

# The Effect of Population Age Structure on Direct Health Care System Cost in 2020 and 2030

## Purpose

The population age structure in Alberta (the number of Albertans at each age) is expected to change by 2020 and 2030, especially for those 60 and older, whose proportion of the population is expected to increase from 16 per cent in 2010 to 20 per cent by 2020 and 22 per cent by 2030.

The purpose of this *Public Health Surveillance Bulletin* is to estimate the effect of population age structure on the direct health care system cost in 2020 and 2030.

## Key Findings

1. The total direct health care system cost (cost that can be entirely attributed to providing the health care service) in Alberta in 2010 was approximately \$8.06 billion; \$2.39 billion for physician services, \$3.75 billion hospital admissions and \$1.93 billion for ambulatory care visits.
2. The total direct health care system cost increased an average of 8.3 per cent each year between 2003 and 2010.
3. Those aged 60 and older comprised 16 per cent of the population of Alberta and accounted for 41 per cent (\$3.34 billion) of the total direct health care system cost in 2010.
4. Taking into account the effect of increases in direct health care system cost over time and the effect of population age structure, the forecasted total direct health care service costs were \$16.05 billion for 2020 and \$32.41 billion for 2030.
5. The direct health care system cost per working-age Albertan (20 to 64) in 2010 was \$3,318, and the forecasted cost was \$5,973 for 2020 and \$10,980 for 2030.

## Applications

The effect of population age structure alone is expected to contribute an additional \$825 million in 2020 and \$3.80 billion in 2030 to the total direct health care system cost in Alberta.

Although population age structure contributes significantly to total direct health care system cost, the larger contributor is the increase in the cost of health care services. When the effect of population age structure was controlled for, the increase in health care costs between 2003 and 2010 was an average of 5.2 per cent each year, which increased faster than the average of 1.8 per cent each year in the Consumer Price Index (CPI) over the same time period.

The total direct health care system cost can be managed by controlling the direct cost of health care services and by controlling the burden of disease. Increasing the efficiency of health care services must be coupled with decreasing the demand for those services by targeted investment in disease prevention, health promotion and population health initiatives. One without the other is unlikely to respond to the anticipated demand.

## Results

### Total Direct Health Care System Cost in Alberta

The total direct health care system cost (cost that can be entirely attributed to providing the health care service) in Alberta in 2010 was approximately \$8.06 billion; \$2.39 billion for physician services, \$3.75 billion hospital admissions and \$1.93 billion for ambulatory care visits.

The total direct health care system cost increased an average of 8.3 per cent each year between 2003 and 2010, although the cost did not increase from 2009 to 2010. The population of Alberta increased 2.5 per cent each year between 2003 and 2010.

**Table 1:** Total Direct Health Care System Cost in Alberta, 2003 to 2010

Year	Total Cost	Change (%)
2003	\$4,633,698,107	-
2004	\$5,096,557,448	9.99
2005	\$5,462,788,192	7.19
2006	\$5,873,306,664	7.51
2007	\$6,526,364,329	11.12
2008	\$7,461,844,695	14.33
2009	\$8,079,530,045	8.28
2010	\$8,062,984,714	-0.20

In 2010, the direct health care system cost of physician services increased 7.9 per cent while the cost of hospital admissions decreased 1.9 per cent and ambulatory care visits decreased 5.8 per cent.

**Table 2:** Total Direct Health Care System Cost in Alberta by Service Type, 2003 to 2010

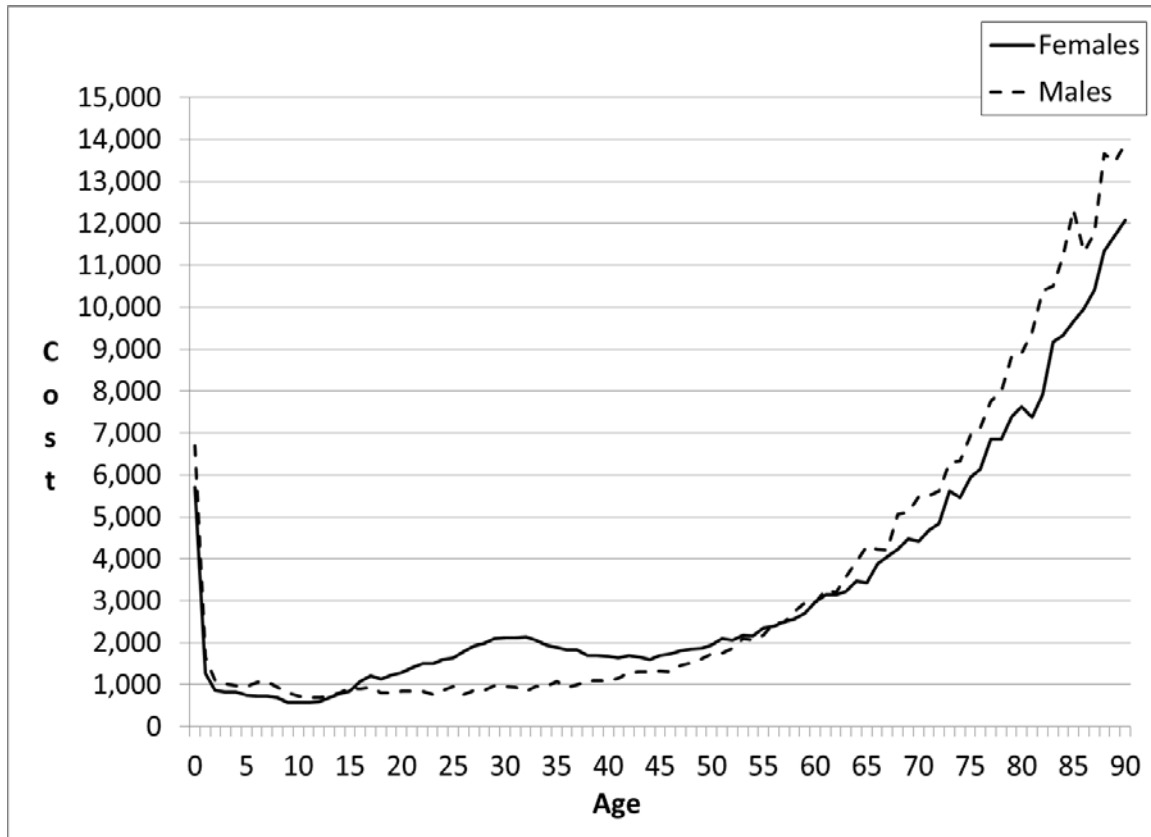
Year	Physician Services	Change (%)	Hospital Admissions	Change (%)	Ambulatory Care Visits	Change (%)
2003	\$1,370,812,276	-	\$2,157,472,425	-	\$1,105,413,407	-
2004	\$1,448,057,801	5.64	\$2,369,694,644	9.84	\$1,278,805,004	15.69
2005	\$1,561,028,829	7.80	\$2,584,152,879	9.05	\$1,317,606,485	3.03
2006	\$1,686,826,860	8.06	\$2,767,720,507	7.10	\$1,418,759,297	7.68
2007	\$1,826,637,339	8.29	\$3,075,786,634	11.13	\$1,623,940,357	14.46
2008	\$1,985,152,361	8.68	\$3,577,609,390	16.32	\$1,899,082,944	16.94
2009	\$2,213,992,223	11.53	\$3,820,059,929	6.78	\$2,045,477,893	7.71
2010	\$2,389,472,634	7.93	\$3,746,136,755	-1.94	\$1,927,375,326	-5.77

## Total Direct Health Care System Costs by Sex and Age

Aside from additional cost related to childbirth, the average direct health care system cost for Albertans younger than 40 years old in 2010 was typically around \$1,000. For Albertans between 40 and 60, the average cost was between \$1,000 and \$3,000. For Albertans over 60, the average cost increased sharply with age from around \$3,000 to around \$13,000.

Those aged 60 and older accounted for 3.34 billion (41 per cent) of the total direct health care system cost in 2010.

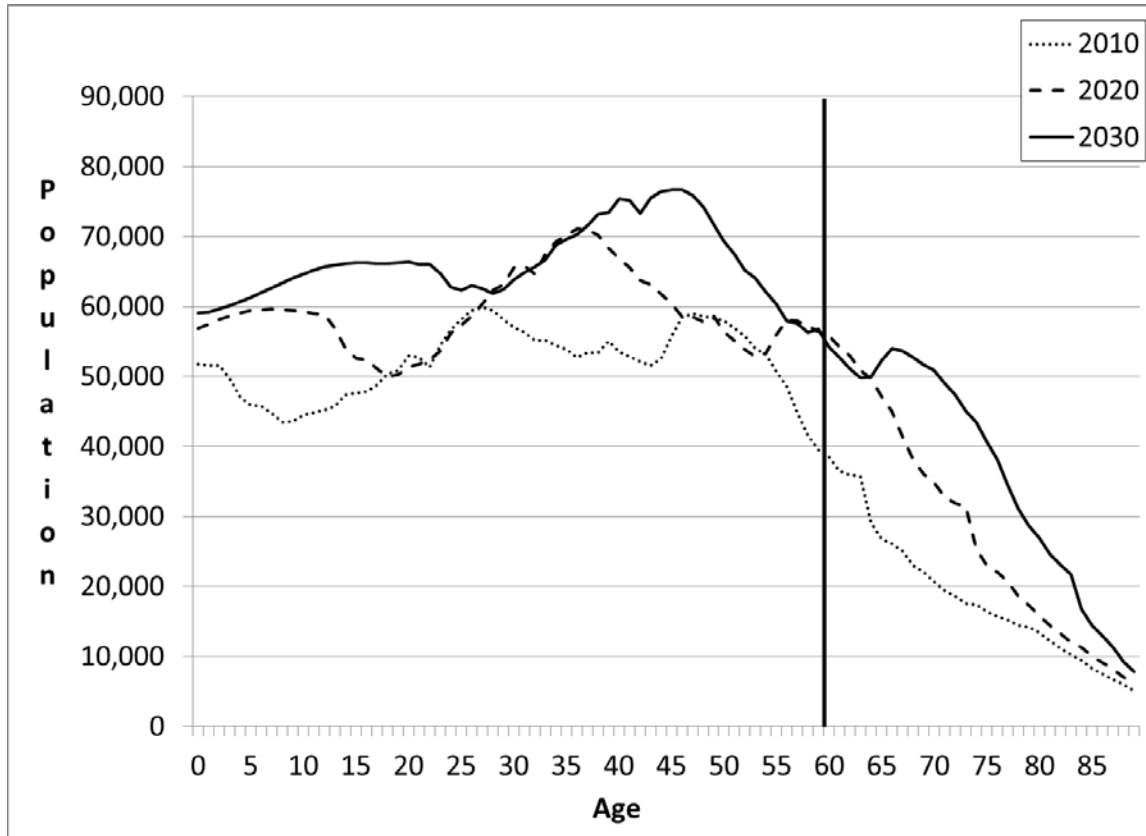
**Figure 1:** Average Direct Health Care System Cost by Sex and Age, 2010



## Population Structure

In 2010, those aged 60 and older comprised 16 per cent of the population of Alberta and are expected to comprise 20 per cent by 2020 and 22 per cent by 2030.

**Figure 2:** Population Age Structure in Alberta, 2010, 2020 and 2030



## Model

The direct annual health care system cost per person was estimated using a gamma-distributed generalized least squares model with a log link. This model was used to determine the independent effects of sex, age and time on direct health care system cost.

The model was applied to population projections to estimate the total direct health care system cost for 2020 and 2030. The model assumed that the independent effects of sex and age will remain the same and that the effect of time will increase according to three scenarios: 3 per cent, 5 per cent and 7 per cent per year.

## 2020 and 2030

Figure 1 shows that Albertans over 60 have high direct health care system costs that increase sharply with age and Figure 2 shows that the number and proportion of Albertans over 60 is expected to increase by 2020 and 2030.

Assuming that the independent effects of sex and age will remain the same and that the effect of time will increase as between 2003 and 2010 (around 5 per cent each year, after accounting for population age structure), the modeled total direct health care service costs were \$16.05 billion for 2020 and \$32.41 billion for 2030.

If the population age structures in 2020 and 2030 remain the same as in 2010, the modeled total direct health care service costs were \$15.22 billion for 2020 and \$28.61 billion for 2030; an additional \$825 million in 2020 and \$3.80 billion in 2030 can be attributed to the effect of population age structure.

**Table 3:** Modeled Total Direct Health Care System Cost in Alberta, 2020 and 2030

Scenario	2020	2030
3 Per Cent	\$13,240,743,109	\$22,060,886,297
5 Per Cent	\$16,048,450,362	\$32,408,911,401
7 Per Cent	\$19,381,076,217	\$47,266,562,154

The direct health care system cost per working-age Albertan (20 to 64) in 2010 was \$3,318, and the modeled cost was \$5,973 in 2020 and \$10,980 in 2030.

## Model Evaluation

The model was evaluated in four ways:

1. The modeled total direct health care system costs for 2003 to 2010 were compared to the actual total costs. The actual and modeled costs were very similar.

**Table 4:** Actual and Modeled Total Direct Health Care System Cost, 2003 to 2010

Year	Actual Cost	Modeled Cost	Per Cent Difference
2003	\$4,615,283,056	\$4,674,913,703	1.29
2004	\$5,080,738,293	\$5,161,016,457	1.58
2005	\$5,436,140,346	\$5,492,693,320	1.04
2006	\$5,844,179,244	\$5,860,278,064	0.28
2007	\$6,498,030,800	\$6,533,287,370	0.54
2008	\$7,434,471,748	\$7,429,615,447	-0.07
2009	\$8,055,341,043	\$8,064,707,672	0.12
2010	\$8,057,413,454	\$8,014,860,912	-0.53

- The model was redeveloped on a random sample of 10 per cent of the records and then used to predict the actual total costs of the unmodeled 90 per cent of records. The regression coefficients in the original model and the redeveloped model were very similar.

**Table 5:** Actual and Modeled Total Direct Health Care System Cost, 2003 to 2010

Year	Actual Cost 90 Per Cent	Modeled Cost 90 Per Cent	Per Cent Difference
2003	\$4,574,094,689	\$4,609,747,864	0.78
2004	\$5,035,631,518	\$5,016,952,711	-0.37
2005	\$5,387,127,194	\$5,403,047,576	0.30
2006	\$5,792,983,478	\$5,636,663,634	-2.70
2007	\$6,442,068,390	\$6,041,955,972	-6.21
2008	\$7,368,184,599	\$7,292,690,685	-1.02
2009	\$7,985,737,656	\$8,005,273,839	0.24
2010	\$7,983,750,576	\$7,864,747,985	-1.49

- The model was redeveloped on records from 2003 to 2006 and then used to predict the total direct health care system cost for 2007 to 2010. The regression coefficients in the original model and the redeveloped model were very similar.

**Table 6:** Actual and Modeled Total Direct Health Care System Cost, 2007 to 2010

Year	Actual Cost 2007 to 2010	Modeled Cost 2007 to 2010	Per Cent Difference
2007	\$6,498,030,800	\$6,360,185,884	-2.12
2008	\$7,434,471,748	\$6,892,114,018	-7.30
2009	\$8,055,341,043	\$7,475,564,360	-7.20
2010	\$8,057,413,454	\$8,074,763,234	0.22

- The modeled total direct health care system cost for 2020 and 2030 was compared to cost estimates derived by inflating age- and sex-specific averages in 2010 by 5 per cent per year and applying them to the population projections for 2020 and 2030.

The modeled total direct health care system cost for 2020 was \$16.05 billion and the inflated total direct health care system cost for 2020 was \$16.20 billion. The modeled total direct health care system cost for 2030 was \$32.40 billion and the inflated total direct health care system cost for 2030 was \$32.70 billion.

## Caveats

### Estimated Hospital Admission and Ambulatory Care Visit Costs

The actual cost for each hospital admission and ambulatory care visit is not always known directly. Alberta Health works with Alberta Health Services and the Canadian Institute for Health Information to calculate the cost of hospital admissions and ambulatory care visits. Each year, a sample of hospital admissions and ambulatory care visits are used to derive cost estimates.

The cost estimates from this project were used to estimate the cost of hospital admissions and ambulatory care visits in this bulletin. The suitability of the estimated cost per hospital admission and ambulatory care visit to reflect the actual cost of each service will influence the accuracy of the estimated total costs.

### Availability of Cost Estimates

Cost estimates for hospital admission and ambulatory care visits used in this bulletin were available to calendar year 2010. Cost estimates for 2011, 2012 and 2013 were not available to inform the direct health care system cost forecasts for 2020 and 2030, although those effects would almost certainly have altered the forecasts.

For example, Table 2 shows that direct health care system costs for hospital admissions and ambulatory care services decreased between 2009 and 2010. Without cost estimates for 2011, 2012 and 2013 it cannot be determined whether the decrease between 2009 and 2010 was due to an anomaly or a longer-term change.

### Effects in Addition to Time and Population Age Structure

The direct health care system cost forecasts for 2020 and 2030 assume that sex, age and any other effects that affect direct health care system cost will remain the same and that only the effect of time and the population age structure will change.

The direct health care system cost forecasts should not be considered as literal expectations of the direct health care system costs in 2020 and 2030. They are more appropriately considered as estimates of what might be expected in 2020 and 2030 if direct health care system cost continues as between 2003 and 2010.

It is likely that effects in addition to sex and age will not remain constant to 2020 and 2030, such as the increasing occurrence of chronic disease, nominal inflation, direct health care cost inflation, changes in occurrence of risk factors or changes to the health care system. It is possible to estimate and forecast other effects and this may be addressed in upcoming Public Health Surveillance Bulletins.

For example, the prevalence of diabetes in Alberta increased from around 3 percent in 1994 to around 7 per cent in 2013. Modeling from another project has suggested that Albertans that develop diabetes between 2003 and 2010 have direct health care system costs around 2.5 times higher in the incident year and around 1.4 times higher in each following year when compared to Albertans with the same sex, age and geography that did not develop diabetes. If the prevalence of diabetes continues to increase in Alberta, the additional direct health care system cost of developing diabetes will add to the effect of population age structure.

**For further information or to suggest a topic for a Public Health Surveillance Bulletin:**

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