969	1.06	1.0546	1.1303	1.0334
9	1.3139	1.2851	1.1854	1.1507	1.2204	1.1131
10	1.4048	1.3461	1.2403	1.2065	1.1846	1.1803
>10	$0.1236*los+0.0044$	$0.1195*los+0.0043$	$0.1113*los_0.0042$	$0.1357*los+0.0045$	$0.1404*los+0.0036$	$0.1455*los+0.0037$

Appendix D: Imputation of missing Day Surgery Day Procedure Group Weights

Calendar Year	Mean Imputation Values ^A		Replacement Values ^B
	Control	Diabetes Cases	Diabetes Cases and Controls
1991	-	-	0.2175
1992	-	-	0.2220
1993	-	-	0.2304
1994	0.2683	0.2753	-
1995	0.2591	0.2803	-
1996	0.2669	0.2902	-
1997	0.2543	0.2708	-
1998	0.2393	0.2615	-
1999	-	-	-
2000	-	-	-
2001	-	-	-

^A Missing day surgery DPG weights for 1994 to 1998 were replaced with the mean value for each cohort for a particular year. There were no missing day surgery DPG weights for 1999 to 2001.

^B Actual DPG weights were unavailable for three fiscal years: 1991/92 through 1993/94. Although 1993/94 was the introductory year for DPGs and DPG weights, the reported values for this fiscal year are considered unreliable. We therefore used the respective fiscal annual average DPG weight calculated and provided by Saskatchewan Health (W. Downey, personal communication, October 11, 2001) for all day surgery records for the calendar years 1991 through 1993.

Appendix E: Dialysis Cost Estimation

	Hemodialysis	Peritoneal Dialysis
Total expenses Including Physician Billings and Medications ¹ (2000 US\$)	\$42,057	\$26,959
Physician Billing ¹ (2000 US\$)	\$6761	\$1899
Total expenses Excluding Physician Billings (2000 US\$)	\$35,296	\$25,060
2000 Canadian Dollars ^A	\$51,179	\$36,337
2001 Canadian Dollars ^B	\$52,719	\$37,431

^A US \$1 = CAN \$1.45

^B Converted to 2001 dollars using the Consumer Price Index Health Care Services Basket

¹ Lee et al. (2002). 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; 40: 611 – 622.

Table 1: Comparison of Diabetes Cohorts by Urban or Rural Residence at Index

	Rural	Small Urban	Large Urban
N (%)	26656 (46)	11678 (20)	19440 (34)
Age – Mean (S.D.) years	63.1 (16.2)	62.5 (16.9)	59.3 (17.3)*
Sex – n (%) Male	14572 (54.7)	5956 (51.0)	10626 (54.7)*
Follow-Up – Mean (S.D.) years	5.6 (3.5)	5.6 (3.5)	5.6 (3.5)
Deaths 1991-2001 – n (%)	7351 (27.6)	3270 (28.0)	4545 (23.4)*

* P value < 0.001

Table 2: Diabetes Cases (1991 – 2001)

Year	Incident Cases	Prevalent Cases	Total Diabetes Cohort	NDSS Criteria Not Yet Satisfied	Follow-Up^{a,b} Terminated
1991	4731	18338	23069	34705	---
1992	3783	22276	26059	30922	793
1993	3451	24860	28311	27471	1992
1994	3119	26944	30063	24352	3359
1995	3192	28502	31694	21160	4920
1996	3235	30149	33384	17925	6465
1997	3691	31630	35321	14234	8219
1998	3698	33472	37170	10536	10068
1999	3765	35280	39045	6771	11958
2000	3663	37026	40689	3108	13977
2001	3108	38522	41630	---	16144

^a - Total number of diabetes cases whose follow-up was terminated as of the beginning of each year (i.e., January 1st)

^b – Total number of diabetes cases followed between 1991 and 2001 is 57,774, which is the sum of Total Diabetes Cohort in 2001 (41,630) and Follow-up Terminated in 2001 (16,144).

Table 3: Pharmacologic Management of Diabetes and Related Comorbidities by Urban or Rural Residence, 2001

	Large Urban (n=14207)	Small Urban (n=8220)	Rural (n=19203)	Total (N=41630)
Vascular Protection^a				
ACE Inhibitor***	38.1	37.6	40.0	38.9
Statin***	20.1	16.6	17.3	18.1
ASA***	6.5	7.7	8.3	7.6
ACE Inhibitor and Statin***	11.6	9.5	10.0	10.4
ACE Inhibitor, Statin, ASA	1.8	1.7	2.0	1.9
Diabetes Medications				
Metformin***	39.0	35.8	38.6	38.2
Sulfonylurea***	30.9	31.1	34.6	32.6
Other Oral Agent*	5.3	4.5	4.7	4.9
Insulin***	21.9	19.6	20.0	20.6
Testing Supplies				
Blood and urine testing supplies***	53.4	50.3	53.1	52.6

* p < 0.05

*** p < 0.001

^a Categories are not mutually exclusive (e.g. some individuals on ACE inhibitor and statins are included in the ACE inhibitor, statin and ASA group).

Table 4: Utilization of Antidiabetic Agents by Urban or Rural Residence, 2001

	Large Urban	Small Urban	Rural	Total
	(n=14207)	(n=8220)	(n=19203)	(N=41630)
No Medications***	33.3	37.5	33.0	34.0
Insulin Alone***	16.0	14.1	14.5	14.9
Oral Agents With Insulin***	5.9	5.6	5.5	5.6
Metformin and Insulin	3.0	2.9	2.8	2.9
Sulfonylurea and Insulin	0.3	0.4	0.4	0.3
Metformin, Sulfonylurea, Insulin	1.4	1.3	1.3	1.3
Other Combination, With Insulin	1.2	1.0	1.0	1.1
Oral Agents Without Insulin	44.8	42.8	47.2	45.4
Metformin Alone	14.8	12.8	13.6	13.9
Sulfonylurea Alone	10.4	11.2	12.6	11.5
Other Oral Agent Alone	0.4	0.3	0.4	0.4
Metformin and Sulfonylurea	15.6	15.3	17.2	16.2
Other Combination, Without Insulin	3.6	3.2	3.4	3.4

*** p < 0.001

Table 5: Top Five Most Responsible Reasons for Hospitalizations by Urban or Rural Residence, 1991 to 2001

Year	Large Urban	Small Urban	Rural
1991	Cardiovascular (19.2%) Digestive (9.1%) Diabetes (8.8%) Neoplasms (5.6%) Injury and Poisoning (5.6%)	Cardiovascular (17.1%) Diabetes (11.5%) Digestive (10.1%) Respiratory (6.1%) Neoplasms (5.7%)	Cardiovascular (17.2%) Diabetes (12.3%) Digestive (9.8%) Respiratory (7.4%) Injury and Poisoning (5.4%)
1992	Cardiovascular (20.9%) Digestive (9.0%) Diabetes (8.3%) Neoplasms (5.9%) Injury and Poisoning (5.4%)	Cardiovascular (17.5%) Digestive (11.4%) Diabetes (9.2%) Respiratory (7.5%) Neoplasms (5.4%)	Cardiovascular (17.4%) Diabetes (11.6%) Digestive (9.0%) Respiratory (7.5%) Neoplasms (5.4%)
1993	Cardiovascular (19.5%) Digestive (9.4%) Neoplasm (7.3%) Diabetes (7.3%) Respiratory (5.8%)	Cardiovascular (17.9%) Digestive (9.6%) Diabetes (9.6%) Respiratory (8.9%) Symptoms, Signs, Ill Defined Conditions (5.4%)	Cardiovascular (17.7%) Diabetes (11.1%) Digestive (10.3%) Respiratory (8.3%) Symptoms, Signs, Ill Defined Conditions (5.3%)
1994	Cardiovascular (20.3%) Digestive (9.4%) Respiratory (7.7%) Neoplasm (6.9%) Diabetes (6.5%)	Cardiovascular (20.2%) Digestive (9.4%) Respiratory (8.3%) Diabetes (8.0%) Neoplasm (6.0%)	Cardiovascular (17.9%) Digestive (9.6%) Diabetes (9.2%) Respiratory (8.5%) Neoplasm (5.8%)
1995	Cardiovascular (21.1%) Digestive (9.4%) Respiratory (6.6%) Diabetes (6.3%) Injury or Poisoning (5.9%)	Cardiovascular (19.3%) Digestive (9.8%) Respiratory (7.4%) Diabetes (7.3%) Symptoms, Signs, Ill Defined Conditions (6.5%)	Cardiovascular (18.5%) Digestive (10.4%) Diabetes (8.9%) Respiratory (8.7%) Symptoms, Signs, Ill Defined Conditions (5.7%)
1996	Cardiovascular (23.1%) Digestive (10.7%) Respiratory (7.6%) Diabetes (6.2%) Neoplasm (6.1%)	Cardiovascular (18.3%) Digestive (10.8%) Respiratory (8.9%) Diabetes (7.4%) Neoplasm (6.6%)	Cardiovascular (18.7%) Digestive (10.5%) Respiratory (8.9%) Diabetes (7.7%) Symptoms, Signs, Ill Defined Conditions (6.3%)

Table 5: Top Five Most Responsible Reasons for Hospitalizations by Urban or Rural Residence, 1991 to 2001 (continued)

Year	Large Urban	Small Urban	Rural
1997	Cardiovascular (22.2%)	Cardiovascular (19.8%)	Cardiovascular (19.1%)
	Digestive (9.6%)	Digestive (10.6%)	Digestive (11.2%)
	Respiratory (7.4%)	Respiratory (8.6%)	Respiratory (8.8%)
	Diabetes (6.4%)	Diabetes (7.0%)	Diabetes (8.3%)
	Injury or Poisoning (5.9%)	Symptoms, Signs, Ill Defined Conditions (6.0%)	Symptoms, Signs, Ill Defined Conditions (6.9%)
1998	Cardiovascular (21.8%)	Cardiovascular (20.9%)	Cardiovascular (19.2%)
	Digestive (10.2%)	Digestive (10.2%)	Digestive (10.3%)
	Respiratory (7.3%)	Respiratory (9.4%)	Respiratory (8.8%)
	Symptoms, Signs, Ill Defined Conditions (6.3%)	Diabetes (6.8%)	Diabetes (7.4%)
	Diabetes (6.1%)	Neoplasm (6.5%)	Symptoms, Signs, Ill Defined Conditions (6.6%)
1999	Cardiovascular (20.9%)	Cardiovascular (21.1%)	Cardiovascular (17.6%)
	Digestive (9.2%)	Digestive (10.2%)	Respiratory (10.9%)
	Respiratory (8.8%)	Respiratory (9.7%)	Digestive (10.2%)
	Injury or Poisoning (6.6%)	Injury and Poisoning (6.0%)	Symptoms, Signs, Ill Defined Conditions (7.3%)
	Neoplasm (6.4%)	Symptoms, Signs, Ill Defined Conditions (6.0%)	Diabetes (6.5%)
2000	Cardiovascular (21.2%)	Cardiovascular (18.9%)	Cardiovascular (18.2%)
	Digestive (9.7%)	Digestive (11.2%)	Digestive (10.8%)
	Respiratory (7.8%)	Respiratory (9.0%)	Respiratory (9.2%)
	Symptoms, Signs, Ill Defined Conditions (6.8%)	Symptoms, Signs, Ill Defined Conditions (6.6%)	Symptoms, Signs, Ill Defined Conditions (6.8%)
	Diabetes (6.5%)	Diabetes (6.2%)	Diabetes (6.5%)
2001	Cardiovascular (22.3%)	Cardiovascular (20.8%)	Cardiovascular (17.8%)
	Digestive (10.2%)	Digestive (10.7%)	Digestive (10.7%)
	Respiratory (8.1%)	Respiratory (8.6%)	Respiratory (8.2%)
	Symptoms, Signs, Ill Defined Conditions (6.5%)	Neoplasm (6.7%)	Neoplasm (6.5%)
	Injury and Poisoning (5.7%)	Diabetes (6.7%)	Diabetes (6.7%)

Table 6: Annual Hospitalizations by Type of Facility and Urban or Rural Residence, 1991 to 2001

Year	Location	Large Urban	Small Urban	Rural	Total
1991	Base	88.7%	22.5%	26.5%	40.4%
	Community	5.9%	29.3%	62.2%	41.7%
	Regional	3.2%	46.7%	8.4%	15.4%
	Out of Province	2.3%	1.5%	2.9%	2.4%
1992	Base	87.7%	22.2%	27.0%	40.0%
	Community	6.9%	29.2%	61.1%	41.8%
	Regional	2.5%	46.4%	9.3%	15.6%
	Out of Province	2.8%	2.3%	2.6%	2.6%
1993	Base	88.7%	21.2%	25.7%	40.7%
	Community	6.3%	28.3%	61.9%	40.9%
	Regional	2.4%	47.9%	9.6%	15.7%
	Out of Province	2.5%	2.6%	2.8%	2.7%
1994	Base	90.3%	20.8%	28.5%	43.0%
	Community	4.7%	28.9%	56.6%	37.0%
	Regional	2.7%	48.1%	11.2%	17.0%
	Out of Province	2.3%	2.2%	3.7%	3.0%
1995	Base	90.2%	20.9%	28.7%	43.8%
	Community	4.3%	26.8%	55.8%	35.7%
	Regional	2.9%	50.4%	12.3%	17.8%
	Out of Province	2.6%	1.9%	3.1%	2.7%
1996	Base	91.2%	19.8%	29.7%	43.6%
	Community	4.2%	29.4%	55.7%	36.7%
	Regional	2.1%	49.0%	11.2%	16.9%
	Out of Province	2.4%	1.8%	3.3%	2.8%
1997	Base	92.6%	20.8%	29.0%	43.3%
	Community	3.7%	27.5%	55.9%	36.7%
	Regional	1.8%	49.9%	11.8%	17.4%
	Out of Province	2.0%	1.8%	3.2%	2.6%
1998	Base	93.5%	19.1%	29.0%	43.9%
	Community	3.2%	29.5%	55.5%	36.0%
	Regional	1.4%	49.3%	11.9%	17.3%
	Out of Province	1.9%	2.1%	3.6%	2.8%
1999	Base	93.7%	19.4%	28.1%	43.7%
	Community	2.6%	29.7%	57.6%	37.1%
	Regional	1.3%	48.8%	11.3%	16.6%
	Out of Province	2.4%	2.2%	3.1%	2.7%

Table 6: Annual Hospitalizations by Type of Facility and Urban or Rural Residence, 1991 to 2001 (continued)

Year	Location	Large Urban	Small Urban	Rural	Total
2000	Base	95.6%	20.7%	29.0%	45.0%
	Community	1.6%	28.4%	57.1%	36.2%
	Regional	0.7%	49.2%	10.5%	16.1%
	Out of Province	2.2%	1.8%	3.4%	2.7%
2001	Base	96.2%	21.8%	29.8%	46.0%
	Community	1.5%	24.6%	56.2%	35.1%
	Regional	0.6%	51.8%	10.7%	16.4%
	Out of Province	1.8%	1.7%	3.3%	2.6%

Table 7: Overall Per Capita^a Health Care Costs by Urban or Rural Residence

Year	Large Urban		Small Urban		Rural	
	Crude	Age-Standardized	Crude	Age-Standardized	Crude	Age-Standardized
1991	5441	4256	6148	3838	6970	4037
1992	5580	4003	6255	4081	6624	3768
1993	5020	3563	5521	3321	5966	3368
1994	4407	3229	5907	3269	5213	3101
1995	4798	3499	5422	3290	5061	2994
1996	4270	3197	5092	3400	5008	3141
1997	4229	3275	5025	3202	4800	3075
1998	4252	3312	4648	3111	4418	2988
1999	4175	3240	4333	3153	4244	2905
2000	4378	3508	4620	3235	4347	3105
2001	4493	3454	4518	3427	4426	3289

^a Total cost for all diabetes cases divided by the number of diabetes cases, according to location of residence.

Figure 1: Total Physician Visits Per Capita, 1991 – 2001, by Urban or Rural Residence

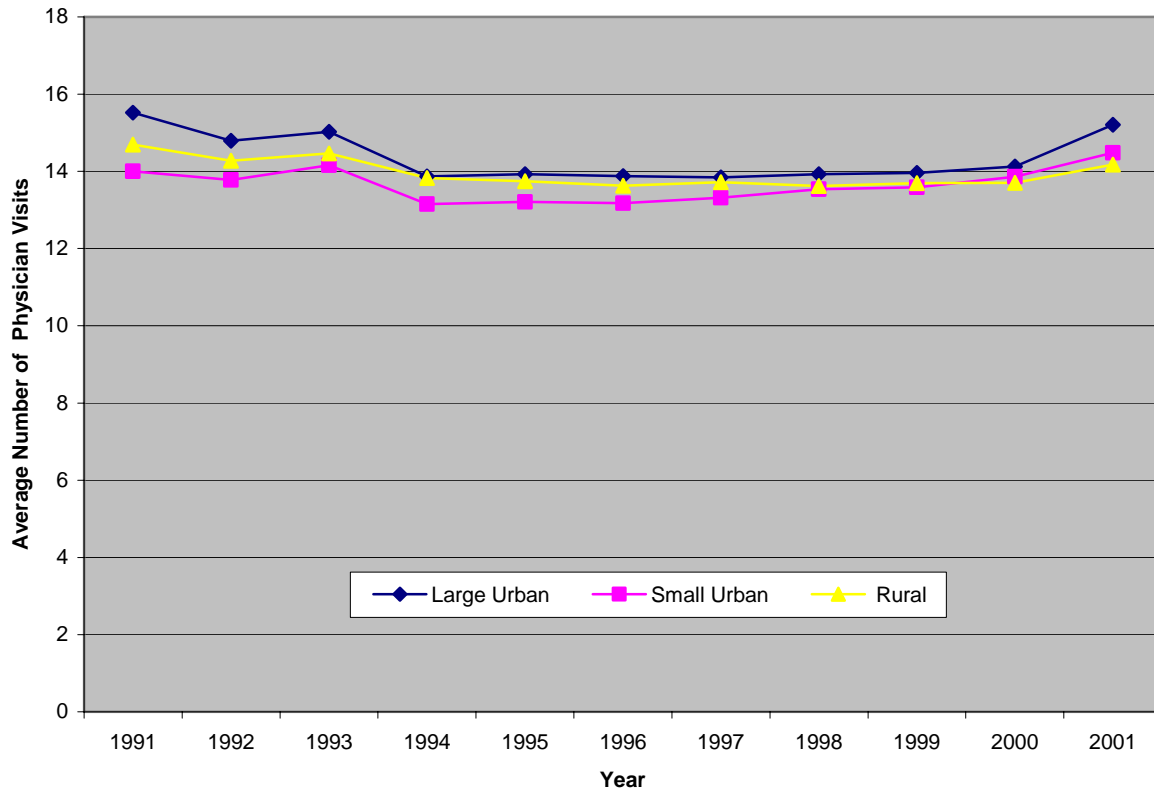


Figure 2A: General Practitioner Visits Per Capita, 1991 – 2001, by Urban or Rural Residence

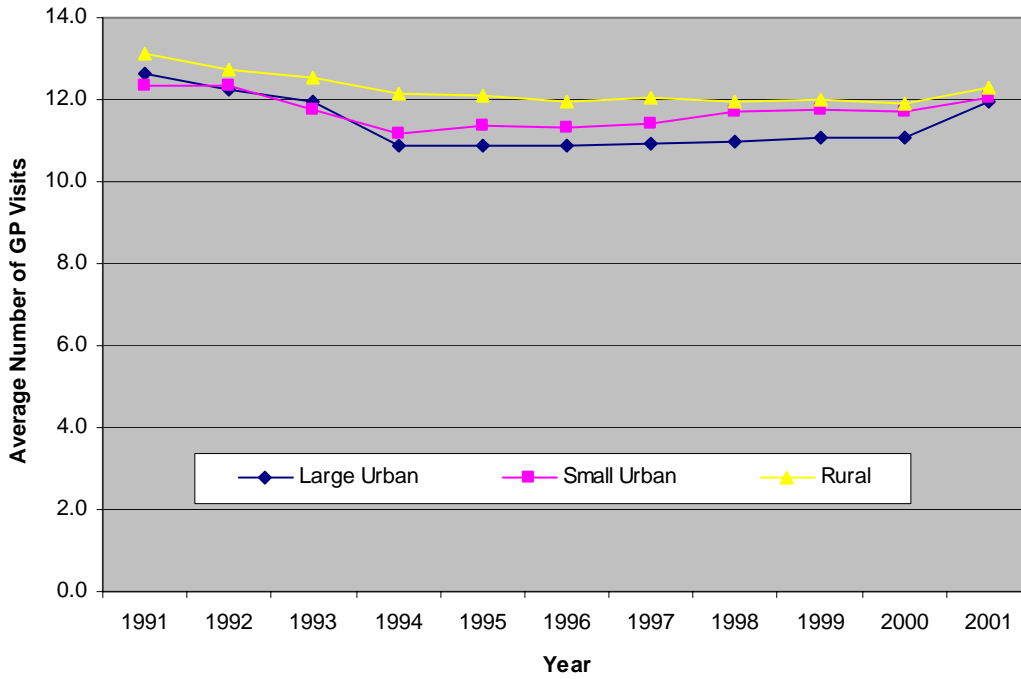


Figure 2B: Specialist Visits Per Capita, 1991 – 2001, by Urban or Rural Residence

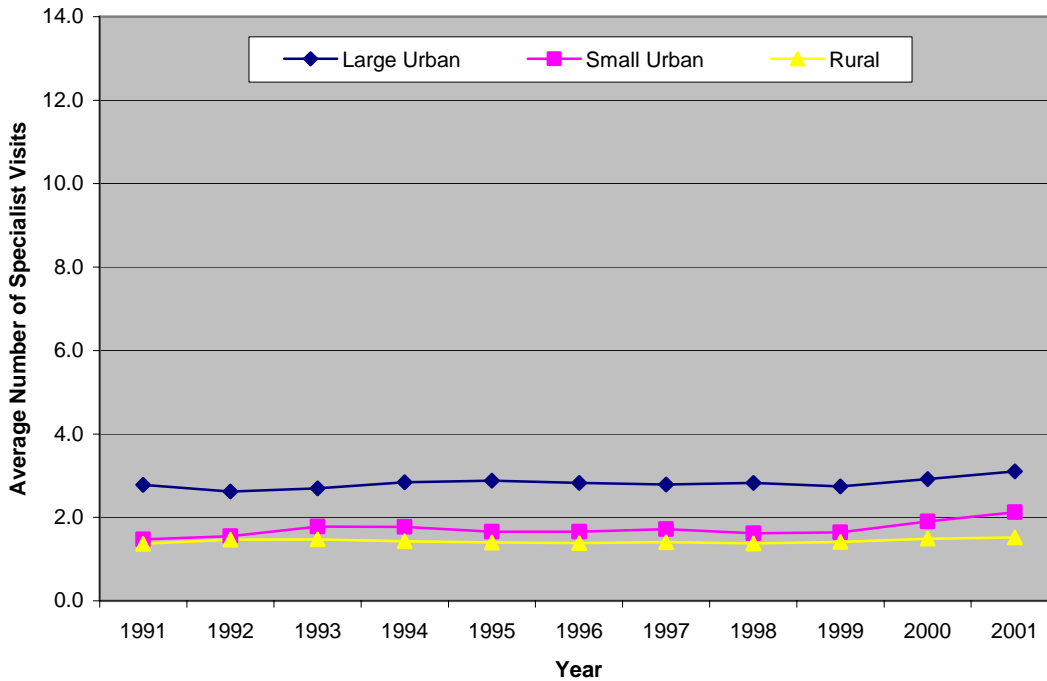


Figure 3A: Crude Physician Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

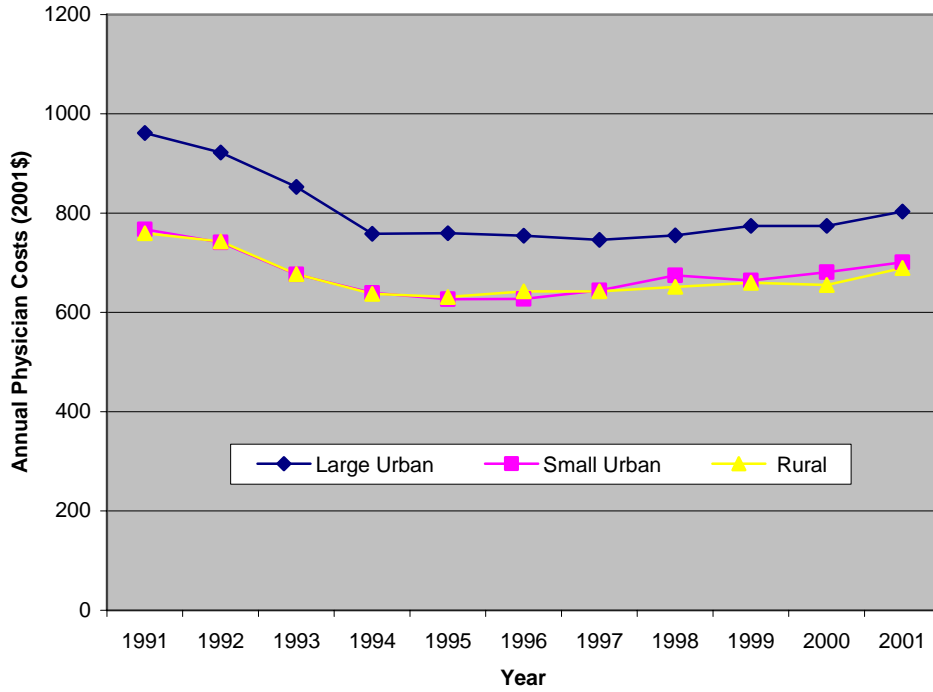


Figure 3B: Age-Standardized Physician Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

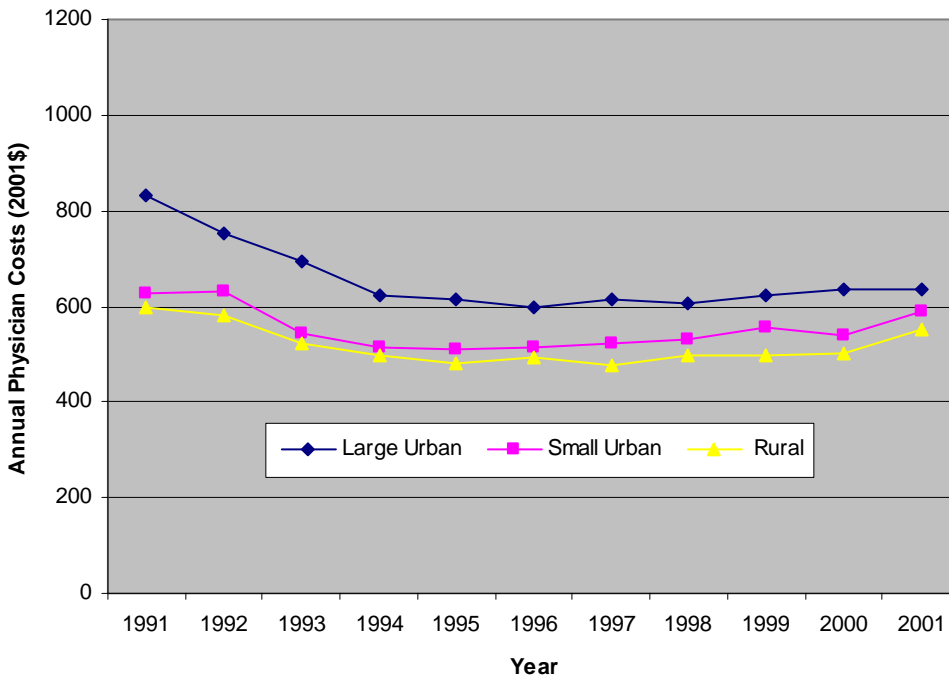


Figure 4: Average Annual Per Capita Prescription Dispensations, 1991 – 2001, by Urban or Rural Residence

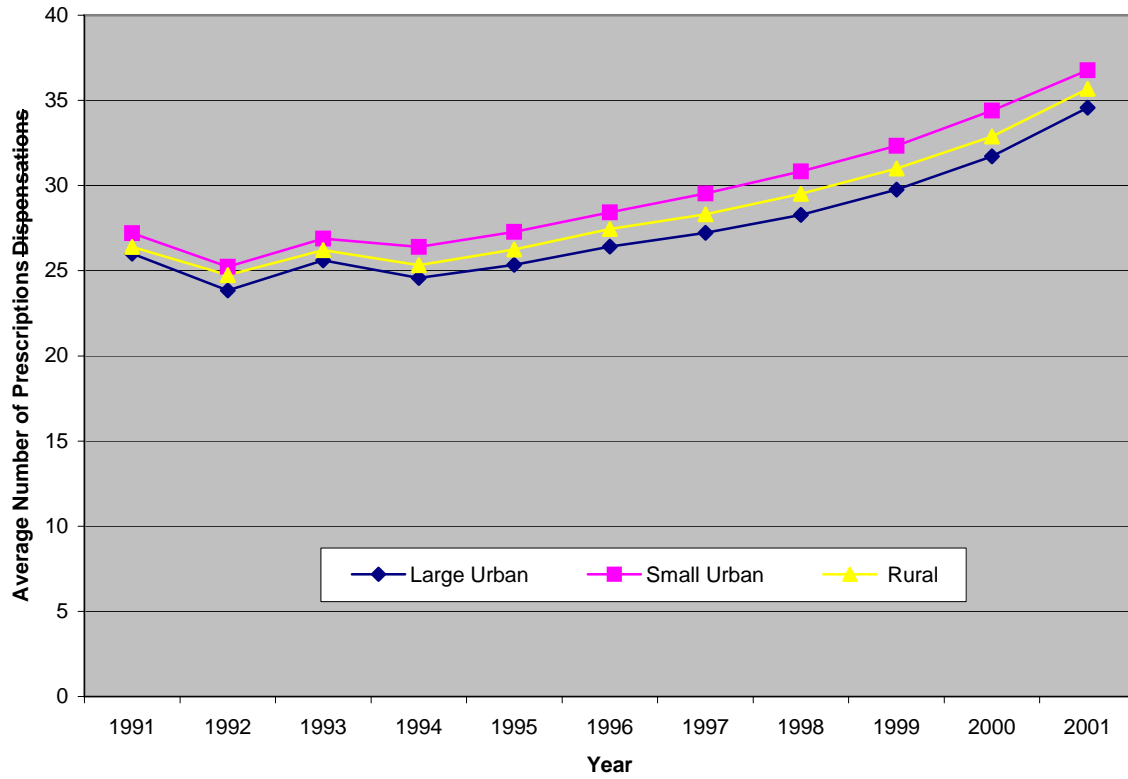


Figure 5A: Crude Annual Average Prescription Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

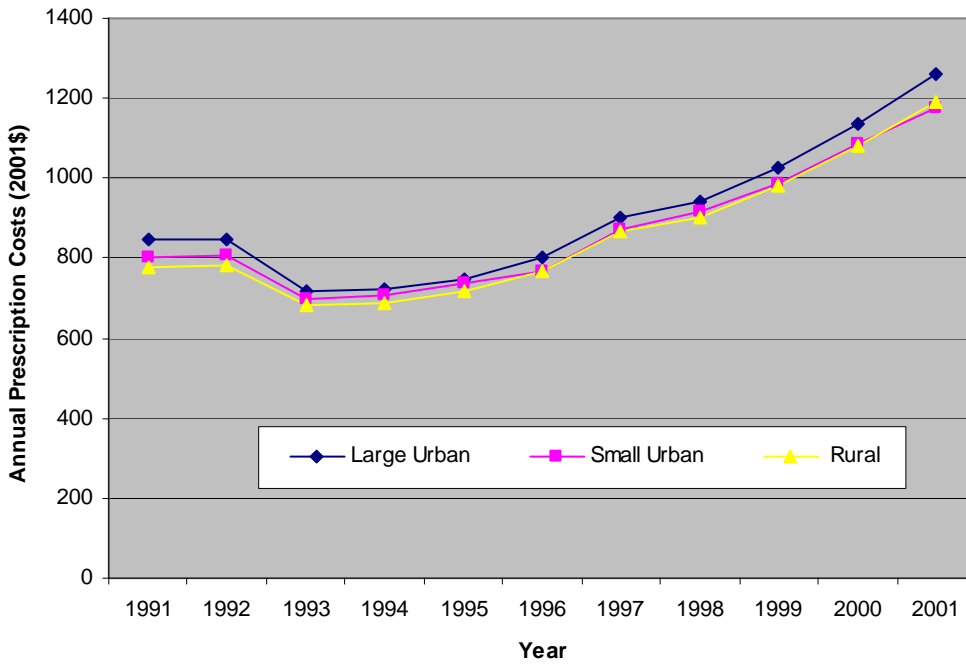


Figure 5B: Age-Standardized Annual Average Prescription Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

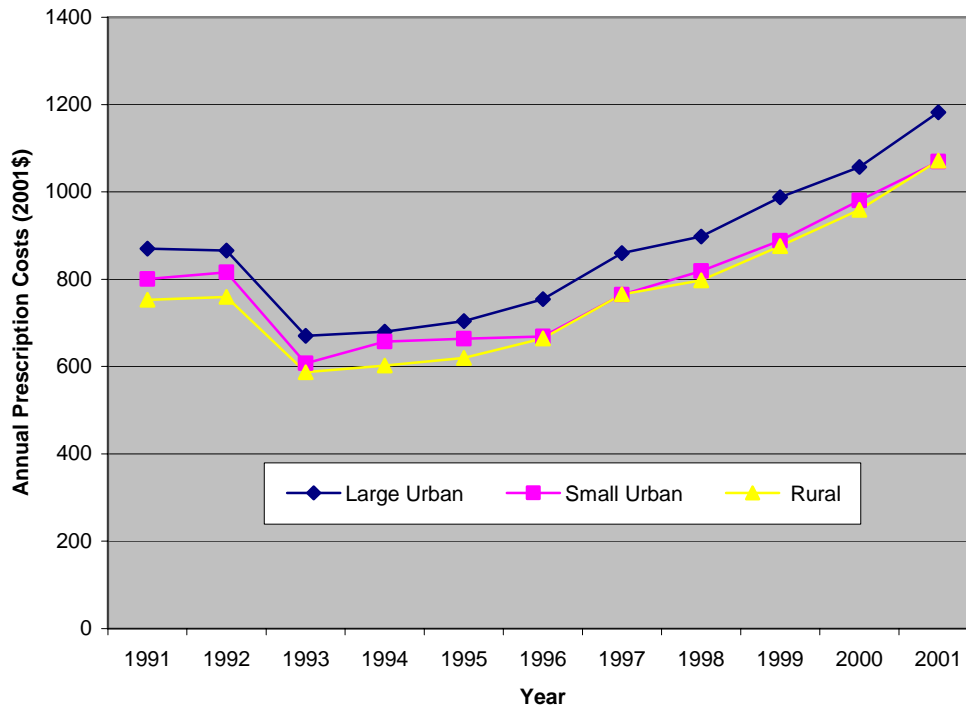


Figure 6: Hospital Discharges Per Capita, 1991 – 2001, by Urban or Rural Residence

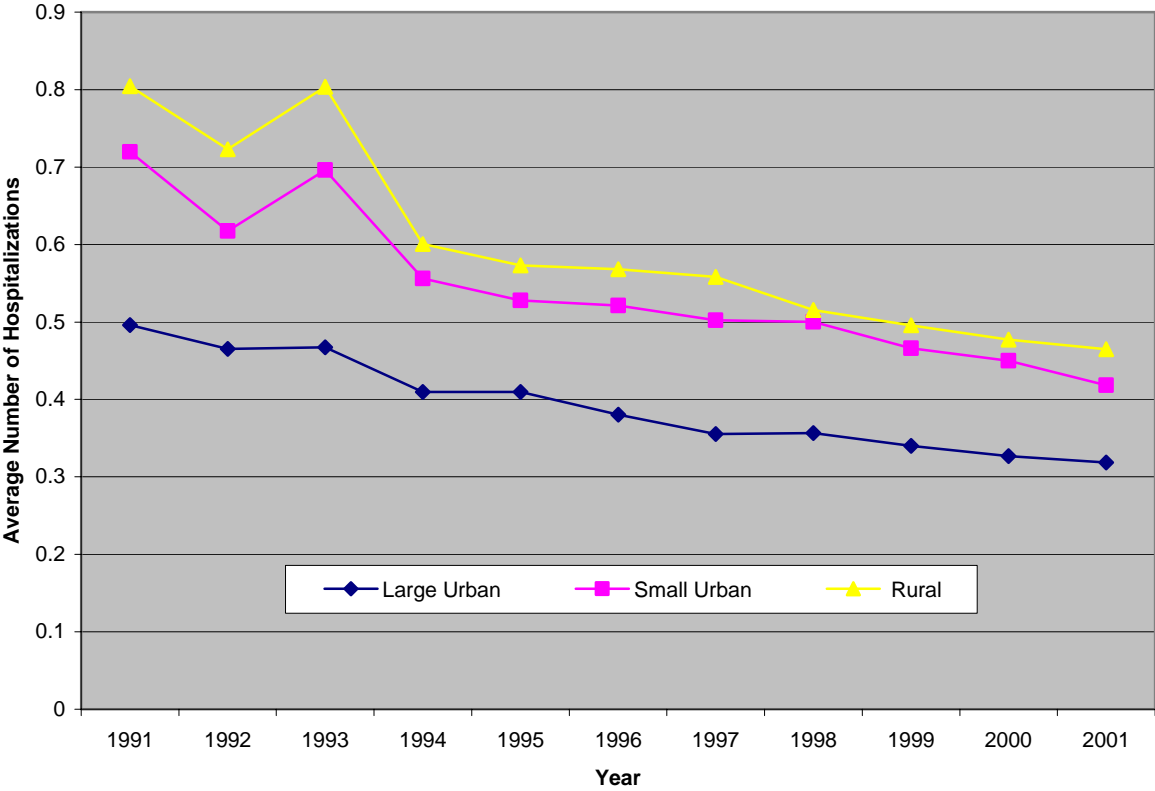


Figure 7: Average Length of Stay, 1991 – 2001, by Urban or Rural Residence

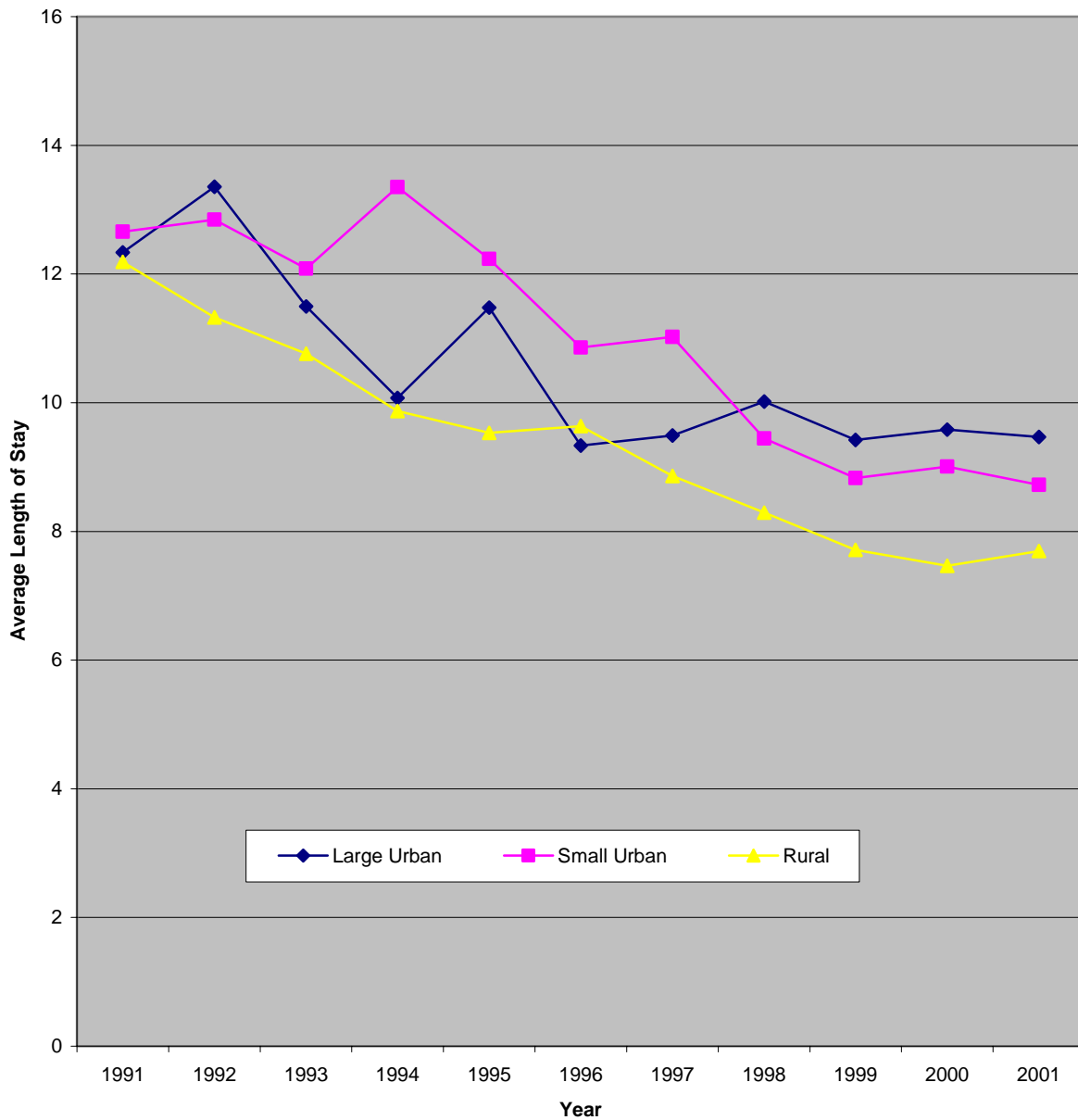


Figure 8A: Crude Hospital Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

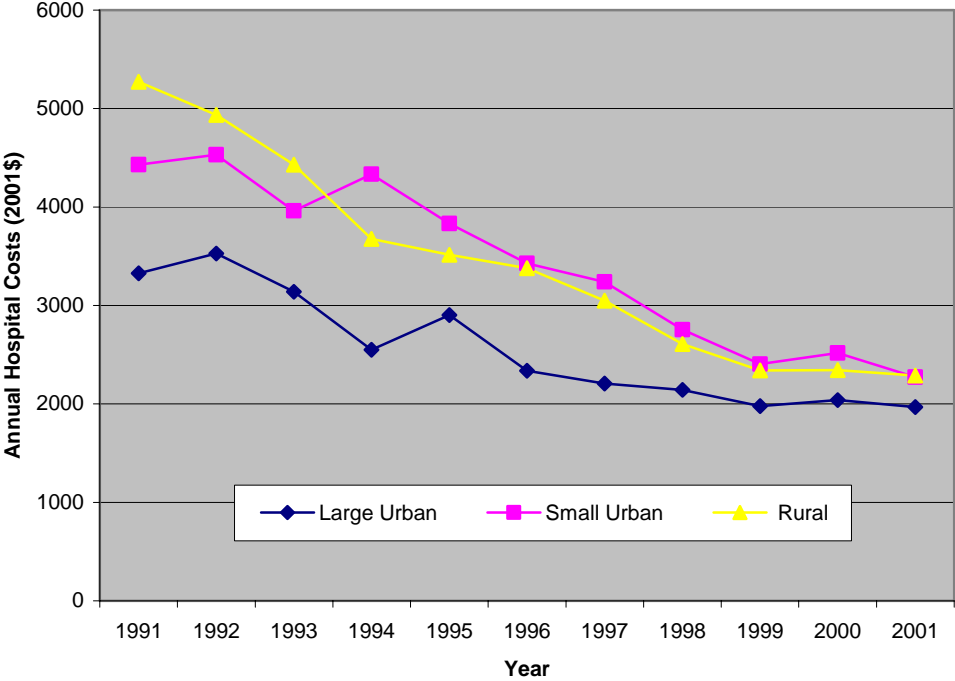


Figure 8B: Age-Standardized Hospital Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

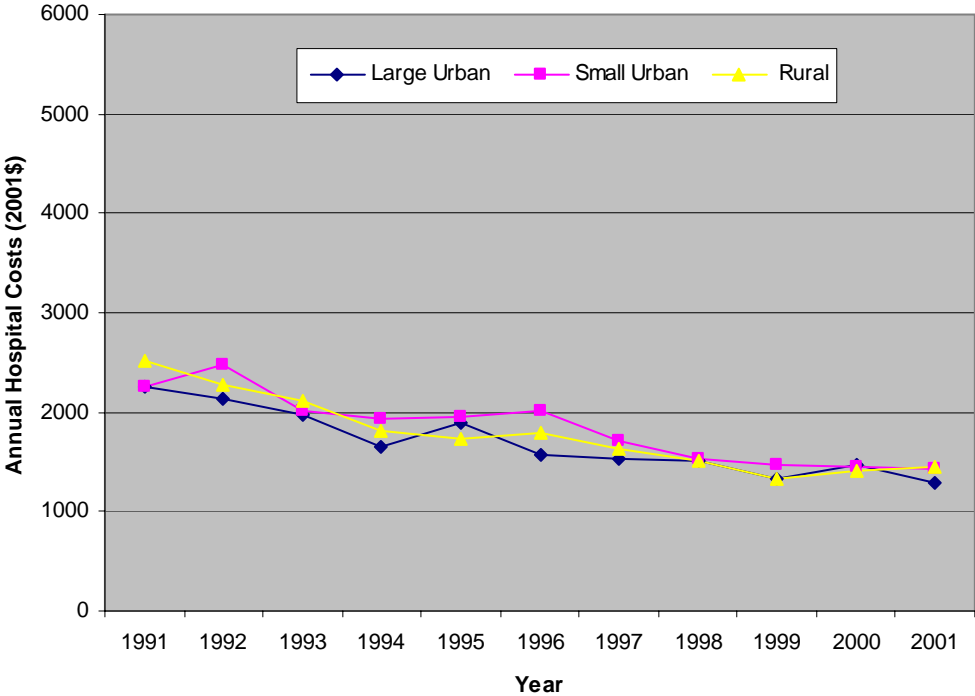


Figure 9: Day Surgery Utilization Per Capita, 1991 – 2001, by Urban or Rural Residence

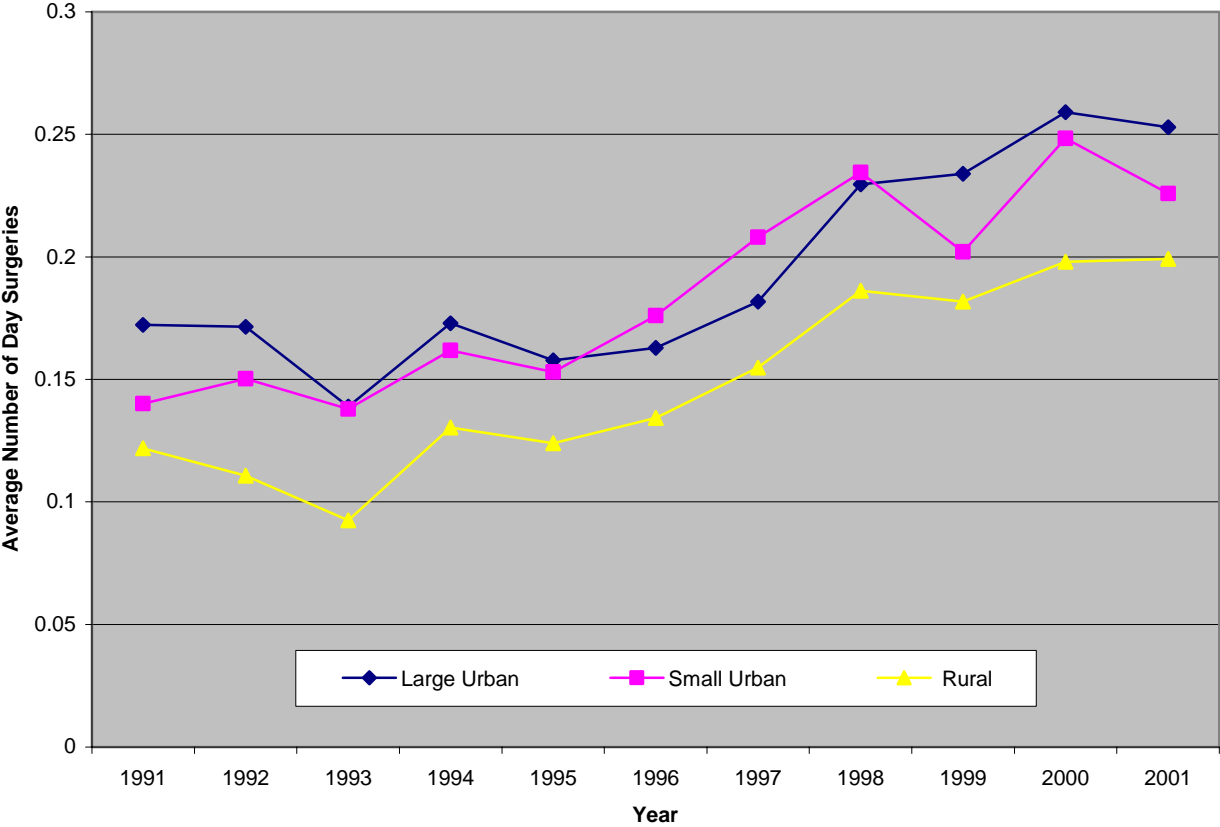


Figure 10A: Day Surgery Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

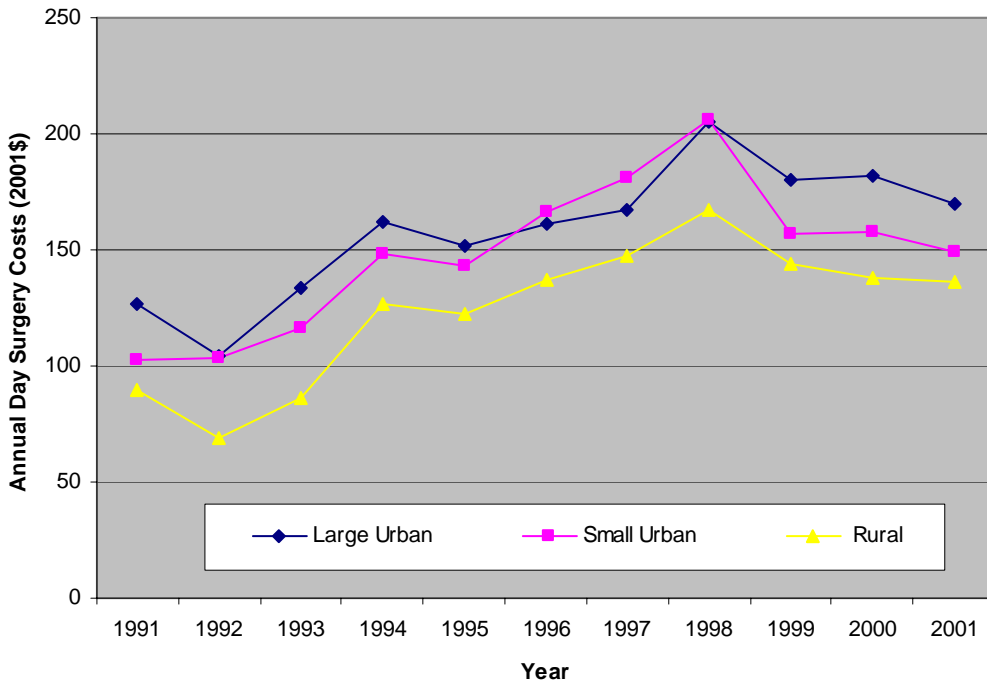


Figure 10B: Age-Standardized Day Surgery Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

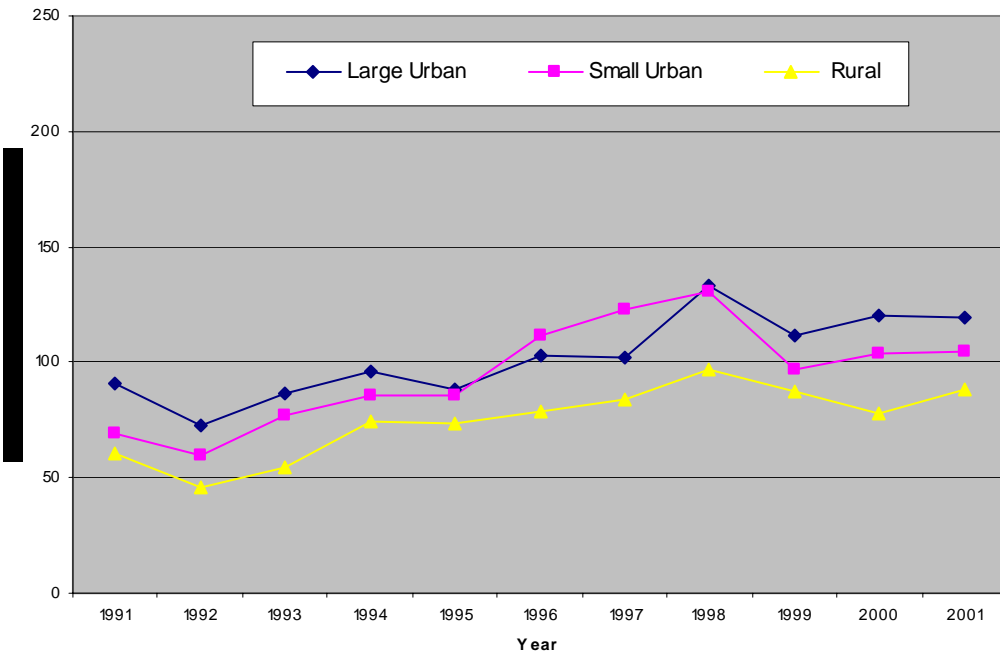


Figure 11: Average Annual Number of Days on Haemodialysis Per Dialysis Recipient, 1991 – 2001, by Urban or Rural Residence

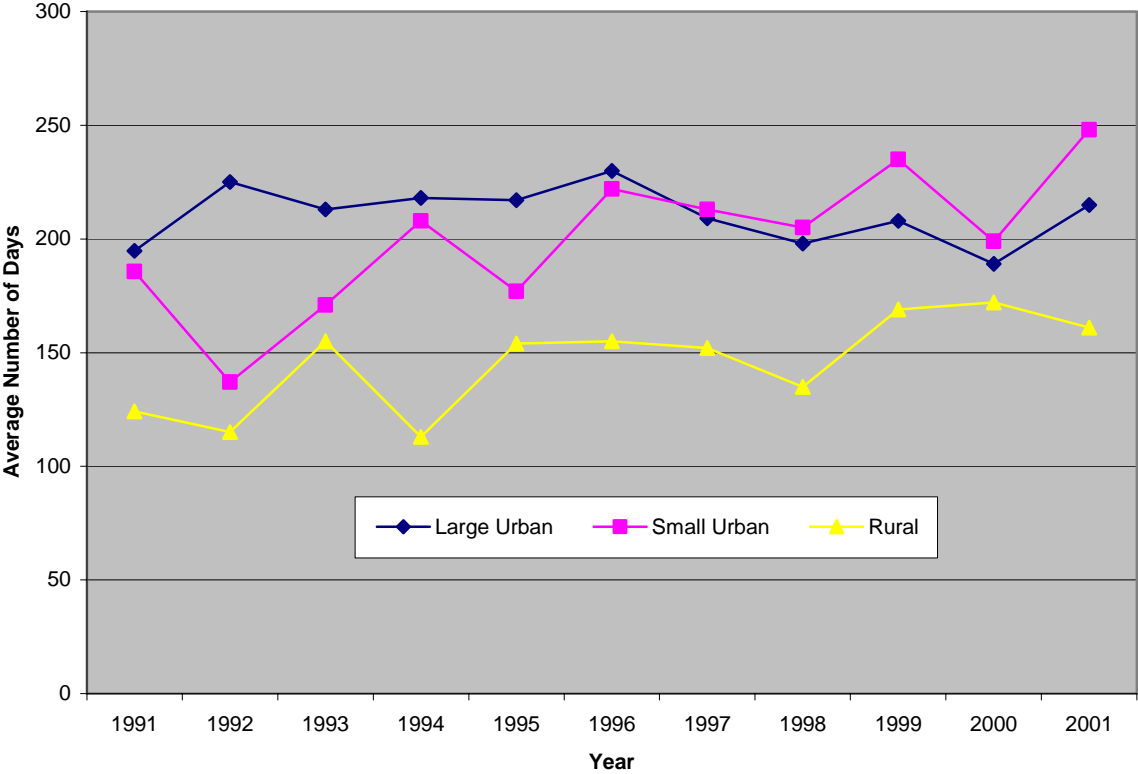


Figure 12: Annual Number of Days on Peritoneal Dialysis Per Dialysis Recipient, 1991 – 2001, by Urban or Rural Residence

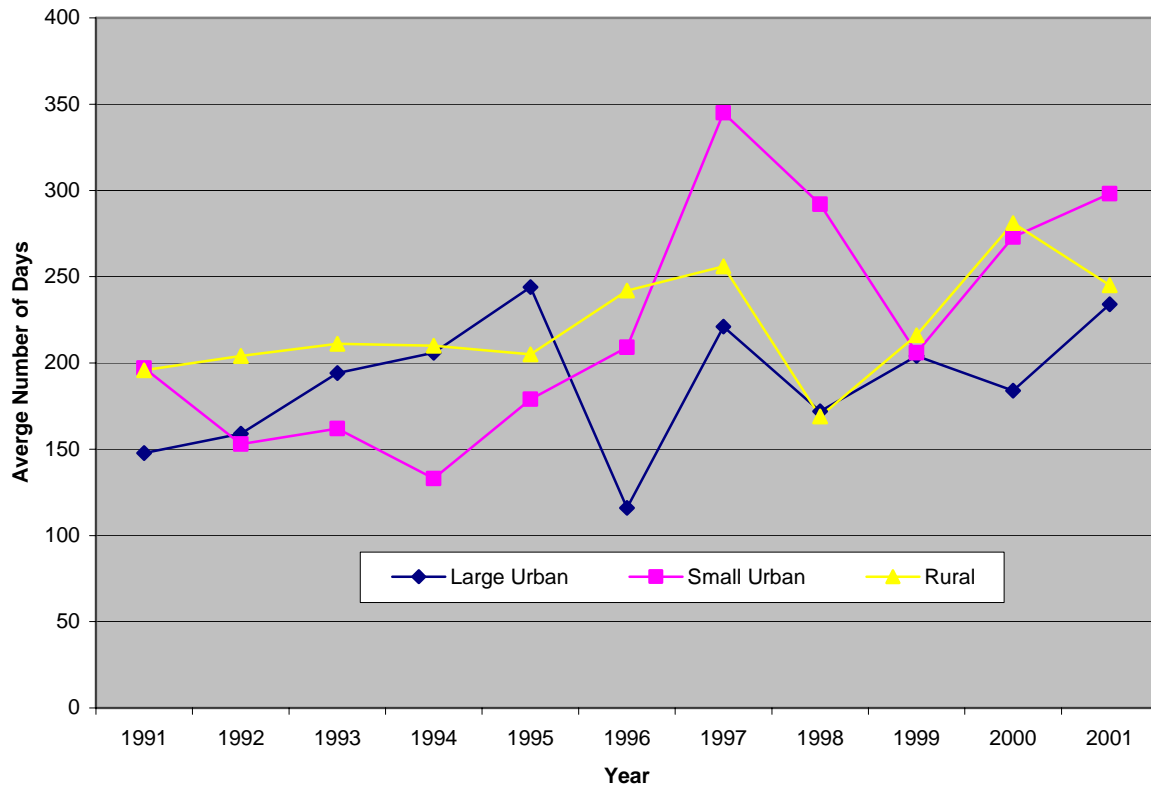


Figure 13: Haemodialysis Utilization (Alone or in Combination with Peritoneal Dialysis), 1991 – 2001, by Urban or Rural Residence

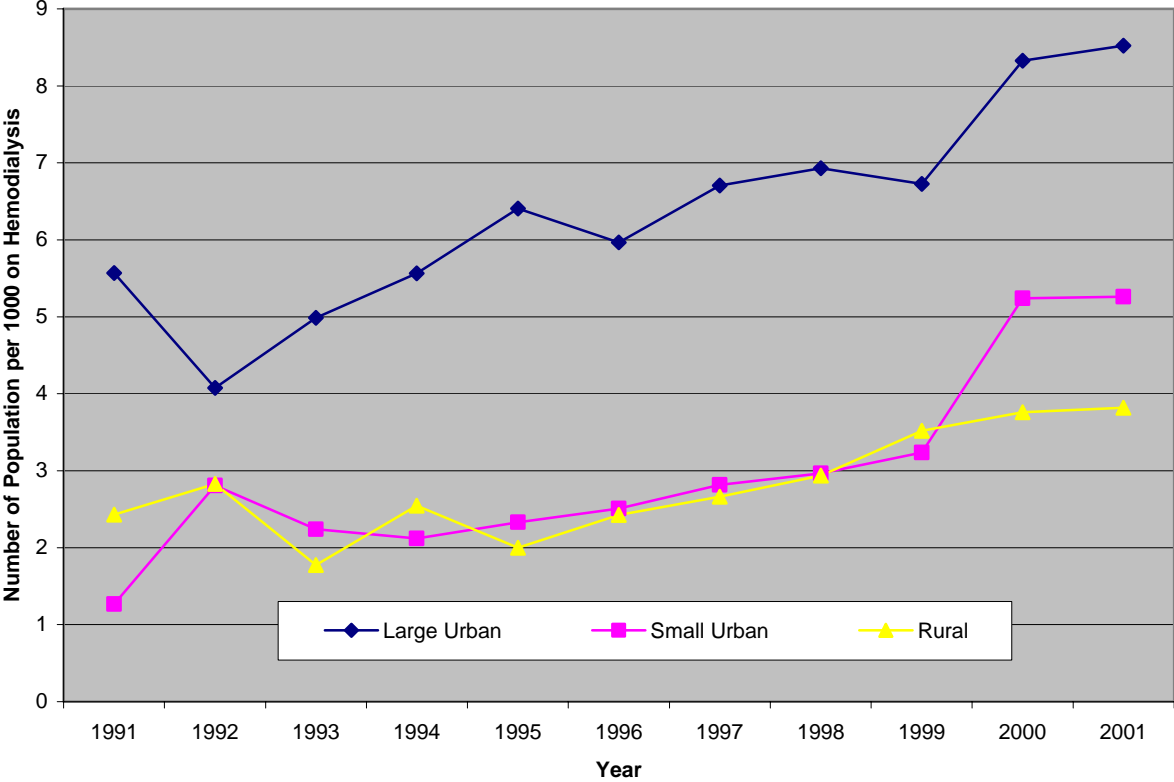


Figure 14: Percent of Dialysis Population who Received Any Haemodialysis Alone or in Combination with Peritoneal Dialysis, 1991 – 2001, by Urban or Rural Residence

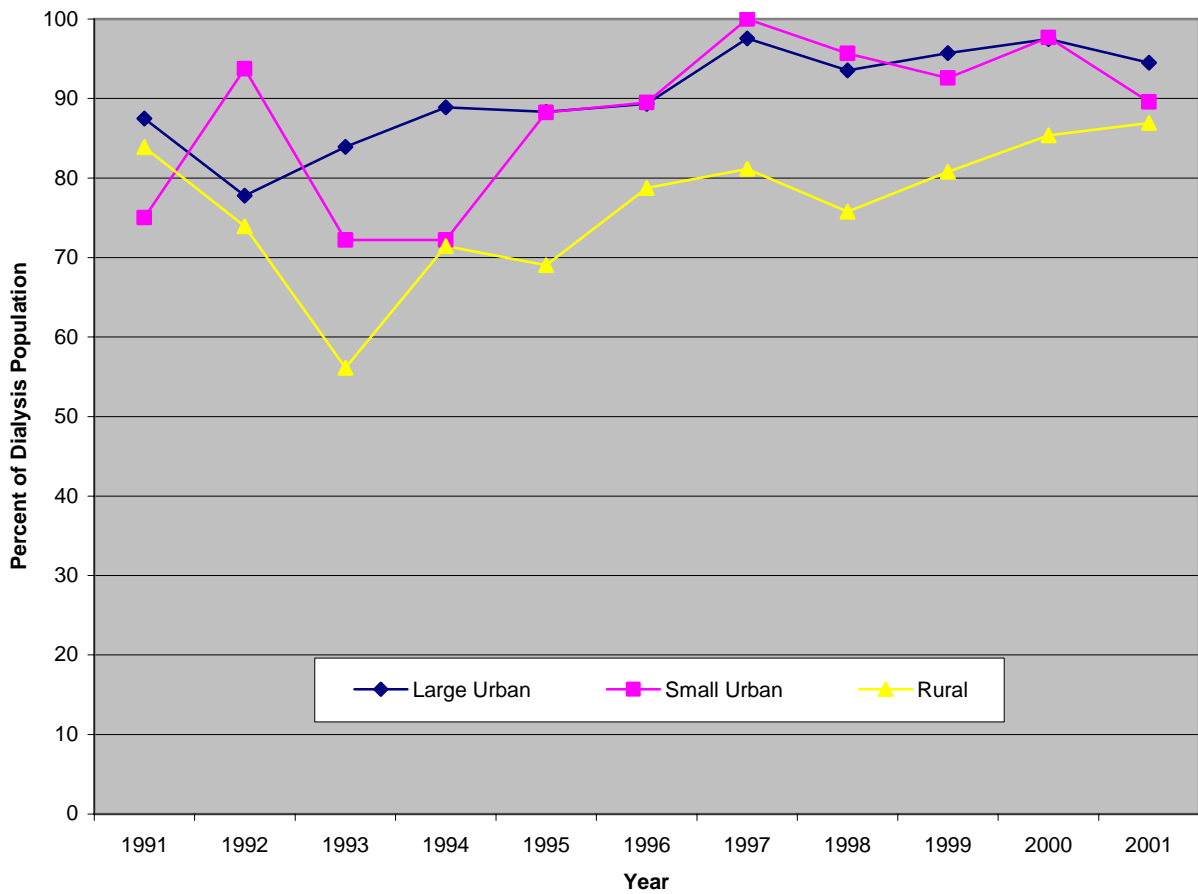


Figure 15: Dialysis Costs Per Capita, 1991 – 2001, by Urban or Rural Residence

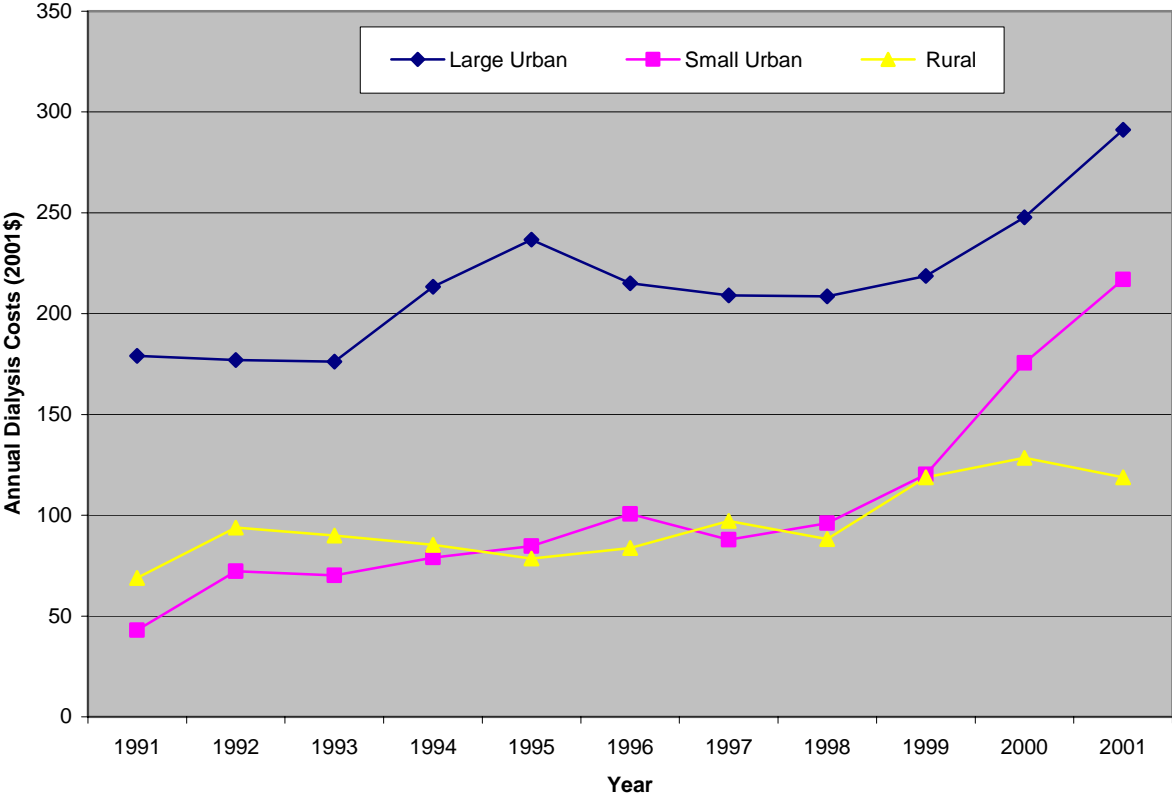


Figure 16A: Crude Per Capita Total Health Services Costs, 1991 – 2001, by Urban or Rural Residence

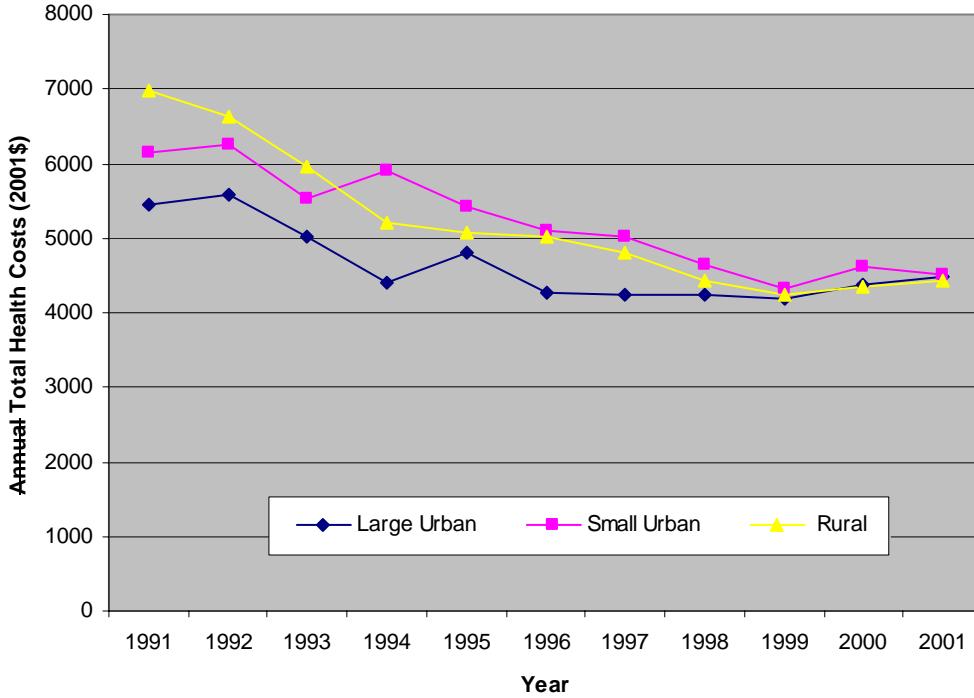


Figure 16B: Age-Standardized Per Capita Total Health Services Costs, 1991 – 2001, by Urban or Rural Residence

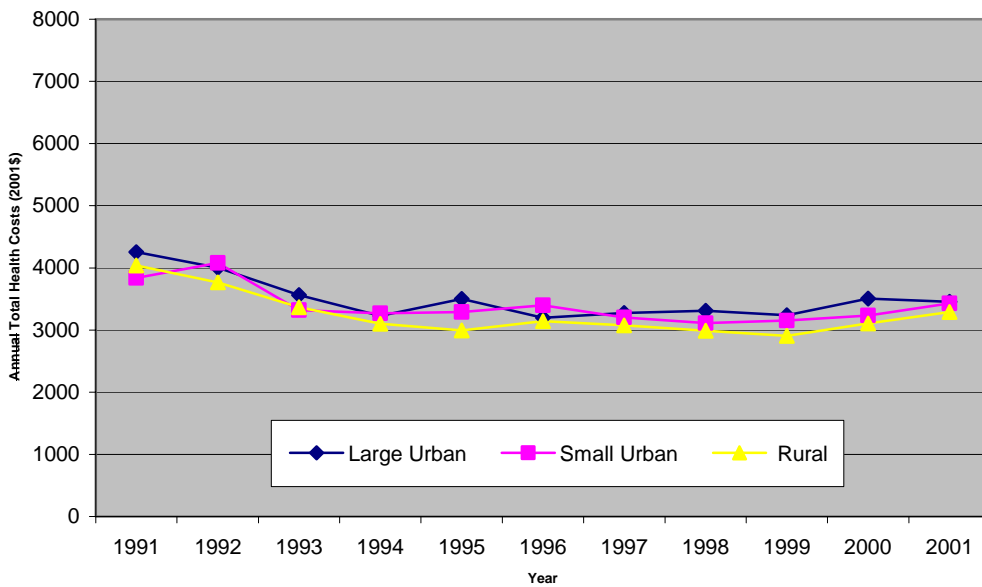


Figure 17A: Per Capita Total Health Care Costs for the Large Urban Population with Diabetes, 2001

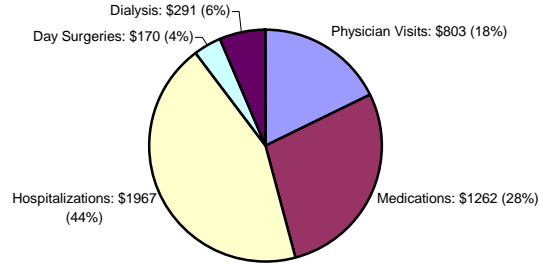


Figure 17B: Per Capita Total Health Care Costs for the Small Urban Population with Diabetes, 2001

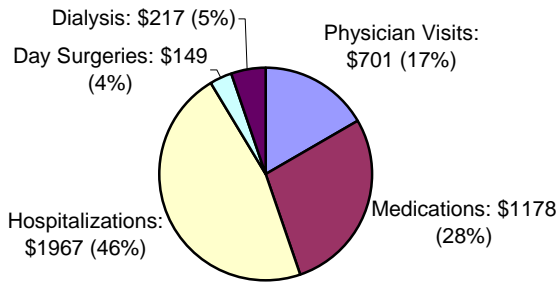


Figure 17C: Per Capita Total Health Care Costs for the Rural Population with Diabetes, 2001

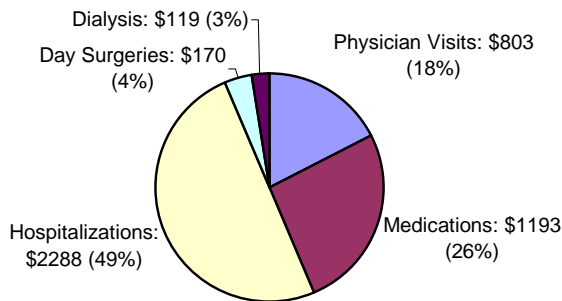


Figure 18A: Crude Mortality Rate, 1991 – 2001, by Urban or Rural Residence

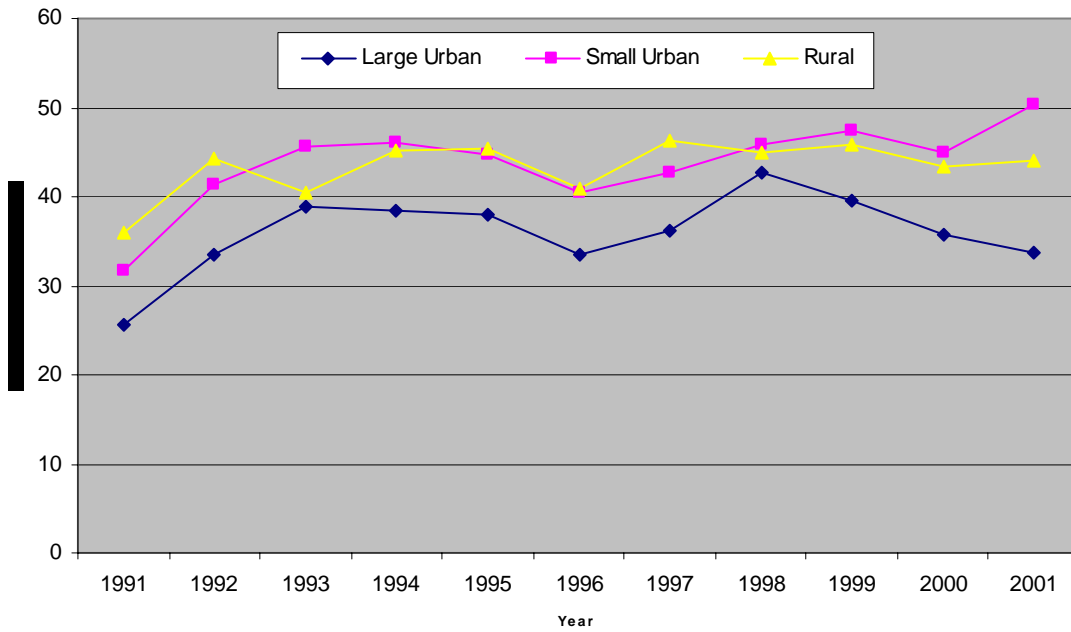


Figure 18B: Age-Standardized Mortality Rate, 1991 – 2001, by Urban or Rural Residence

