

BMJ Open Trajectories of health system use and survival for community-dwelling persons with dementia: a cohort study

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ABSTRACT

Objectives To determine the long-term trajectories of health system use by persons with dementia as they remain in the community over time.

Design Population-based cohort study using health administrative data.

Setting Ontario, Canada from 1 April 2007 to 31 March 2014.

Participants 62 622 community-dwelling adults aged 65+ years with prevalent dementia on 1 April 2007 matched 1:1 to persons without dementia based on age, sex and comorbidity.

Main outcome measures Rates of health service use, long-term care placement and mortality over time.

Results After 7 years, 49.0% of persons with dementia had spent time in long-term care (6.8% without) and 64.5% had died (30.0% without). Persons with dementia were more likely than those without to use home care (rate ratio (RR) 3.02, 95% CI 2.93 to 3.11) and experience hospitalisations with a discharge delay (RR 2.36, 95% CI 2.30 to 2.42). As they remained in the community, persons with dementia used home care at a growing rate (10.7%, 95% CI 10.0 to 11.3 increase per year vs 6.7%, 95% CI 4.3 to 9.0 per year among those without), but rates of acute care hospitalisation remained constant (0.6%, 95% CI -0.6 to 1.9 increase per year).

Conclusions While persons with dementia used more health services than those without dementia over time, the rate of change in use differed by service type. These results, particularly enumerating the increased intensity of home care service use, add value to capacity planning initiatives where limited budgets require balancing services.

BACKGROUND

An estimated 564 000 Canadians were living with dementia in 2016, and this number is expected to rise to 937 000 by 2031.¹ Across health systems internationally, evidence is mounting about the high health systems use and costs, and potential for poor care outcomes among older adults with dementia.^{2–5} Efforts to support persons with dementia in their homes, outside of acute and long-term care settings, are at the forefront of

Strengths and limitations of this study

- This population-based cohort study examined health service use over time among a large sample of community-dwelling persons with prevalent dementia compared with a matched control group of persons without dementia.
- The use of multiple linked health administrative databases allowed for the comprehensive examination of healthcare use in a variety of settings, including in hospital, home and nursing home settings.
- The long follow-up period of 7 years allowed for an investigation of changes in the intensity of health system use over time, which has not been described in previous studies.
- Despite the use of a validated health administrative data algorithm to capture dementia, we did not have information on clinical diagnosis and there is a potential for misclassification.
- Data regarding the causal reasons for health system contacts including individual, household and health system factors leading to the use of healthcare services were not available and should be explored in future research.

policy agendas internationally⁶ with a goal of promoting quality of life and limiting potentially avoidable care transitions.

These efforts coincide with concerns that current health system supports for community-dwelling older adults with dementia are inadequate and place a substantial burden on informal caregivers, including family.^{7–9} However, there is limited evidence describing the intensity with which older adults with dementia use health services as they remain in the community over time; particularly in relation to other older populations. While several studies^{2 10 11} have shown increases in utilisation at specific points in time, such as around the time of long-term care admission¹² and in the year of diagnosis,¹³ longer time horizons and trajectories of health service use have not been well-documented.



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Comprehensive information on population-level patterns of health service use for persons with dementia is required to understand current (and projected) health system impacts and to explore gaps in care. We determined trajectories of health service use, transitions to long-term care and mortality among a population-based cohort of community-dwelling older adults with prevalent dementia compared with matched controls over 7 years in Ontario, Canada.

METHODS

Study design and population

We conducted a cohort study using population-based health administrative data from 1 April 2007 to 31 March 2014 in Ontario, Canada. We included all prevalent community-dwelling adults aged 65–105 years with dementia (including Alzheimer's disease) who were alive and eligible to receive provincial health insurance coverage on 1 April 2007 (index date). These individuals were matched 1:1 to a control group with no documented history of dementia. All individuals were followed for up to 7 years to examine trends in health system use, transitions to long-term care and mortality.

Data sources

Ontario provides universal healthcare coverage for its citizens. These encounters are captured in health administrative databases that were linked using unique encoded identifiers and analysed at ICES (online supplementary table 1). ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse healthcare and demographic data, without consent, for health system evaluation and improvement. This study is reported according to REporting of studies Conducted using Observational Routinely-collected Data guidelines (online supplementary table 2). The use of data in this project was authorised under section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a Research Ethics Board.

Patient and public involvement

No patients were involved at the outset of this study due to limited time and resources. We have invited patients and stakeholders to help us develop our knowledge dissemination strategy.

Persons with dementia

We identified 117 337 persons with dementia on 1 April 2007 using a previously validated algorithm based on diagnosis codes recorded in hospitalisation records and physician claims, as well as prescription drug reimbursements for cholinesterase inhibitors.¹⁴ The algorithm has been used to produce national dementia prevalence and incidence estimates by the Canadian Chronic Disease Surveillance System.¹⁵ This prevalent cohort included individuals at various stages of dementia. Individuals

who resided in long-term care in the 60 days prior to and including the index date were excluded (N=54 715). This resulted in a cohort of 62 622 older adults with dementia.

Persons without dementia

We selected 1:1 matched controls (age (± 1 year), sex, number of comorbidities (± 2) as measured by Aggregated Diagnosis Groups (ADGs)) from the remaining population of community-dwelling older adults. ADGs were derived using the Johns Hopkins Adjusted Clinical Group ACG Case-Mix System¹⁶ V.10.0 from diagnoses in hospitalisation records and physician claims in the 2 years prior to index date.

Individual characteristics

We described age, sex, number of ADGs (0, 1–5, 6–10 and 11+), neighbourhood income quintile and rurality of residence. Neighbourhood income quintile was captured by linking to Statistics Canada census data using postal codes. Rurality was determined by the Rurality Index of Ontario, which is an index based on population factors and distance to referral centres; ranges are from 0 to 100 and communities with higher values (≥ 40) considered rural.¹⁷

Patterns of transition and health system use from the community

We examined long-term care placement and mortality and rates of health service use over 7 years. Mortality analyses included deaths occurring both in the community and long-term care. In long-term care placement and mortality analyses, individuals were censored at first evidence of: (a) developing dementia; (b) loss of health insurance eligibility; (c) no health system contact for 5 years or (d) study end. To be eligible for long-term care in Ontario, individuals must require access to 24 hours nursing and personal care, frequent assistance with activities of daily living and on-site supervision to ensure safety and well-being. This setting does not include retirement homes or assisted living facilities.

Health system use included home care visits, emergency department (ED) visits, acute care hospitalisations, acute care hospitalisations with any discharge delay days and visits to family physicians as well as to dementia specialists (defined as geriatricians, neurologists and psychiatrists). Publicly funded home care services may include homemaking, transportation, personal care, nursing care, end-of-life care, physiotherapy, occupational and speech-language therapy. Home care is provided on either a short-stay (ie, services provided for <60 days to aid in recovery post-surgery or injury) or long-stay (ie, clients requiring services in the home for ≥ 60 days in a single episode) basis; although the majority of service in our cohort is for long-stay. Discharge delays indicate a patient is medically ready for discharge, but was not able to be discharged for other reasons such as lack of suitable care in the community or lack of available long-term care beds.¹⁸ We did not examine medication use as it was not

possible to track in acute care settings. For health service utilisation rates, given our focus on health system use by individuals as they *remain in the community over time*, individuals were censored at the first of: (a) entering long-term care; (b) death; (c) developing dementia; (d) loss of health insurance eligibility; (e) no health system contact for 5 years or (f) study end.

Statistical analysis

Descriptive statistics were used to compare the demographic characteristics of older adults with (vs without) dementia at baseline and at the start of the last year of follow-up. Sankey plots were used to visualise changes in setting of care over time. Rate ratios (RRs) were used to compare rates of health service use between persons with dementia and persons without dementia. Trends in the intensity with which individuals used health services over time *as they remained alive and in the community* were assessed using generalised estimating equations for serially correlated data. Differences in trends between those with and without dementia were assessed using Wald tests for interaction. All analyses were conducted using SAS Enterprise Guide V.6.1 (SAS Institute).

RESULTS

Characteristics of older persons with dementia

The 62 622 matched pairs had a mean age of 81.1 years (SD: 6.8 years) and 60.4% were women (table 1). The median number of ADGs was 9 and 79.4% of individuals had 6 or more ADGs, indicating a high level of comorbidity. The neighbourhood income distribution and proportion living in rural settings were similar across the matched pairs. By 1 April 2013, persons with dementia who had remained in the community were modestly younger (mean 83.5 years vs 84.3 years) and more likely to reside in urban areas (90.7% vs 88.0%) compared with persons without dementia.

Persons with dementia were followed until mortality for an average of 4.5 years (SD: 2.4 years) compared with an average of 5.0 years (SD: 2.4 years) in those without dementia. For long-term care placement, persons with dementia were followed for an average of 3.3 years (SD: 2.4 years) compared with an average of 4.8 years (SD: 2.44 years) in those without dementia.

Patterns of transition for long-term care placement and mortality

Figure 1A,B shows yearly transitions between community, long-term care and death for older adults with dementia and without dementia. Persons with dementia were more likely to be admitted to long-term care with an average of 12.7% transitioning each year (1.6% without dementia). Table 2 shows that at the end of 7 years, almost half (49.0%) of persons with dementia had been admitted to long-term care (6.8% without dementia) and 64.5% had died (30.0% without dementia).

Rates of health system use

Over 7 years, persons with dementia who continued to live in the community had higher rates of health system use than persons without dementia (table 3). Compared with persons without dementia, older adults with dementia had a fourfold higher rate of dementia specialist visits (RR=4.11, 95% CI 3.95 to 4.28) and a threefold higher rate of home care visits (RR=3.02, 95% CI 2.94 to 3.11) over the study period. The rate of hospitalisations with a discharge delay was 2.36 times higher for persons with dementia (95% CI 2.30 to 2.42) while the rate of acute care hospitalisations was 29% greater (RR=1.29, 95% CI 1.27 to 1.31). Persons with dementia had 23% more ED visits (RR=1.23, 95% CI 1.21 to 1.25) and 25% more family physician visits per person-year (RR=1.25, 95% CI 1.24 to 1.27) than persons without dementia.

Trends in health system use

Rates of home care visits increased as persons with dementia remained in the community over time; an average rate of 10.7% per year (95% CI 10.0 to 11.3) (figure 2A). This rate of increase was different from that for persons without dementia (6.7% per year (95% CI 4.3 to 9.0), $p<0.001$). Most home care visits were for personal support and homemaking; in 2013, 91.1% of visits for persons with dementia and 84.9% of visits for persons without dementia (data not shown). The next most common home care service was nursing visits (6.6% of visits for persons with dementia and 11.5% of visits for persons without dementia). While the ED visit rate among persons with dementia increased by an average of 1.1% per year (95% CI 0.2 to 2.0), the rate of increase was no different in persons without dementia (2.1% per year (95% CI 1.3 to 2.8, $p=0.27$)) (figure 2B). Neither group experienced a significant change in the rate of acute care hospitalisation over time (figure 2C). Notably, the rate of hospitalisations with discharge delay in the dementia cohort decreased by 3.2% per year (95% CI 1.8 to 4.6) while the rate for persons without dementia remained stable (figure 2D). Older adults with and without dementia experienced a decline in rates of physician visits (figure 2E,F) as they remained in the community over time. In particular, the rate of dementia specialist visits declined by 5.4% per year (95% CI 4.4 to 6.5) in persons with dementia; a significantly greater decline than the 2.5% per year experienced by the persons without dementia ($p<0.001$).

DISCUSSION

This study offers a novel look at population-level trajectories of health system use for individuals with prevalent dementia in Ontario, as they remained alive in community settings. We documented the substantial role of long-term care for persons with dementia, with rates of long-term care admission seven times higher than for persons without dementia. As persons with dementia remained in the community over time, they used home

Table 1 Characteristics of community-dwelling older adults with dementia and matched* persons without dementia on 1 April 2007 and on 1 April 2013 in Ontario, Canada

Baseline characteristics	On 1 April 2007		On 1 April 2013 and remaining in community	
	Persons with dementia N=62 622	Persons without dementia* N=62 622	Persons with dementia N=13 807	Persons without dementia* N=31 274
<i>Matching variables</i>				
Age (years)				
Mean (\pm SD)	81.1 \pm 6.8	81.1 \pm 6.8	83.5 \pm 6.4	84.3 \pm 6.3
Median (IQR)	81 (76–86)	81 (76–86)	84 (79–88)	85 (80–89)
Age group (years), n (%)				
65–74	11 131 (17.8)	11 131 (17.8)	1300 (9.4)	2223 (7.1)
75–84	31 462 (50.2)	31 459 (50.2)	6261 (45.3)	13 285 (42.5)
85+	20 029 (32.0)	20 032 (32.0)	6246 (45.2)	15 766 (50.4)
Sex, n (%)				
Female	37 802 (60.4)	37 802 (60.4)	8185 (59.3)	19 129 (61.2)
Male	24 820 (39.6)	24 820 (39.6)	5622 (40.7)	12 145 (38.8)
Aggregated Diagnosis Groups (ADGs)				
Mean (\pm SD)	8.89 \pm 3.89	8.89 \pm 3.89	8.08 \pm 4.04	8.09 \pm 3.77
Median (IQR)	9 (6–12)	9 (6–12)	8 (5–11)	8 (5–11)
Number of ADGs, n (%)				
0	267 (0.4)	267 (0.4)	163 (1.2)	230 (0.7)
1–5	12 612 (20.1)	12 612 (20.1)	3818 (27.7)	8022 (25.7)
6–10	28 872 (46.1)	28 872 (46.1)	5994 (43.4)	14 932 (47.7)
11+	20 871 (33.3)	20 871 (33.3)	3832 (27.8)	8090 (25.9)
<i>Additional characteristics</i>				
Neighbourhood income quintile, n (%)				
Missing	219 (0.3)	167 (0.3)	52 (0.4)	111 (0.4)
Q1: lowest quintile	13 181 (21.0)	12 918 (20.6)	2651 (19.2)	6139 (19.6)
Q2	12 763 (20.4)	13 294 (21.2)	2820 (20.4)	6458 (20.6)
Q3	12 107 (19.3)	12 026 (19.2)	2697 (19.5)	6146 (19.7)
Q4	11 882 (19.0)	11 661 (18.6)	2762 (20.0)	6099 (19.5)
Q5: highest quintile	12 470 (19.9)	12 556 (20.1)	2825 (20.5)	6321 (20.2)
Rural, n (%)				
Yes	7109 (11.4)	8012 (12.8)	1275 (9.2)	3727 (11.9)
No	55 513 (88.6)	54 610 (87.2)	12 527 (90.7)	27 529 (88.0)
Time since dementia first recorded in administrative data, in years				
Mean (\pm SD)	2.79 \pm 2.67		8.79 \pm 2.67	
Median (IQR)	2.03 (0.85–3.89)		8.03 (6.85–9.89)	

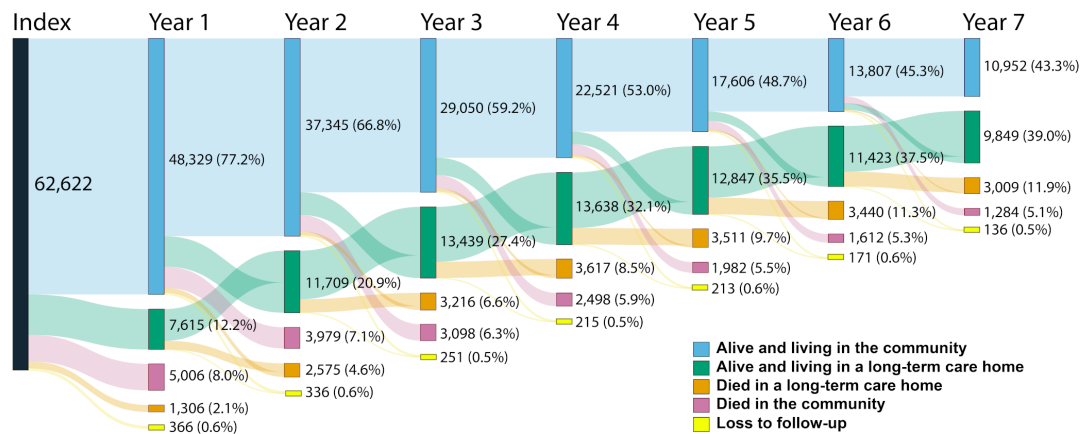
*Control group with no documented history of dementia on 1 April 2007 matched 1:1 on age, sex and Aggregated Diagnosis Groups (\pm 2 ADGs).

care services and visited the ED at increasing rates; while other rates of service use were stable or declined.

Our focus on community-based care is important to the quality of life and health status of persons with dementia, as potentially avoidable care transitions can lead to poor outcomes.^{19–21} Even in a health system such as Ontario's, where provincially funded health services include home

care, we found high rates of long-term care placement—with more than half of persons with dementia being placed in long-term care after 7 years of follow-up. This result is likely a function of our prevalent cohort design, where individuals are represented at various stages of dementia. It also potentially highlights the challenges associated with managing the behavioural and psychosocial

A. Persons with Dementia



B. Persons without Dementia**

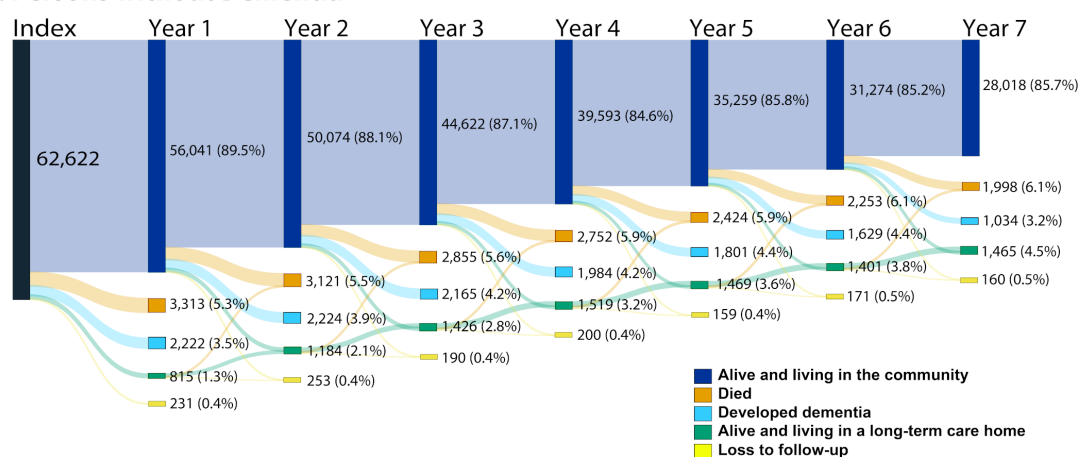


Figure 1 Yearly transitions by setting for community-dwelling older adults with dementia compared with matched* persons without dementia between 1 April 2007 to 31 March 2014 in Ontario, Canada.*Matched 1:1 on age, sex and Aggregated Diagnosis Groups (± 2 ADGs). **Control group with no documented history of dementia on 1 April 2007 matched 1:1 on age, sex and ADGs (± 2 ADGs). Yearly prevalence percentages: denominators for prevalence percentages were calculated among persons alive and living in the community (light blue for persons with dementia (A) and dark blue for controls (B)) or alive and living in long-term care (green in both (A) and (B)) at the start of each year. For example, in (A) at the start of the second year of follow-up, 48 329 persons with dementia were living in the community and 7615 persons with dementia were living in a long-term care home. Among the 55 944 alive at the start of year 2, 66.8% of persons with dementia were alive and living in the community, 20.9% were living in a long-term care home, 7.1% died in the community, 4.6% died in a long-term care home and 0.6% were lost to follow-up by the end of the second year of follow-up.

symptoms of dementia as well as the care burden of worsening dementia over time. The high rate of long-term care placement and increasing intensity of home care visits over time in the dementia group indirectly suggest unmet care needs and a burden on informal caregivers. Limits on the number of publicly funded home care hours may also influence decisions to admit individuals to long-term care, particularly as persons with dementia experience disease progression and require more intensive care. Increased levels of caregiver distress have been associated with earlier long-term care placement²² and may be more pronounced at end-of-life.²³ Caregiver strain can result in depression and anxiety, poorer health status and health behaviours, social isolation and financial

difficulties.²⁴ While long-term care placement can help to reduce some demands on caregivers, it may not result in an improvement in symptoms of anxiety and depression caregivers may experience.⁸ In order to support persons with dementia and their caregivers to live successfully in the community, additional research is needed.

We found that after 7 years, persons with dementia were almost two times as likely to die compared with persons without dementia.²⁵ Our findings are consistent with previous work that has demonstrated persons with dementia experience poorer survival²⁶ and shorter time to long-term care transition than those without dementia,¹¹ however the magnitude of the differences we show is not as large as in some previous work. Differences

Table 2 Transitions by setting for older adults with dementia compared with matched* persons without dementia from 1 April 2007 to 31 March 2014 in Ontario, Canada

Status at end of follow-up period on 31 March 2014	On 1 April 2007	
	Persons with dementia N=62 222	Persons without dementia* N=62 222
Alive and living in the community	10 952 (17.6%)	28 018 (45.0%)
Alive and living in long-term care	9849 (15.8%)	1465 (2.4%)
Died in long-term care	20 674 (33.2%)	2763 (4.4%)
Died in the community (with no long-term care)	19 459 (31.3%)	15 953 (25.6%)
Developed dementia and censored for follow-up		13 059 (21.0%)
Other loss to follow-up†	1688 (2.7%)	1364 (2.2%)

*Control group with no documented history of dementia on 1 April 2007 matched 1:1 on age, sex and Aggregated Diagnosis Groups (\pm 2 ADGs).

†Loss of health insurance eligibility and/or had no health system contact for 5 years.

observed between dementia populations and those without dementia are likely attributable to differences in dementia severity as well as other important risk factors such as frailty.^{27–29} While other studies have demonstrated similar rates of mortality in dementia and non-dementia populations,^{11 30} the differences in mortality in our study suggest unmeasured differences in baseline health characteristics beyond age, sex and comorbidities.

Persons with dementia had approximately 20%–30% higher rates of acute care hospitalisations and ED visits compared with persons without dementia. Studies have shown twofold differences between hospital use in dementia compared with non-dementia cohorts,^{5 11 31 32} including those who have addressed the differences in population characteristics using propensity score matching.³ Phelan and colleagues examined a cohort older adults and found a crude twofold higher rate of hospitalisation for persons with dementia; however,

after adjustment for confounders, persons with dementia had a 41% increased rate of hospitalisation, a similar magnitude as in our study.³¹

Our cohort approach is novel and of value to capacity planning initiatives. There was notable increasing use of home care services among individuals who continued to reside in the community. This finding suggests that additional supports may be required to enable persons to remain in the community. Previous studies examining health service utilisation among persons with dementia have been inconsistent regarding the timing of health-care utilisation increases—with some finding that utilisation increases with time following diagnosis² and others observing increases near the time of death.^{2 12 13 33} International researchers will need to consider our findings in the context of their own healthcare systems. In Ontario, all residents are eligible for universal access to medically necessary physician services, hospital care, home care

Table 3 Health service use among community-dwelling older adults with dementia compared with matched* persons without dementia between 1 April 2007 to 31 March 2014 in Ontario, Canada

	Persons with dementia N=62 622 Rate per person-year (95% CI)	Persons without dementia* N=62 622 Rate per person-year (95% CI)	Rate ratio (95% CI)	P value
Death	9.5 (9.4 to 9.6)	5.3 (5.2 to 5.4)	1.80 (1.76 to 1.84)	<0.0001
Long-term care placement	15.0 (14.8 to 15.2)	2.1 (2.1 to 2.2)	7.07 (6.89 to 7.27)	<0.0001
Health service use				
Dementia specialist visits	1.70 (1.70 to 1.71)	0.41 (0.41 to 0.41)	4.11 (3.95 to 4.28)	<0.0001
Home care visits	65.2 (65.2 to 65.3)	21.8 (21.8 to 21.8)	3.02 (2.94 to 3.11)	<0.0001
Acute care hospitalisations with discharge delay	0.10 (0.10 to 0.10)	0.04 (0.04 to 0.04)	2.36 (2.30 to 2.42)	<0.0001
Acute care hospitalisations	0.40 (0.39 to 0.40)	0.31 (0.31 to 0.31)	1.29 (1.27 to 1.31)	<0.0001
Family physician visits	13.4 (13.3 to 13.4)	10.9 (10.9 to 10.9)	1.25 (1.24 to 1.27)	<0.0001
Emergency department visits	1.0 (1.0 to 1.0)	0.87 (0.87 to 0.88)	1.23 (1.21 to 1.25)	<0.0001

*Control group with no documented history of dementia on 1 April 2007 matched 1:1 on age, sex and Aggregated Diagnosis Group category (0, 1–5, 6–10, 11+).

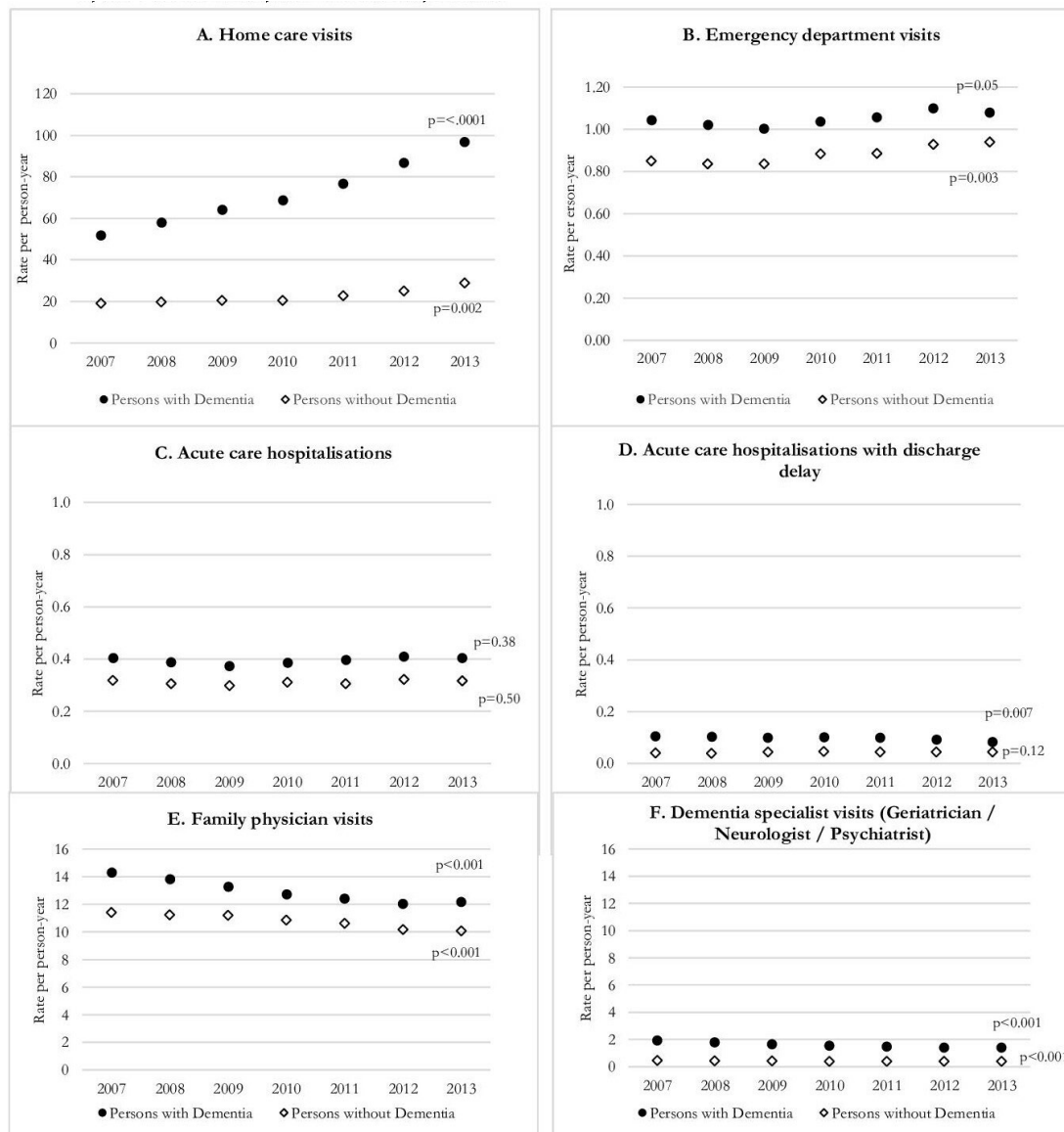


Figure 2 Yearly rates of health service use among community-dwelling older adults with dementia as they remained in the community over time compared with matched* persons without dementia from 1 April 2007 to 31 March 2014 in Ontario, Canada. P values from tests for linear trend. *Control group with no documented history of dementia on 1 April 2007 matched 1:1 on age, sex and Aggregated Diagnosis Groups (± 2 ADGs).

and prescription drugs under the publicly funded health insurance system. Most of the cost of long-term care is covered by the provincial health system and access to long-term care is centrally managed. Although we did not examine healthcare utilisation using years since diagnosis, we observed an increased rates of long-term care placement and home care visits over time and decreases in other forms of healthcare utilisation.

Strengths and limitations

Our study has several strengths. It is the largest Canadian, population-based study to examine persons with dementia matched to persons without dementia followed over a substantial period of time. The cohort design allowed an examination of trends in rates of service use among individuals who remained in the community and

will help health system planners understand the long-term needs of these individuals.

Several limitations should be noted. First, our administrative data definition of dementia, although validated in a primary care population sample,¹⁴ is not a clinical diagnosis of dementia and there is the potential for misclassification. Also, we did not have access to measures of stage of dementia in the health administrative data but were able to capture time since dementia ascertainment as a proxy measure of dementia stage. Second, administrative databases allow for documentation of health system use patterns at a population-level but provide minimal information on the causal path. This poses challenges to understanding the interrelationship between individual, household and health system factors leading to the use of



healthcare services among persons with dementia. Third, we were unable to obtain information on perceived quality of care for persons with dementia and their caregivers in order to better understand the individual and caregiver experience and choices made to enter long-term care. Fourth, there may have been residual confounding by unmeasured covariates such as frailty, activities of daily living, marital status, caregiver and family supports and health behaviours. Fifth, the methods chosen for the present study did not allow for the incorporation of health service utilisation following transition to dementia among persons initially without dementia in the control group. Future work will explore health service utilisation at this important period of transition.

CONCLUSION

We observed higher rates of health service utilisation, long-term care placement and mortality among community-dwelling persons with prevalent dementia compared with persons without dementia. Future work exploring the underlying reasons for patterns of health service utilisation over time may provide opportunities to improve care in the community setting to reduce the need for long-term care placement, as well as to support health system planning to meet the needs of this complex and growing population.

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Contributors SEB, JDW and CJM conceived and designed the study. JG and XW carried out the statistical analysis. SEB, LCM and JDW wrote the manuscript. JG, XW, RN, PAR, EAY, MJV and CJM contributed to the manuscript's critical appraisal and review. All authors had full access to all the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

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Data availability statement The dataset from this study is held securely in coded form at ICES. While data sharing agreements prohibit ICES from making the dataset publicly available, access may be granted to those who meet prespecified criteria for confidential access, available at www.ices.on.ca/DAS. The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to ICES and are therefore either inaccessible or may require modification.

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