

1
2
3 **THE ECOLOGY OF MEDICAL CARE FOR ADULTS IN ALBERTA 2003 TO 2017**
4
5

6 Finlay A McAlister,^{1,2} MD MSc
7

8
9 Marcello Tonelli,³ MD MPH
10

11
12 Natasha Wiebe,⁴ MMath PStat
13

14
15 Meng Lin,² MSc
16

17
18 Lawrence W Svenson,^{3,5} PhD
19

20
21 Stafford Dean,⁶ PhD
22

23
24 **From:** Division of ¹General Internal Medicine and ²Alberta SPOR Support Unit Data
25 Platform and Patient Health Outcomes Research and Clinical Effectiveness Unit,
26 University of Alberta, Edmonton, Canada; ³Departments of Medicine and Community
27 Health Sciences, Cumming School of Medicine, University of Calgary, Alberta, Canada;
28
29 ⁴Division of Nephrology, Department of Medicine, University of Alberta, Edmonton,
30 Canada; ⁵Alberta Health, Edmonton, Canada and the Division of Preventive Medicine
31 and School of Public Health, University of Alberta, Edmonton, Canada; ⁶Data
32 Integration Measurement and Reporting, Alberta Health Services, Calgary, Canada
33
34
35
36
37
38
39
40
41
42

43 **Correspondence:**

44 Dr. F. McAlister, 5-134C Clinical Sciences Building,
45 University of Alberta, 11350 83 Avenue, Edmonton, Alberta, Canada T6G 2G3
46
47 Tel: (780) 492-9824 Fax: (780) 492-7277 e-mail: Finlay.McAlister@ualberta.ca
48
49
50
51
52

53 **Word Count: 215 Abstract, 2778 Text, 21 references, 3 Tables, 2 Figures,**
54 **and 1 eAppendix Table**
55
56
57
58
59
60

ABSTRACT (215 words)

Background: The ecology of medical care describes where and from whom individuals receive health advice and treatment. We designed this study to define the ecology of medical care in Alberta, and to examine whether four policy changes implemented province wide changed the ecology of care in adults.

Methods: Serial cross-sectional studies using routinely collected data from 6 linked administrative health databases, the Canadian Community Health Survey, and the Alberta HealthLink telephone advice system for 3.84 million adults.

Results: Between 2003 and 2017, the proportion of non-institutionalized Albertan adults seeing a primary care physician decreased from 70.8% to 68.2% ($p < 0.001$), with the declines being seen in all subgroups examined, while the proportion seeing a specialist as an outpatient increased from 31.9% to 33.2% ($p < 0.001$) and the proportion receiving at least one medication dispensation increased from 54.9% to 60.2% ($p < 0.001$). However, the proportions of adults seen in an emergency department (19.2% to 20.6%), admitted to an acute care hospital (5.6% to 6.5%), or admitted to an academic hospital (1.2%) were relatively stable over time.

Interpretation: Despite four system-wide changes to the delivery of primary care, pharmacy care, and specialist services in Alberta, the ecology of medical care changed little between 2003 and 2017. We did not examine the timeliness of access to care or quality of care.

1
2
3 A health care system cannot be judged solely on the basis of morbidity and
4 mortality rates. Increasing recognition of the importance of the patient experience has
5 refocused attention on the ecology of medical care: where and with whom individuals
6 receive health advice and treatment. Two studies using UK and US data from the
7 1930s to the 1990s demonstrated that while most adults were healthy most of the time,
8 75% to 80% reported symptoms at least once a year but less than one quarter saw a
9 physician and less than 1% were hospitalized in any given month.[1,2] An update[3]
10 using data from the 2012 Medical Expenditure Panel Survey in the US found very
11 similar frequencies but also demonstrated that approximately half of the outpatient
12 visits were with primary care physicians and half were with specialists. While a
13 contemporaneous study reported that rates of physician visits were similar in Australia
14 to those in the UK and US (26% of adults per month), the distribution was vastly
15 different with primary care visits being six times more frequent than specialist visits.[4]
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33

34 The ecology of medical care clearly differs across settings and is influenced by
35 patient age, sex, socioeconomic status, diagnoses, and comorbidity profiles.[5-7] With
36 that in mind, we explored the ecology of medical care in the Canadian province of
37 Alberta, which has a government-funded health care system that provides universal
38 access for hospital, emergency department, and physician services which is free to the
39 patient at the point of care. We examined whether the ecology of care changed
40 between 2003 and 2017 given 4 policy changes in the province over that time designed
41 to alter care patterns. Primary Care Networks (PCNs) were established in 2005 to help
42 facilitate access to primary care and the wider implementation of chronic disease
43 management programs,[8] the remuneration model for most academic specialists was
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 converted from fee for service to salary between 2005 and 2007,[9] and pharmacists
4
5 were allowed to bill for providing comprehensive annual care plans and ongoing disease
6
7 management to patients with selected chronic diseases from 2012
8
9
10 ([www.ab.bluecross.ca/pdfs/pharmacy-benefacts/346-compensation-for-pharmacy-
12 services.pdf](http://www.ab.bluecross.ca/pdfs/pharmacy-benefacts/346-compensation-for-pharmacy-
11 services.pdf)). The fourth system change was the establishment of the Alberta Health-
13
14 Link telephone line for Albertans to speak to specially trained nurses for medical advice
15
16 as a further means to try to decant some care to non-physician providers.[10] We
17
18 explored the care received by subgroups defined by demographics, geography, and
19
20 whether patients had ambulatory care sensitive conditions (ACSC, defined by the
21
22 Canadian Institute of Health Information as asthma, chronic obstructive pulmonary
23
24 disease, heart failure, coronary disease, hypertension, diabetes, or epilepsy).
25
26
27
28
29
30
31
32

33 **METHODS**

34 ***Design:***

35
36
37
38
39
40 Cross-sectional analysis of health care use per annum using routinely collected
41
42 health data from 6 linked administrative datasets from April 1 2002 to March 31 2003,
43
44 from April 1 2009 to March 31 2010, and from April 1 2016 to March 31 2017. We also
45
46 used the 2016 edition of the Canadian Community Health Survey (a random survey of
47
48 non-institutionalized adults which is anonymous and thus not linked to their health
49
50 records) and the Alberta Health-Link Telephone database for the 2018 calendar year
51
52 (prior years did not have complete data capture). The 2003 and 2017 fiscal years were
53
54
55
56
57
58
59
60

1
2
3 chosen to compare ecology of care before and after implementation of the 4 policy
4
5 changes.
6
7

8 9 ***Data Sources and Study Sample:***

10
11
12 As per previous studies examining the ecology of medical care, we estimated the
13 proportion of adult Albertans who receive health care in various settings. The
14 administrative databases we used included: (1) the Discharge Abstract Database (which
15 records dates, most responsible diagnosis, and up to 24 other diagnoses and
16 procedures for all acute care hospitalizations); (2) the Ambulatory Care Database
17 (which records dates for all patient visits to hospital-based physicians' offices or
18 Emergency Departments (ED) with coding for of up to 10 conditions); (3) the
19 HealthCare Provider Claims Database (which captures dates for all physician claims
20 and includes up to 3 diagnoses per encounter); (4) the Pharmacy Information Network
21 (which captures dates for all medication dispensations from community pharmacies in
22 Alberta after 2008); and (5) the Alberta Health Care Insurance Registry, which includes
23 patient postal code (permitting comparisons between residents of rural vs. urban areas).
24 Personal health numbers were used to link between all datasets; only de-identified data
25 after linkage was available to the investigators and thus the University of Alberta Health
26 Research Ethics Board (Pro00086861) granted a waiver for individual patient consent.
27 Finally, we interrogated the Alberta Blue Cross Pharmacy Services database at Alberta
28 Health which captures publicly funded pharmacy services (modifications of prescriptions
29 or pharmacist-delivered patient counselling on things such as smoking cessation, blood
30 pressure control, or chronic care plans).
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 We used the Canadian Community Health Survey 2016 (last available year) to
4 determine the proportion of non-institutionalized adult Albertans who reported their
5 health as excellent or very good and the proportion reporting that they had unmet health
6 care needs.
7
8
9
10
11
12

13 Alberta Health-Link is a provincial telephone service that receives >1 million calls
14 annually and is staffed by nurses using Echo Access clinical decision support software
15 to assist with symptom triage for several hundred adult and child protocols. As
16 someone may call Health Link on behalf of somebody else (usually a parent calling
17 about an illness in their child), we defined the caller as the person with the health
18 problem prompting the call. Based on the caller's description of symptoms, nurses
19 choose a protocol and use it plus their clinical judgement to select one of 18
20 recommendations about when or whether to seek in person evaluation by medical,
21 pharmacist, or homecare staff and how promptly that should be done. **Covariates:**
22
23
24
25
26
27
28
29
30
31
32
33
34

35 We identified comorbidities for each patient using ICD-9 and ICD-10-CA codes
36 from the Discharge Abstract Database for any hospitalizations, any ED visits, and any
37 outpatient visits in the databases prior to and including the index visit using case
38 definitions previously validated in Alberta.[11]
39
40
41
42
43
44

45 **Statistical Analysis**

46
47

48 We report the proportion of Albertans receiving each service on a yearly basis in
49 the three years studied, and compared between subgroups defined by patient
50 demographics (sex, age strata), geography (rural vs. urban residents), and
51 presence/absence of ACSC. We report the frequencies for long-term care (LTC)
52
53
54
55
56
57
58
59
60

1
2
3 residents separately. Differences were assessed for statistical significance ($P<0.05$)
4
5 using the Kruskal-Wallis or Chi-square tests as appropriate.
6
7

8 **RESULTS**

9

10
11 Between 2003 and 2017, the non-institutionalized adult (aged 18 years or older)
12
13 population of Alberta increased from 2.66 million to 3.84 million; the sex and rural/urban
14
15 distributions did not change appreciably, but the median age increased from 41 to 43
16
17 years and the proportion with at least one ACSC increased from 20.6% to 27.8%
18
19 (Tables 1-3). The number of adults who were long-term care residents increased from
20
21 25,853 (1.0%) to 44,199 (1.1%) over that timeframe and while their median age
22
23 decreased from 82 to 79 years, the median number of comorbidities increased from 4 to
24
25 6.
26
27
28
29

30 The proportion of non-institutionalized Albertan adults seeing a primary care
31
32 physician at least once a year decreased from 70.8% in 2003 to 68.2% in 2017
33
34 ($p<0.001$), with the declines being seen in all subgroups examined, including older
35
36 patients and those with ACSC. On the other hand, the proportion seeing a specialist as
37
38 an outpatient increased over time from 31.9% to 33.2% ($p<0.001$) for any specialist and
39
40 from 2.2% to 4.5% ($p<0.001$) for salaried specialists. Of note, the proportion seeing a
41
42 fee for service specialist did not change appreciably (31.5% in 2003 and 31.8% in
43
44 2017). The proportion receiving at least one medication dispensation from a community
45
46 pharmacy per year also increased between 2010 and 2017 (pharmacy dispensation
47
48 data was not collected in 2003), from 54.9% to 60.2% ($p<0.001$) in non-institutionalized
49
50 adults and from 70.3% to 82.9% ($p<0.001$) in LTC residents, with the increases seen in
51
52 all subgroups we examined. The proportion of LTC residents being seen by primary
53
54
55
56
57
58
59
60

1
2
3 care physicians, fee for service specialists, and salaried specialists all significantly
4 increased between 2003 and 2017. However, the proportions of adults seen in an
5 emergency department, admitted to an acute care hospital, or admitted to an academic
6 hospital was relatively stable between 2003 and 2017 (approximately 20%, 6%, and 1%
7 respectively in non-institutionalized adults and 48%, 35%, and 10% in LTC residents).

8
9
10
11
12
13
14
15 The gradients between demographic subgroups were in the directions expected
16 in all three time periods examined: older patients, females, and LTC residents were
17 more likely to see a primary care physician or specialist, to receive medications, to be
18 seen in an emergency department, to be hospitalized, and to be admitted to an
19 academic hospital. However, some of the gradients were surprisingly large: compared
20 to those without an ACSC, adults with at least one ACSC were far more likely to see
21 their primary care physician per year (87.8% vs. 60.7%), to have at least one
22 medication dispensed (86.8% vs. 50.0%), to be seen as outpatients by a specialist
23 (55.4% vs. 24.6%), to have at least one ED visit (28.5% vs. 15.6%), and to be
24 hospitalized at least once (10.6% vs. 3.7%) in the 2017 fiscal year (all $p < 0.001$), with
25 similar proportions in prior years. Moreover, adults with at least one ACSC were more
26 likely to receive care from both primary care physicians and specialists (both fee for
27 service and salaried specialists) as outpatients compared to adults without ACSC
28 ($p < 0.001$, Figure 1). Very few Albertans received counselling from pharmacists or had
29 their prescriptions modified by a pharmacist as an outpatient (Table 3).

30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50 Overall, 64.2% of Albertan adults who participated in the 2016 CCHS reported
51 that their health was very good or excellent (ranging from 70.3% of those younger than
52 40 years to 48.9% of those older than 65). Respondents without any ACSC were more
53
54
55
56
57
58
59
60

1
2
3 likely to report excellent or very good health (72.3%) than those with 1 or more of the
4
5 ACSC (42.9%) – eAppendix Table. The average score for Alberta respondents on the
6
7 EQ-5D Canadian utilities visual analogue scale for health-related quality of life was
8
9 84.4% (standard error 0.4%). While 3.2% of Albertan adults reported they had unmet
10
11 health care needs in the prior year, the proportions were significantly higher (all
12
13 $p < 0.001$) for younger adults (18-40 years), females, or those with an ACSC (eAppendix
14
15 Table).

16
17
18
19
20 Of the 470,207 Albertan adults who called HealthLink during the 2018 calendar
21
22 year (12.2% of all adults but only 3.5% of those with ACSC), 57.3% did so to ask a
23
24 question about their own symptoms and 33.4% were advised to proceed to an ED or
25
26 medical provider within 4 hours (eAppendix Table). Proportions were similar across the
27
28 demographic subgroups we examined (eAppendix Table), although patients with an
29
30 ACSC were more likely to be advised to present to an ED or physician within 4 hours
31
32 than those without (45.2% vs. 32.3%, $p = 0.001$).

33
34
35
36 Figure 2 summarizes the current ecology of care for Albertan adults.
37
38
39
40
41

42 **DISCUSSION**

43
44
45 Between 2003 and 2017, the non-institutionalized adult population of Alberta
46
47 became older (median age increased by 2 years) and the proportion with at least one
48
49 ACSC increased from 21% to 28%. Despite a 3% decrease in the proportion being
50
51 seen by a primary care physician between 2003 and 2017, a 2% increase in the
52
53 proportion seeing a specialist (mostly due to increases in the proportion seeing salaried
54
55
56
57
58
59
60

1
2
3 specialists), and a 5% increase in the proportion receiving at least one medication
4 dispensation, the proportion presenting to an emergency department, being admitted to
5 an acute care hospital, or being admitted to an academic hospital was relatively stable
6 over the years we studied (approximately 20%, 6%, and 1% respectively). Despite
7 introduction of specific fee payments for pharmacists providing these services, we found
8 that few Albertans (less than 1 in 27 adults, and less than 1 in 7 with an ACSC) received
9 counselling from pharmacists or had their outpatient prescriptions modified by a
10 pharmacist as an outpatient. On the other hand, 1 in 8 Albertan adults accessed the
11 Alberta Health Link telephone line for health advice (but only 1 in 29 of those with
12 ACSC).

13
14
15
16
17
18
19
20
21
22
23
24
25
26
27 In contrast to data from two prior US studies which showed that just over half of
28 outpatient visits were with a primary care physician,[2,3] in Alberta non-institutionalized
29 adults were more than twice as likely to see a primary care physician than a specialist.
30 Although it is not possible to compare absolute outpatient visit rates in the US versus
31 Canada from the prior published studies,[2,3] perusal of the Medical Expenditure Panel
32 Survey (MEPS) website (https://meps.ahrq.gov/mepstrends/hc_use/ accessed July 1, 2019)
33 reveals that the proportion of noninstitutionalized American adults who had an
34 outpatient physician visit was lower than Alberta during all years studied, and also
35 declined between 2003 and 2016 (from 68% to 65%). Of note, 2016 is the last year of
36 data available on the MEPS website at this time. Although MEPS participants were less
37 likely to present to an ED in a year (approximately 13%) than Albertans, they were
38 slightly more likely to be hospitalized (about 8-9% per year) – mirroring the Alberta data,
39 these proportions did not change appreciably between 2003 and 2016. Thus, while the
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 trends since 2003 were similar in Alberta and the US, the ecology of medical care
4
5 differs in that Albertan adults were more likely to see a primary care physician or
6
7 present to an ED than their American counterparts but were less likely to be
8
9 hospitalized.
10

11
12
13 While it is well recognized that Canadian health care is more primary-care based
14
15 than US health care, unlike prior examinations of ecology of care, we were able to
16
17 compare the care patterns for different subgroups of patients. This revealed that
18
19 although patients with ACSC were far more likely to receive outpatient care from their
20
21 primary care physician (88% vs. 61%) or a specialist (55% vs. 25%), and to have at
22
23 least one medication dispensed (87% vs. 50%), they were still more likely to have an
24
25 ED visit (29% vs. 16%) or to be hospitalized (11% vs. 4%, all $p < 0.001$, with similar
26
27 relative proportions in all years studied). This raises questions about whether ED visits
28
29 or hospitalizations for ACSC truly are preventable with outpatient care and is consistent
30
31 with previous work showing that ACSC-related ED visits and hospitalizations are not
32
33 sensitive to frequency of outpatient care received: collectively these findings cast doubt
34
35 on the validity of the term "ACSC".[12-17]
36
37
38
39
40

41 Approximately 1% of Alberta adults were long-term care residents in the years
42
43 we studied. These individuals had a median of 6 comorbidities and were far more likely
44
45 to be dispensed medications and to see primary care physicians or specialists.
46
47 Surprisingly, we found that although the proportion of LTC residents seeing a specialist
48
49 in an outpatient setting increased from 2003 to 2017 and approached 50%, LTC
50
51 residents were still more than twice as likely to present to an ED (49% per year), six
52
53 times as likely to be admitted to a hospital (35% per year), and ten times more likely to
54
55
56
57
58
59
60

1
2
3 be admitted to an academic tertiary care hospital (10% per year) as non-institutionalized
4 adults. Without information on the goals of care for these LTC residents we cannot
5
6 comment further on the appropriateness of this pattern of health service use but it would
7
8 appear to be an area where future policy changes might be fruitfully targeted.
9
10
11

12
13 Although we were able to examine all interactions with physicians, pharmacists,
14 and EDs/hospitals for all adults in an entire Canadian province, there are some
15
16 limitations to our study. First, and most importantly, our data does not permit us to
17
18 examine the timeliness of access or quality of care provided to Albertan adults.
19
20 However, a recent analysis of 195 countries in the Global Burden of Disease Study
21
22 revealed that Canada was in the top 10% on the Healthcare Access and Quality
23
24 Index.[18] Second, we relied on administrative data to define ACSC and do not have
25
26 information on clinical assessment or biomarkers that would delineate severity of each
27
28 condition. However, we used validated ICD-10-CA case definition algorithms to assign
29
30 diagnoses.[11] Third, we were unable to examine visits to non-physician health care
31
32 providers, such as public health nurses, dentists, or chiropractors.
33
34
35
36
37
38

39 In conclusion, we have demonstrated that the ecology of medical care changed
40
41 little in Alberta between 2003 and 2017 despite four system-wide changes to the
42
43 delivery of primary care, pharmacy care, and specialist services explicitly designed to
44
45 alter care patterns. The stability of health care delivery patterns over the past decade
46
47 and a half is consistent with prior publications in other settings showing little change in
48
49 the ecology of care between the 1930s and early 2000s.[1-3] Thus, it would appear that
50
51 inertia in health care afflicts more than just the therapy decision making of clinicians and
52
53 patients.[19-21] Rather than searching for a policy magic bullet, health care planners
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

may be better served focusing on upscaling and implementing those specific interventions already proven to be effective in pilot studies. However, as not all good ideas have the anticipated effects, any implementation should be accompanied by robust evaluation plans.

Confidential

1
2
3 **Role of Funder/Sponsor:** The sponsors had no role in the design and conduct of the
4 study; collection, management, analysis, and interpretation of the data; preparation,
5 review, or approval of the manuscript; nor in the decision to submit the manuscript for
6 publication.
7

8 **Disclaimer:** This study is based in part by data provided by Alberta Health and Alberta
9 Health Services. The interpretation and conclusions contained herein are those of the
10 researchers and do not represent the views of the Government of Alberta or Alberta
11 Health Services. Neither the Government of Alberta nor Alberta Health or Alberta Health
12 Services express any opinion in relation to this study.
13
14

15 **Funding/Support:** Funding was provided by a team grant to the Interdisciplinary
16 Chronic Disease Collaboration from Alberta Innovates, and a Leaders Opportunity Fund
17 grant from the Canada Foundation for Innovation. FM is supported by the Alberta Health
18 Services Chair in Cardiovascular Outcomes Research and MT is supported by the
19 David Freeze Chair in Health Services Research at the University of Calgary.
20

21 **Author Contributions:** FM had full access to all of the data in the study and takes
22 responsibility for the integrity of the data and the accuracy of the data analysis. FM
23 conceived and designed the study, wrote the first draft of the manuscript, NW and ML
24 performed the statistical analyses. All authors critically reviewed, revised, and approved
25 the final manuscript.
26
27

28 **Conflict of Interest Disclosures:** None reported.
29

30 **Data Sharing Statement:** We are not able to make our dataset available to other
31 researchers due to our contractual arrangements with the provincial health ministry
32 (Alberta Health), who is the data custodian. Researchers may make requests to obtain
33 a similar dataset at [https://albertainnovates.ca/our-health-innovation-focus/the-alberta-spor-
35 support-unit/](https://albertainnovates.ca/our-health-innovation-focus/the-alberta-spor-
34 support-unit/)
36
37



REFERENCES

1. White KL, Williams TF, Greenberg BG. The ecology of medical care. *N Engl J Med* 1961;265:885-892
2. Green LA, Fryer GE Jr, Yawn BP, Lanier D, Dovey SM. The ecology of medical care revisited. *N Engl J Med* 2001;344:2021-2025
3. Johansen ME, Kircher SM, Huerta TR. Reexamining the Ecology of Medical Care. *N Engl J Med* 2016;374:495-496.
4. Sturmberg JP, McDonnell GM. How Modelling could Contribute to Reforming Primary Care—Tweaking “the Ecology of Medical Care” in Australia. *AIMS Medical Science* 2016;3:298-311.
5. Fryer GE Jr, Green LA, Dovey SM, Yawn BP, Phillips RL, Lanier D. Variation in the ecology of medical care. *Ann Fam Med* 2003;1:81-89.
6. Tonelli M, Wiebe N, Manns BJ, et al. Comparison of the complexity of patients seen by different medical specialists in a universal health care system. *JAMA Network Open* 2018;1:e184852
7. Pilla SJ, Segal JB, Maruthur NM. Primary care provides the majority of outpatient care for patients with diabetes in the US: NAMCS 2009-2015. *J Gen Intern Med* 2019;online early.
8. McAlister FA, Bakal J, Green LA, Bahler B, Lewanczuk R. The effect of provider affiliation with a primary care network on emergency department visits and hospital admissions. *CMAJ* 2018;190:E276-E284.
9. Bichel A, Bacchus M, Meddings J, Conly J. Academic Alternate Relationship Plans for internal medicine: a lever for health care transformation. *Open Medicine* 2011;5:e28–e32.
10. De Coster C, Quan H, Elford R, Li B, Mazzei L, Zimmer S. Follow-through after calling a nurse telephone advice line: a population-based study. *Family Practice* 2010;27:271–278.
11. Tonelli M, Wiebe N, Fortin M, et al. for the Alberta Kidney Disease Network. Methods for identifying 30 chronic conditions: application to administrative data. *BMC Medical Informatics and Decision Making* 2015;15:31. DOI 10.1186/s12911-015-0155-5
12. Weinberger M, Oddone EZ, Henderson WG. Does increased access to primary care reduce hospital readmissions? Veterans Affairs Cooperative Study Group on Primary Care and Hospital Readmission. *N Engl J Med* 1996;334:1441-1447.

- 1
2
3 13. Rosano A, Loha CA, Falvo R, van der Zee J, Ricciardi W, Guasticchi G, de
4 Belvis AG. The relationship between avoidable hospitalization and accessibility to
5 primary care: a systematic review. *Eur J Public Health* 2013 June;23(3):356-60.
6
7
- 8 14. Walker RL, Chen G, McAlister FA, et al. Relationship between
9 primary care physician visits and hospital/emergency use for uncomplicated
10 hypertension, an ambulatory care-sensitive condition. *Can J Cardiol*
11 2014;30:1640-1648.
12
- 13 15. Solberg LI. Preventable hospital admissions: are they? *Fam Pract* 2015;32:245–
14 246
15
- 16 16. Vuik SI, Fontana G, Mayer E, et al. Do hospitalisations for ambulatory care
17 sensitive conditions reflect low access to primary care? An observational cohort
18 study of primary care usage prior to hospitalization. *BMJ Open* 2017;7:e015704.
19
- 20 17. Paul MC, Dik JWH, Hoekstra T, van Dijk CE. Admissions for ambulatory care
21 sensitive conditions: a national observational study in the general and COPD
22 population. *Eur J Public Health* 2019;29: 213–219.
23
24
- 25 18. Global Burden of Disease 2015 Healthcare Access and Quality Collaborators.
26 Healthcare access and quality index based on mortality from causes amenable to
27 personal health care in 195 countries and territories, 1990-2015: a novel analysis
28 from the Global Burden of Disease Study 2015. *Lancet* 2017;390:231-266.
29
30
- 31 19. Phillips LS, Branch WT, Cook CB, Doyle JP, El-Kebbi IM, Gallina DL, et al.
32 Clinical Inertia. *Ann Intern Med.* 2001;135:825–834.
33
- 34 20. Majumdar SR, McAlister FA, Furberg CD. From publication to practice in chronic
35 cardiovascular disease – The Long and Winding Road. *J Am Coll Cardiol*
36 2004;43:1738-42.
37
- 38 21. Nieuwlaat R, Wilczynski N, Navarro T, et al. Interventions for enhancing
39 medication adherence. *Cochrane Database Syst Rev.* 2014 Nov
40 20;11:CD000011.
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Table 1: Health services use by adults in Alberta in fiscal year 2003

	Non-institutionalized Albertan Adults										LTC residents
	Overall	Urban	Rural	18-40 y	40-65 y	≥65 y	Male	Female	No ACSC	≥1 ACSC	
N	2,660,947 (99.0)	2,206,514 (88.2)	295,685 (11.8)	1,251,465 (47.0)	1,086,555 (40.8)	322,927 (12.1)	1,353,551 (50.9)	1,307,396 (49.1)	2,113,374 (79.4)	547,573 (20.6)	25,853 (1.0)
Median age (IQR)	41 (29,53)	41 (29,53)	43 (31,56)	28 (23,34)	49 (44,55)	73 (69,79)	40 (29,52)	41 (29,54)	37 (27,47)	60 (48,71)	82 (73,88)
Female	1,307,396 (49.1)	1,099,863 (49.8)	142,766 (48.3)	601,486 (48.1)	529,133 (48.7)	176,777 (54.7)	0 (0.0)	1,307,396 (100.0)	1,020,754 (48.3)	286,642 (52.3)	16,743 (64.8)
Median number of comorbidities (IQR)	0 (0,1)	0 (0,1)	1 (0,1)	0 (0,1)	1 (0,1)	2 (1,3)	0 (0,1)	0 (0,1)	0 (0,1)	2 (1,3)	4 (3,6)
Urban Residence	2,206,514 (88.2)	2,206,514 (100.0)	0 (0.0)	1,024,656 (89.1)	911,686 (87.6)	270,172 (87.0)	1,106,651 (87.9)	1,099,863 (88.5)	1,736,468 (88.6)	470,046 (86.8)	23,338 (90.9)
Saw a Primary Care Physician in office setting	1,883,353 (70.8)	1,661,432 (75.3)	215,357 (72.8)	796,915 (63.7)	807,792 (74.3)	278,646 (86.3)	833,798 (61.6)	1,049,555 (80.3)	1,377,949 (65.2)	505,404 (92.3)	11,452 (44.3)
Saw a salaried specialist as an outpatient	58,979 (2.2)	52,898 (2.4)	5,914 (2.0)	15,459 (1.2)	26,622 (2.5)	16,898 (5.2)	26,204 (1.9)	32,775 (2.5)	29,217 (1.4)	29,762 (5.4)	1,069 (4.1)
Saw a Fee For Service specialist as an outpatient	838,916 (31.5)	759,658 (34.4)	77,230 (26.1)	268,626 (21.5)	384,902 (35.4)	185,388 (57.4)	344,465 (25.4)	494,451 (37.8)	529,599 (25.1)	309,317 (56.5)	10,780 (41.7)
Saw any specialist as an outpatient	849,668 (31.9)	768,955 (34.8)	78,584 (26.6)	272,436 (21.8)	389,988 (35.9)	187,244 (58.0)	350,055 (25.9)	499,613 (38.2)	536,064 (25.4)	313,604 (57.3)	10,917 (42.2)
Had at least one medication dispensation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Had at least one ED visit	549,039 (20.6)	450,325 (20.4)	97,354 (32.9)	259,600 (20.7)	199,755 (18.4)	89,684 (27.8)	273,085 (20.2)	275,954 (21.1)	375,784 (17.8)	173,255 (31.6)	11,586 (44.8)

	Non-institutionalized Albertan Adults										LTC residents
Had at least one hospitalization	173,179 (6.5)	144,560 (6.6)	28,436 (9.6)	70,102 (5.6)	54,580 (5.0)	48,497 (15.0)	64,116 (4.7)	109,063 (8.3)	92,465 (4.4)	80,714 (14.7)	9,127 (35.3)

Data reported as counts and percentages. ACSC ambulatory care sensitive condition, ED emergency department, FFS fee for service, IQR interquartile range, LTC long-term care, NA not applicable, PCP primary care provider, PIN pharmaceutical information network, UAH University of Alberta Hospital. Data on patient residence (rural or urban) missing for 6.0%. In the 2003 fiscal year the administrative database did not include type of hospital.

Confidential

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Table 2: Health services use by adults in Alberta in fiscal year 2010

	Non-institutionalized Albertan Adults										LTC residents
	Overall	Urban	Rural	18-40 y	40-65 y	≥65 y	Male	Female	No ACSC	≥1 ACSC	
N	3,261,459 (99.0)	2,731,980 (88.9)	339,996 (11.1)	1,492,764 (45.8)	1,369,231 (42.0)	399,464 (12.3)	1,672,187 (51.3)	1,589,272 (48.7)	2,458,843 (75.4)	802,616 (24.6)	34,121 (1.0)
Median age (IQR)	42 (29,55)	42 (29,55)	44 (29,57)	28 (23,34)	50 (45,56)	73 (68,79)	41 (29,54)	42 (29,55)	37 (27,48)	59 (49,70)	82 (71,88)
Female %	1,589,272 (48.7)	1,346,267 (49.3)	165,347 (48.6)	715,257 (47.9)	660,282 (48.2)	213,733 (53.5)	0 (0.0)	1,589,272 (100.0)	1,182,963 (48.1)	406,309 (50.6)	21,164 (62.0)
Median number of comorbidities (IQR)	0 (0,1)	0 (0,2)	1 (0,2)	0 (0,1)	1 (0,2)	3 (1,4)	0 (0,1)	1 (0,2)	0 (0,1)	2 (2,4)	6 (4,7)
Urban Residence	2,731,980 (88.9)	2,731,980 (100.0)	0 (0.0)	1,246,856 (89.7)	1,154,496 (88.8)	330,628 (86.5)	1,385,713 (88.8)	1,346,267 (89.1)	2,036,905 (89.5)	695,075 (87.4)	30,109 (88.8)
Saw a Primary Care Physician in office setting	2,213,242 (67.9)	1,966,992 (72.0)	242,026 (71.2)	888,408 (59.5)	985,739 (72.0)	339,095 (84.9)	985,842 (59.0)	1,227,400 (77.2)	1,486,193 (60.4)	727,049 (90.6)	26,655 (78.1)
Saw a salaried specialist as an outpatient	34,357 (1.1)	30,910 (1.1)	3,337 (1.0)	8,639 (0.6)	15,261 (1.1)	10,457 (2.6)	14,521 (0.9)	19,836 (1.2)	16,766 (0.7)	17,591 (2.2)	705 (2.1)
Saw a Fee For Service specialist as an outpatient	998,159 (30.6)	902,039 (33.0)	94,234 (27.7)	301,515 (20.2)	470,601 (34.4)	226,043 (56.6)	419,346 (25.1)	578,813 (36.4)	560,979 (22.8)	437,180 (54.5)	15,796 (46.3)
Saw any specialist as an outpatient	999,737 (30.7)	903,392 (33.1)	94,421 (27.8)	302,290 (20.3)	471,294 (34.4)	226,153 (56.6)	420,266 (25.1)	579,471 (36.5)	562,203 (22.9)	437,534 (54.5)	15,808 (46.3)
Had at least one medication dispensation	1,789,513 (54.9)	1,575,859 (57.7)	212,030 (62.4)	675,570 (45.3)	797,895 (58.3)	316,048 (79.1)	769,355 (46.0)	1,020,158 (64.2)	1,123,292 (45.7)	666,221 (83.0)	23,983 (70.3)
Had at least one ED visit	644,247 (19.8)	526,163 (19.3)	116,673 (34.3)	295,663 (19.8)	243,185 (17.8)	105,399 (26.4)	314,769 (18.8)	329,478 (20.7)	409,589 (16.7)	234,658 (29.2)	16,268 (47.7)

	Non-institutionalized Albertan Adults										LTC residents
	Overall	Urban	Rural	18-40 y	40-65 y	≥65 y	Male	Female	No ACSC	≥1 ACSC	
Had at least one hospitalization	192,409 (5.9)	163,362 (6.0)	28,886 (8.5)	79,556 (5.3)	61,568 (4.5)	51,285 (12.8)	69,420 (4.2)	122,989 (7.7)	98,222 (4.0)	94,187 (11.7)	12,308 (36.1)
Had at least one acute care hospitalization	191,853 (5.9)	162,833 (6.0)	28,860 (8.5)	79,546 (5.3)	61,496 (4.5)	50,811 (12.7)	69,223 (4.1)	122,630 (7.7)	98,133 (4.0)	93,720 (11.7)	11,908 (34.9)
Hospitalized at academic centre	40,686 (1.2)	37,000 (1.4)	3,650 (1.1)	12,251 (0.8)	15,742 (1.1)	12,693 (3.2)	19,200 (1.1)	21,486 (1.4)	16,855 (0.7)	23,831 (3.0)	3,289 (9.6)

Data reported as counts and percentages. ACSC ambulatory care sensitive condition, ED emergency department, FFS fee for service, IQR interquartile range, LTC long-term care, NA not applicable, PCP primary care provider, PIN pharmaceutical information network, UAH University of Alberta Hospital. Data on patient residence (rural or urban) missing for 5.8%.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Table 3: Health services use by adults in Alberta in fiscal year 2017

	Non-institutionalized Albertan Adults										LTC residents
	Overall	Urban	Rural	18-40 y	40-65 y	≥65 y	Male	Female	No ACSC	≥1 ACSC	
N	3,840,527 (98.9)	3,264,235 (89.7)	377,048 (10.4)	1,664,530 (43.3)	1,617,231 (42.1)	558,766 (14.6)	1,961,342 (51.1)	1,879,185 (48.9)	2,774,814 (72.3)	1,065,713 (27.8)	44,199 (1.1)
Median age (IQR)	43 (31,57)	43 (31,57)	45 (30,60)	30 (24,34)	51 (45,57)	72 (68,79)	43 (31,57)	43 (31,58)	37 (28,49)	60 (49,70)	79 (62,88)
Female %	1,879,185 (48.9)	1,611,933 (49.4)	184,876 (49.0)	812,923 (48.8)	775,091 (47.9)	291,171 (52.1)	0 (0.0)	1,879,185 (100.0)	1,355,404 (48.8)	523,781 (49.1)	25,357 (57.4)
Median number of comorbidities (IQR)	0 (0,2)	1 (0,2)	1 (0,2)	0 (0,1)	1 (0,2)	3 (1,4)	0 (0,2)	1 (0,2)	0 (0,1)	3 (2,4)	6 (4,8)
Urban Residence	3,264,235 (89.6)	3,264,235 (100.0)	0 (0.0)	1,428,028 (89.9)	1,371,563 (90.2)	464,644 (87.4)	1,652,302 (89.6)	1,611,933 (89.7)	2,330,393 (90.2)	933,842 (88.3)	38,674 (88.0)
Saw a Primary Care Physician in office setting	2,620,547 (68.2)	2,354,013 (72.1)	264,572 (70.2)	1,032,584 (62.0)	1,136,067 (70.2)	451,896 (80.9)	1,199,365 (61.2)	1,421,182 (75.6)	1,684,849 (60.7)	935,698 (87.8)	33,037 (74.7)
Saw a salaried specialist as an outpatient	173,541 (4.5)	158,633 (4.9)	14,878 (3.9)	46,302 (2.8)	77,135 (4.8)	50,104 (9.0)	75,608 (3.9)	97,933 (5.2)	71,407 (2.6)	102,134 (9.6)	5,447 (12.3)
Saw a Fee For Service specialist as an outpatient	1,221,966 (31.8)	1,108,923 (34.0)	112,086 (29.7)	371,194 (22.3)	546,251 (33.8)	304,521 (54.5)	534,034 (27.2)	687,932 (36.6)	655,537 (23.6)	566,429 (53.2)	20,704 (46.8)
Saw any specialist as an outpatient	1,273,175 (33.2)	1,154,894 (35.4)	117,310 (31.1)	389,028 (23.4)	570,256 (35.3)	313,891 (56.2)	557,575 (28.4)	715,600 (38.1)	683,110 (24.6)	590,065 (55.4)	22,082 (50.0)
Had at least one medication dispensation	2,313,406 (60.2)	2,058,693 (63.1)	252,755 (67.0)	820,186 (49.3)	1,047,437 (64.8)	445,783 (79.8)	1,047,875 (53.4)	1,265,531 (67.3)	1,388,384 (50.0)	925,022 (86.8)	36,653 (82.9)
Had at least one ED visit	735,973 (19.2)	613,342 (18.8)	121,334 (32.2)	313,954 (18.9)	278,553 (17.2)	143,466 (25.7)	353,512 (18.0)	382,461 (20.4)	432,441 (15.6)	303,532 (28.5)	21,678 (49.0)

	Non-institutionalized Albertan Adults										LTC residents
Had at least one hospitalization	215,148 (5.6)	184,571 (5.7)	30,288 (8.0)	83,562 (5.0)	66,848 (4.1)	64,738 (11.6)	80,152 (4.1)	134,996 (7.2)	101,565 (3.7)	113,583 (10.7)	15,744 (35.6)
Had at least one acute care hospitalization	214,558 (5.6)	184,003 (5.6)	30,266 (8.0)	83,547 (5.0)	66,768 (4.1)	64,243 (11.5)	79,940 (4.1)	134,618 (7.2)	101,504 (3.7)	113,054 (10.6)	15,524 (35.1)
Hospitalized at academic centre	47,642 (1.2)	43,213 (1.3)	4,354 (1.2)	13,120 (0.8)	18,020 (1.1)	16,502 (3.0)	22,828 (1.2)	24,814 (1.3)	17,975 (0.6)	29,667 (2.8)	4,248 (9.6)
Pharmacist-delivered patient counselling or prescription modification	169,243 (3.7%)	127,315 (3.5%)	41,928 (4.4%)	36,917 (2.4%)	65,716 (4.4%)	48,645 (8.5%)	73,820 (3.2%)	95,423 (4.2%)	167,894 (3.7%)	1,349 (13.7%)	N/A

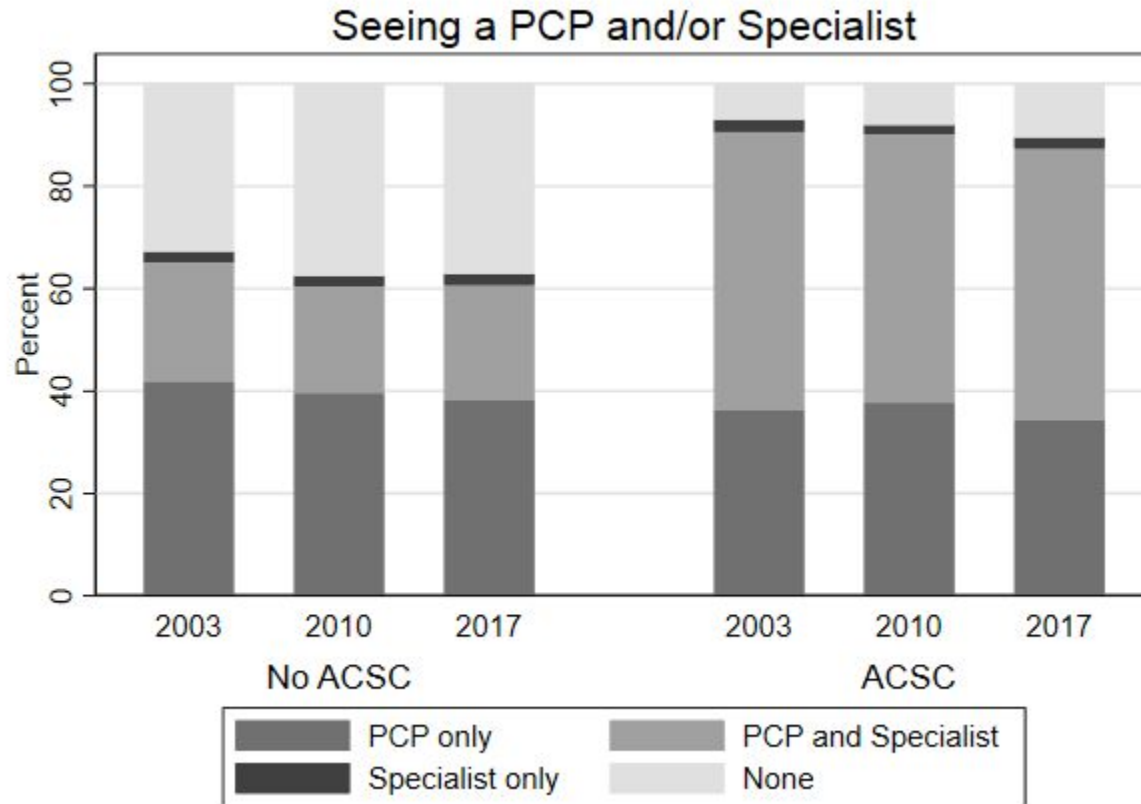
Data reported as counts and percentages. ACSC ambulatory care sensitive condition, ED emergency department, FFS fee for service, IQR interquartile range, LTC long-term care, NA not applicable, PCP primary care provider, PIN pharmaceutical information network, UAH University of Alberta Hospital. Data on patient residence (rural or urban) missing for 5.2%.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

eAppendix Table: Self-report of symptoms and health status, results from Alberta respondents to the Canadian Community Health Survey and callers to the HealthLink telephone service

	Non-institutionalized Albertan Adults									
	Overall	Urban	Rural	18-40 y	40-65 y	≥65 y	Male	Female	No ACSC	≥1 ACSC
From Canadian Community Health Survey 2016:										
N	12,071	--	--	4,494	4,899	2,678	5,643	6,428	8,187	3,884
% reporting their health as excellent or very good	64.2 (62.9, 65.5) CV=1.0			70.3 (68.4, 72.2) CV=1.4	63.2 (61.0, 65.4) CV=1.8	48.9 (46.2, 51.5) CV=2.8	64.6 (62.7, 66.5) CV=1.5	63.8 (62.0, 65.5) CV=1.4	72.3 (70.8, 73.8) CV=1.0	42.9 (40.5, 45.3) CV=2.8
% reporting they had unmet health care needs	3.2 (2.8, 3.8) CV=8.1			3.8 (3.0, 4.8) CV=12.2	3.1 (2.5, 3.9) CV=11.2	1.8 (1.3, 2.5) CV=16.3	2.5 (1.9, 3.2) CV=13.2	4.0 (3.3, 4.9) CV=10	2.7 (2.2, 3.3) CV=10.2	4.7 (3.7, 6.0) CV=12.3
From Alberta Health Link data 2018:										
N	470,207	383,931	75,267	308,804	123,002	38,401	357,741	106,085	424,926	37,701
Median age (IQR)	35 (29, 46)	35 (29,45)	35 (28,48)	31 (27,35)	49 (44,57)	73 (68,78)	34 (29,43)	39 (32,54)	34 (29,43)	56(40,68)
% calling Health Link for themselves	57.3 (57.2, 57.5)	56.8 (56.6, 56.9)	57.6 (57.2, 57.9)	49.6 (49.5, 49.8)	67.5 (67.3, 67.8)	86.6 (86.2, 86.9)	68.7 (68.4, 69.0)	53.8 (53.7, 54.0)	55.5 (55.3, 55.6)	77.9 (77.5, 78.3)
% advised to attend an ED or seek medical care within 4 hours	33.4 (33.2, 33.5)	33.2 (33.0, 33.3)	33.8 (33.5, 34.2)	31.5 (31.4, 31.7)	36.2 (35.9, 36.5)	39.2 (38.7, 39.6)	33.1 (32.9, 33.2)	34.3 (34.0, 34.6)	32.3 (32.2, 32.4)	45.2 (44.7, 45.7)

1
2
3 **Figure 1: Patterns of outpatient clinic visits by adults with versus without an ambulatory care sensitive**
4 **condition**
5
6
7



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47

Figure 2: The ecology of medical care for adult Albertans in 2017

