

The association between home care visits and same-day emergency department use: a case–crossover study

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■ Cite as: *CMAJ* 2018 April 30;190:E525-31. doi: 10.1503/cmaj.170892

Visual abstract available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC2

See related article at www.cmaj.ca/lookup/doi/10.1503/cmaj.180263

ABSTRACT

BACKGROUND: The extent to which home care visits contribute to the delay or avoidance of emergency department use is poorly characterized. We examined the association between home care visits and same-day emergency department use among patients receiving publicly funded home care.

METHODS: We conducted a population-based case–crossover study among patients receiving publicly funded home care in the Hamilton–Niagara–Haldimand–Brant region of Ontario between January and December 2015. Within individuals, all days with emergency department visits after 5 pm were selected as cases and matched with control days from the pre-

vious week. The cohort was stratified according to whether patients had ongoing home care needs (“long stay”) or short-term home care needs (“short stay”). We used conditional logistical regression to estimate the association between receiving a home care visit during the day and visiting the emergency department after 5 pm on the same day.

RESULTS: A total of 4429 long-stay patients contributed 5893 emergency department visits, and 2836 short-stay patients contributed 3476 visits. Receiving a home care nursing visit was associated with an increased likelihood of visiting the emergency department after 5 pm on the same day in both long-stay

(odds ratio [OR] 1.32, 95% confidence interval [CI] 1.17–1.48) and short-stay patients (OR 1.22, 95% CI 1.07–1.39). Stronger associations were observed for less acute visits to the emergency department. No associations were observed for other types of home care visits.

INTERPRETATION: Patients receiving home care were more likely to visit the emergency department during the evening on days they received a nursing visit. The mechanism of the association between home care visits and same-day emergency department use and the extent to which same-day emergency department visits could be prevented or diverted require additional investigation.

Older adults are more likely to use the emergency department, have longer lengths of stay in the emergency department and are more likely to be admitted to hospital from the emergency department than younger patients.^{1–3} Despite being highly used by older adults, the emergency department is often not the ideal place for seniors to receive care. Older adults are increasingly presenting to the emergency department with complex care needs that require greater assessment and coordination than the traditional disease-centric and episodic models of care typically permit.^{4–6}

Increased access to publicly funded home and community care has been suggested as a way to reduce or prevent unnecessary or avoidable visits to the emergency department.^{7–9} How-

ever, evidence on the relation between home care and emergency department use is limited and mixed. Several clinical trials have tested enhanced models of home care and found no effect on emergency department use, whereas increased levels of home care service have been associated with a reduction in emergency department use in patients receiving palliative care.^{10–12}

Within health systems, concerns persist that home care has evolved into a task-focused, visit-based, contracted service model that precludes comprehensive practice, and that this task-based model contributes to silos of care.¹³ There have been calls to shift home care to a more comprehensive, team-based practice model that supports disease management in the home.^{10,13,14} One could assume that a transient association between home

care visits and emergency department use may exist when home care clinicians have limited flexibility to act beyond a set of pre-defined tasks during a visit or when they encounter clinical issues beyond the scope of their practice. If home care clinicians identify a clinical issue that they are unable to address during that visit, they may refer the patient to receive care elsewhere on the same day of the visit.

The objective of this study was to investigate the association between home care visits and same-day emergency department use among patients receiving publicly funded home care. We hypothesized that receiving nursing visits during the day would be associated with an increased likelihood of visiting the emergency department during the evening hours of the same day. We hypothesized that there would be no association with other types of home care visits (e.g., personal support, physiotherapy and occupational therapy) given that their traditional scope of practice would make them less likely to detect acute medical issues.

Methods

Study design and data sources

We conducted a population-based case-crossover study among adult patients receiving home care within the Hamilton–Niagara–Haldimand–Brant health region in Ontario. The health region includes more than 1.3 million people, accounting for roughly 11% of the population of Ontario, and has the largest number of adults older than 65 years in the province. The region contains more than 10 municipalities with wide variations in population density, socioeconomic status and access to care from tertiary centres. Ontario provides universal access to emergency department and home care services via the publicly funded provincial health care system.

We used multiple linked population-based health administrative databases. Home care records were obtained from the Client Health and Related Information System, which is the health administrative database used by Ontario's publicly funded home care system.¹⁵ Information on emergency department visits and hospital stays were obtained from the National Ambulatory Care Reporting System and the Discharge Abstract Database, which contain standardized reporting for all emergency department visits and acute hospital admissions in Ontario, respectively.^{16,17} The 3 databases are regularly checked for validity and have been used extensively in research.^{16–24}

Regional versions of the administrative databases were accessed at the Health Data Library at McMaster University. Records were linked at the individual level using encrypted, unique identifiers.

Participants

We constructed a population-based cohort of every day that each patient aged 19 years and older and receiving home care was eligible to receive service in the Ontario region between Jan. 1, 2015, and Dec. 31, 2015. Home care billing records were used to identify which home care services a patient received on each day, including nursing, personal support and therapies (physiotherapy, occupational therapy, speech and language

therapy, nutritional therapy and social work). The cohort was linked to emergency department records to identify any day that a patient visited the emergency department after 5 pm and to identify the Canadian Triage and Acuity Scale (CTAS)²⁵ score, discharge disposition and primary diagnosis (International Statistical Classification of Diseases and Related Health Problems, 10th revision [ICD-10-CA])²⁶ associated with the visit. In the rare case that a patient visited the emergency department twice after 5 pm on the same day, only the first visit was included. Days that a patient was admitted to hospital were excluded from the cohort.

We used existing administrative service categories to stratify the cohort into “long stay,” “short stay” and palliative groups (Appendix 1, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC1). Patients receiving palliative care were excluded from the cohort.

Statistical analysis

The case-crossover design matches an exposure period that precedes an event of interest with 1 or more control exposure periods within the same subject.²⁷ The design is appropriate for investigating the transient effects of an intermittent exposure on acute events.²⁸ Through self-matching, the design eliminates confounding from any fixed patient-level factors.

Cases were defined as days that a member of our cohort of patients receiving home care visited the emergency department after 5 pm. The primary exposure measured was home care visits received on the same day as the emergency department visit. Control exposure periods were identified by selecting all days in the 7 days immediately preceding the case day that the patient did not visit the emergency department after 5 pm. Each day formed a separate matched control with exposure measured as the home care services that the patient received on that day. Matched sets of case and control days were analyzed with conditional logistic regression.

The analysis was limited to emergency department visits after 5 pm to ensure that the emergency department visits occurred after any home care visits on that day, home care visits in the evening being uncommon. Weekends and holidays were excluded from the selection of both cases and controls owing to varying exposure patterns and availability of other health care services on those days. Cases and control periods were selected separately for each type of home care service (nursing, therapies and personal support) with a requirement that the patient be actively authorized to receive the service. Patients could be authorized for all or none of the services on any day. Personal support was not studied in short-stay patients because they do not typically receive the service. Analyses were stratified by patient group and performed separately for each service type. In addition to the primary case definition of any emergency department visit after 5 pm, we also examined emergency department cases defined by discharge disposition (hospital admission v. non-hospital admission) and higher or lower acuity (CTAS score 1–3 v. 4–5). We examined effect modification by sex and self-reported health using the interaction term approach.

Some patients visited the emergency department after 5 pm on more than 1 day during the study period, creating dependencies between cases. To avoid violating independence assumptions, we adopted a within-cluster resampling analytic approach.²⁹ One case and 1 matched control day were randomly selected per patient, creating a set of independent matched pairs that was analyzed with conditional logistic regression. This process was repeated 10 000 times, resampling cases and control days with replacement. The ensemble of individual model results was combined according to the method of Riegar and Weinberg²⁹ to produce overall estimates of the model parameters and associated variances. All statistical tests were 2-tailed, and $p < 0.05$ was set as the significance level.

Sensitivity analysis

We performed a sensitivity analysis to examine the robustness of the results to changes in elements of the study design. We conducted the analysis using 4 pm and 6 pm rather than 5 pm as the threshold for capturing emergency department visits. We also explored the effects of selecting control periods from the 5 days, 3 days or 1 day immediately preceding the case day rather than the 7 days used in the primary analysis.

Ethics approval

We received ethics approval from the Hamilton Integrated Research Ethics Board, which is affiliated with McMaster University, St. Joseph's Healthcare Hamilton and Hamilton Health Sciences.

Results

The cohort contained 30 253 long-stay and 35 097 short-stay patients receiving home care. A total of 4429 unique long-stay patients contributed 5893 emergency department visits to the case–crossover analysis, and 2836 unique short-stay patients contributed 3476 visits. The characteristics of patients contributing cases to the analysis can be found in Table 1. Long-stay patients were largely frail older adults with multiple chronic conditions, functional impairments and ongoing home support needs. Short-stay patients tended to be younger, post-acute care patients with short-term care needs, such as wound care, intravenous medication administration or rehabilitation. Clinical assessment data were available for only 3958 (89.4%) long-stay patients and 2676 (94.4%) short-stay patients because some patients were discharged before a clinical assessment was completed (e.g., death or hospital admission). Long-stay patients had a median age of 81 years, and 61.6% were female. Short-stay patients were younger, with a median age of 66, and had a slight preponderance of women (51.6%).

The number of cases available for analysis varied by the home care service examined, because patients had to be actively authorized to receive the service for a day to be included as a case. A matrix of the total cases and controls and exposed cases and controls by emergency department visit by outcome and type of home care service can be found in Table 2.

Home care nursing visits were significantly associated with a greater likelihood of same-day emergency department visits

after 5 pm in both long-stay (odds ratio [OR] 1.32, 95% confidence interval [CI] 1.17–1.48) and short-stay patients (OR 1.22, 95% CI 1.07–1.39) (Figure 1). In both patient groups, the effect was stronger in visits to the emergency department that did not

Table 1: Characteristics of patients receiving home care who visited the emergency department

Characteristic	No. (%) of patients*	
	Long stay <i>n</i> = 3958†	Short stay <i>n</i> = 2676‡
Demographic		
Age, median (IQR), yr	81 (19)	66 (26)
Sex, female	2438 (61.6)	1381 (51.6)
Lives alone	1305 (33.0)	612 (22.9)
Health		
Impairment in activities of daily living§	3536 (89.3)	967 (36.1)
Cognitive impairment¶	2374 (60.0)	300 (11.2)
Dyspnea	1377 (34.8)	736 (27.5)
Poor self-reported health	1056 (26.7)	575 (21.5)
Fall in last 90 d	1890 (47.8)	–
Mood symptoms**	1799 (45.5)	–
Wandering	121 (3.1)	–
Aggressive behaviour††	427 (10.8)	–
Weight loss‡‡	379 (9.6)	–
No. of medications, mean ± SD	7.39 ± 2.09	–
Informal caregiver status		
Caregiver distress§§	895 (22.6)	–
Informal care per day, mean ± SD, h	2.65 ± 2.92	–
Diagnosis		
Cardiovascular	2311 (58.4)	–
Dementia	869 (22.0)	–
Neurologic	438 (11.1)	–
Musculoskeletal	2680 (67.7)	–
Psychiatric	1055 (26.7)	–
Cancer	588 (14.9)	–
Diabetes	1271 (32.1)	–
COPD	982 (24.8)	–

Note: COPD = chronic obstructive pulmonary disease, IQR = interquartile range, SD = standard deviation.
 *Unless stated otherwise.
 †Data available for 3958 of 4429 patients.
 ‡Data available for 2676 of 2836 patients.
 §Supervision or any assistance in bathing, dressing lower body, personal hygiene or locomotion.
 ¶Modified independence or impairment in cognitive skills for daily decision-making.
 **Depression Rating Scale score > 0.
 ††Verbal abuse, physical abuse, socially inappropriate behaviour or resistance to care in last 3 days.
 ‡‡Unintended weight loss of ≥ 5% in the last 30 days or ≥ 10% in the last 180 days.
 §§Caregiver expresses feelings of distress, anger or depression.

Table 2: Number of cases and controls and exposed cases and controls by outcome, patient group and service type

Outcome	No. of patients (exposed patients)				
	Long stay			Short stay	
	Nursing	Therapy*	Personal support	Nursing	Therapy*
Cases					
ED visit	2610 (1014)	2309 (262)	3737 (2453)	2430 (971)	1128 (156)
ED visit, admission	1029 (408)	1025 (129)	1552 (1,032)	614 (235)	454 (64)
ED visit, no admission	1581 (606)	1284 (133)	2185 (1421)	1816 (736)	674 (92)
ED visit, CTAS score 1–3	2243 (855)	2063 (234)	3280 (2157)	1843 (676)	956 (129)
ED visit, CTAS score 4–5	367 (159)	246 (28)	457 (296)	587 (295)	172 (27)
Controls					
ED visit	10 784 (3638)	9520 (1092)	16 524 (11 011)	8212 (2880)	4333 (491)
ED visit, admission	4382 (1619)	4201 (542)	6895 (4696)	2377 (852)	1844 (227)
ED visit, no admission	6475 (2051)	5361 (553)	9701 (6358)	5870 (2042)	2504 (266)
ED visit, CTAS score 1–3	9356 (3139)	8550 (985)	14 588 (9740)	6629 (2175)	3732 (415)
ED visit, CTAS score 4–5	1493 (515)	1011 (111)	1989 (1298)	1651 (738)	624 (79)

Note: CTAS = Canadian Triage Acuity Scale, ED = emergency department.

*Physiotherapy, occupational therapy, speech and language therapy, nutritional therapy or social work.

result in a hospital admission (long stay: OR 1.50, 95% CI 1.29–1.76; short stay: OR 1.30, 95% CI 1.11–1.52). The effect was also stronger in emergency department visits with a CTAS score of 4 or 5 in the long-stay patient group (OR 1.63, 95% CI 1.20–2.21).

The association between home care nursing visits and emergency department visits was not significant when emergency department visits were restricted to those that resulted in a hospital admission. There were also no significant associations between any type of emergency department visit and home care therapies or personal support visits.

Primary diagnoses for emergency department visits that occurred on the same day as home care nursing visits were broad, with the top 10 diagnoses accounting for only 31.37% of all diagnoses among long-stay patients and 37.78% among short-stay patients (Appendix 2, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC1). There was no consistent, appreciable effect modification by sex or self-reported health (Appendices 3 and 4, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC1).

Sensitivity analysis

Using a threshold of 4 pm or 6 pm rather than 5 pm for emergency department visits did not have a meaningful effect on the results (Appendix 5, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC1). The odds ratios between nursing visits and emergency department visits produced using the

6 pm threshold tended to be slightly smaller than those from the 5 pm threshold, which is in line with expectations that a transient association would attenuate over time. Selecting control exposures from the 5 days, 3 days or 1 day immediately preceding the case day yielded similar results to using 7 days (Appendix 6, available at www.cmaj.ca/lookup/suppl/doi:10.1503/cmaj.170892/-/DC1).

Interpretation

Receiving home care nursing visits during the day was associated with an increased likelihood of visiting the emergency department between 5 pm and midnight of the same day. Stronger associations were observed for emergency department visits that did not result in a hospital admission and for visits with a CTAS score of 4 or 5 among long-stay patients.

This study examined the transient effect of home care visits on emergency department use, considering only emergency department visits that occurred on the same day as a home care visit. Accordingly, our results cannot be compared with studies that looked at emergency department use over periods of weeks and months. The results of the study supported our hypothesis that home care nursing would be associated with a higher likelihood of same-day emergency department use. An emergency department visit is not necessarily a negative outcome, but may be if patients could more appropriately receive treatment in the

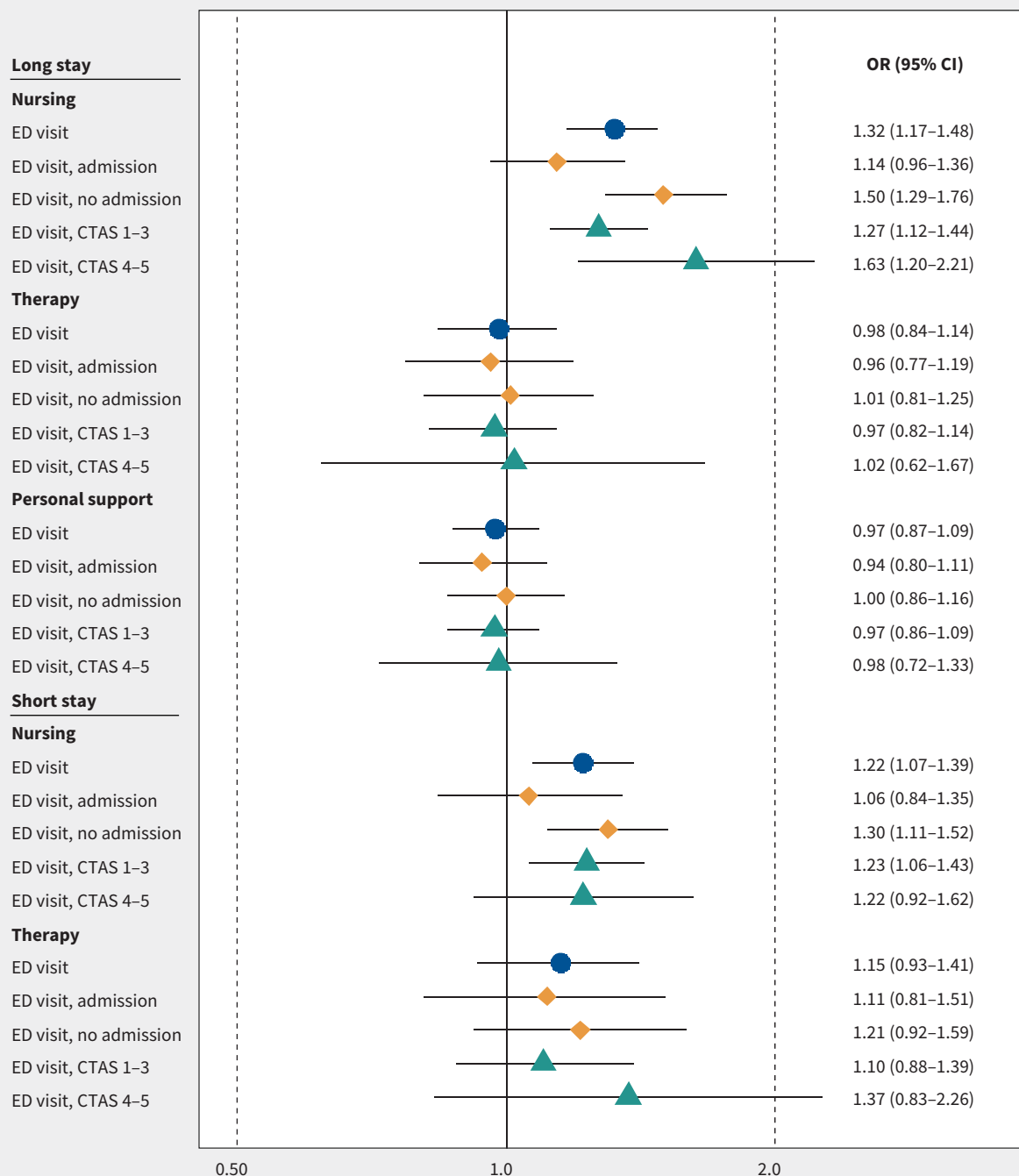


Figure 1: Emergency department (ED) visits after 5 pm by outcome, patient group and service type. CI = confidence interval, CTAS = Canadian Triage Acuity Scale, OR = odds ratio.

community setting by their usual providers. Although it is difficult to determine the appropriateness of an emergency department visit from administrative data, the stronger associations noted for non-hospital admission and less acute emergency department visits suggests that some patients likely could have received treatment in less acute settings.

Our findings correspond with previous reports on the challenges of nursing care in the community, such as limited time and the lack of direct management of clinical problems.³⁰ Currently, care and monitoring outside of the home care visits is predominantly assumed by the patient and family, who would require self-care knowledge and skills to prevent unplanned

hospital admissions.²¹ The involvement of more nurse practitioners in home care or on-call primary care could address some of the acute needs that would otherwise result in an emergency department visit. Additionally, the current model of care for patients not receiving palliative care (nearly all) does not operate with full integration of primary care. Home care staff and patients may have no viable option other than to proceed to the emergency department, because there are limited mechanisms in place for timely access to diagnostics and physician support to address or consult on emergent problems. Better integration with primary care may also support greater continuity of care, which has been associated with lower emergency department use.^{31,32}

Our findings support the need for further investigation into the reason or reasons that home care nursing visits are associated with a higher likelihood of same-day emergency department visits and into the appropriateness of these visits. Experimental studies are needed to test the cost-effectiveness of home and primary care models that support safe and timely access to community-based care when nonurgent clinical issues arise.

Limitations

This study has several limitations. First, given that the case-crossover design examines only cases, only patients who visited the emergency department after 5 pm contributed to the analysis. Also, the data sources used in this study contained the billing records for all publicly funded home care in the region, but no information on privately funded home care that a patient may have been receiving at the same time. Finally, the use of regional data prevents the capture of emergency department visits by patients who resided in the region but went to the emergency department in another region. However, our analyses suggest that potential confounding was rare and would only serve to make our results more conservative.

Conclusion

We found that patients receiving home care were more likely to visit the emergency department during the evening on days that they received a home care nursing visit. The association trended stronger for emergency department visits that did not result in a hospital admission and for lower-acuity visits among patients with ongoing care needs. Future work should continue to explore the mechanisms by which home care nursing visits are associated with emergency department use and other outcomes, incorporating additional effect modifiers, such as primary care access.

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Competing interests: None declared.

This article has been peer reviewed.

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Contributors: Andrew Costa and Aaron Jones conceived the study and developed the design in consultation with the other authors. Aaron Jones completed the analysis. All of the authors contributed to the interpretation of data. Aaron Jones drafted the manuscript, which all of the authors revised. All of the authors approved the final version to be published and agreed to be accountable for all aspects of the work.

Funding: Andrew Costa is supported by the Schlegel Chair in Clinical Epidemiology and Aging, McMaster University. This study was funded by a grant from the Canadian Frailty Network (TG2015-15P) and the Canadian Institutes

for Health Research (148933). The opinions and conclusions expressed in this article are those of the authors and do not necessarily reflect the views of the contributing centres or funders.

Preliminary findings from this study were presented at the Canadian Association for Health Services and Policy Research Annual Conference, Toronto, Ont., May 24, 2017, and the Achieving Excellence Together Conference, Toronto, Ont., June 15, 2017.

Accepted: Nov. 28, 2017

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