RESEARCH PAPER

Adverse Events Associated with Hospitalization or Detected through the RAI-HC Assessment among Canadian Home Care Clients

Événements indésirables associés à l'hospitalisation ou détectés à l'aide du RAI-HC chez les clients qui reçoivent des soins à domicile au Canada

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Abstract

Background: The occurrence of adverse events (AEs) in care settings is a patient safety concern that has significant consequences across healthcare systems. Patient safety problems have been well documented in acute care settings; however, similar data for clients in home care (HC) settings in Canada are limited. The purpose of this Canadian study was to investigate AEs in HC, specifically those associated with hospitalization or detected through the Resident Assessment Instrument for Home Care (RAI-HC).

Method: A retrospective cohort design was used. The cohort consisted of HC clients from the provinces of Nova Scotia, Ontario, British Columbia and the Winnipeg Regional Health Authority.

Results: The overall incidence rate of AEs associated with hospitalization ranged from 6% to 9%. The incidence rate of AEs determined from the RAI-HC was 4%. Injurious falls, injuries from other than fall and medication-related events were the most frequent AEs associated with hospitalization, whereas new caregiver distress was the most frequent AE identified through the RAI-HC.

Conclusion: The incidence of AEs from all sources of data ranged from 4% to 9%. More resources are needed to target strategies for addressing safety risks in HC in a broader context. Tools such as the RAI-HC and its Clinical Assessment Protocols, already available in Canada, could be very useful in the assessment and management of HC clients who are at safety risk.

Résumé

Contexte : L'occurrence d'événements indésirables (EI) dans les établissements de soins est une préoccupation en matière de sécurité des patients qui a des répercussions significatives dans les systèmes de services de santé. Les problèmes touchant la sécurité des patients sont bien documentés pour les établissements de soins de courte durée; cependant, de telles données pour les clients qui reçoivent des soins à domicile au Canada sont plus rares. Cette étude canadienne a pour objet d'examiner la question des EI dans le contexte des soins à domicile, particulièrement ceux qui sont associés à l'hospitalisation ou qui sont détectés à l'aide du *Resident Assessment Instrument for Home Care* (RAI-HC).

Méthode : Nous avons effectué une étude rétrospective de cohorte. La cohorte était formée de clients recevant des soins à domicile en Nouvelle-Écosse, en Ontario, en Colombie-Britannique et sur le territoire de l'Office régional de la santé de Winnipeg.

Résultats : Le taux d'incidence général des EI associés à une hospitalisation variait de 6 % à 9 %. Le taux d'incidence des EI déterminés à l'aide du RAI-HC était de 4 %. Les EI les plus fréquemment associés à l'hospitalisation sont les blessures causées par une chute, les autres types de blessures et les événements liés à la prise de médicaments, tandis que l'EI le plus fréquemment détecté à l'aide du RAI-HC est la détresse des nouveaux soignants.

Conclusion : L'incidence des EI provenant de toutes les sources de données varie de 4 % à 9 %. Il faut davantage de ressources pour concevoir des stratégies afin de traiter les risques liés à la sécurité dans le contexte général des soins à domicile. Des outils tels que le RAI-HC et

ses protocoles d'évaluation clinique, déjà disponibles au Canada, peuvent être très utiles pour l'évaluation et la gestion des clients de soins à domiciles pour lesquels il existe un risque lié à la sécurité.

Home care (HC) has been a critical part of healthcare restructuring and has played a key role in primary healthcare, chronic disease management and aging-at-home strategies across Canada (Canadian Home Care Association 2013a). Current demographic changes in Canada suggest that the utilization of HC services will escalate significantly over the next two decades. Home care programs across Canada have already experienced a 51% increase in the number of recipients since 2008 (Canadian Home Care Association 2013b). The Canadian Home Care Association (2013a) estimates that 1.8 million Canadians receive publicly funded HC services annually at an estimated cost of $5.8 billion.

Patient safety problems have been well documented in acute care settings (Baker et al. 2004); however, similar data for clients in HC settings in Canada are limited. This paper presents findings that compare adverse events (AEs) in HC that are associated with hospitalization or determined by the Resident Assessment Instrument for Home Care (RAI-HC) for four jurisdictions in Canada: Nova Scotia, Ontario, British Columbia and the Winnipeg Regional Health Authority (WRHA).

While the paper focuses on the aspects of HC delivery that need reform and improvement, it is important to recognize the impressive contributions and positive impacts of those who are engaged each day in providing safe care to the hundreds of thousands of Canadians who benefit from HC services.

The purpose of our study was to investigate the incidence, magnitude and types of AEs associated with hospitalization or determined through the RAI-HC instrument for Canadian HC clients.

Two previous North American studies (Madigan 2007; Sears et al. 2013) reported that 13% of HC clients experienced an AE each year. The types of AEs reported were falls, adverse drug events, urinary tract infections, accidents at home, wound deterioration, unexpected nursing home admissions and an increase in the number of pressure ulcers. Clients who experienced such events were generally older. These two studies were limited with regard to the population studied and sample size. For example, the study by Sears and colleagues (2013) included 430 Ontario HC clients; Madigan's (2007) study was limited to HC clients who qualified for Medicare or Medicaid in the United States.

Doran and colleagues (2009a) described the prevalence of patient safety problems in a study of 238,958 HC clients from Ontario, Nova Scotia and the WRHA. That study determined that new falls, unintended weight loss, new emergency department (ED) visits and new hospital visits were the most common of the AEs. Significant variations in the prevalence

of patient safety problems were found between regions of the country. Variation can occur because of differences in client population served, jurisdictional factors such as delivery modes (e.g., interdisciplinary coordination) and care processes (e.g., differences in service) (Canadian Home Care Association 2013a). It is important to understand the factors that contribute to such variation because they have implications for policy or practice change. A follow-up paper was designed to generate this knowledge by investigating the extent to which safety risk factors explained variation in regional rates of AEs, focusing specifically on unplanned ED visits (Doran et al. 2009b). A history of falls, a cancer diagnosis, polypharmacy, anxiolytic medication use and antidepressant medication use were associated with increased risk of an ED visit. A limitation of these studies was that only HC clients who qualified for a RAI-HC assessment were included, so findings may not be representative of all types of HC clients.

Our current study attempted to address the limitations identified in previous literature by focusing on HC clients from regions in Canada where comparative data were available and by including short- and long-stay clients. By linking RAI-HC (Hirdes et al. 2004) data from the Home Care Reporting System (HCRS) and the hospital Discharge Abstract Database (DAD), we were able to determine pre-admission conditions associated with hospital admission and construct a profile of the types of AEs that HC clients experience.

The study questions included the following:

1. What is the incidence of AEs associated with hospitalization or determined through the RAI-HC assessment among Canadian HC clients?
2. What are the types of AEs that HC clients experience?
3. What are the factors associated with increased risk of experiencing an AE during hospitalization?

Methodology

The World Health Organization (WHO 2008) framework guided the conceptualization of the patient safety variables, and we adapted its definitions to the HC context. The WHO defines patient safety as "freedom, for a patient, from unnecessary harm or potential harm associated with healthcare" (WHO 2008: 7). Adapting this definition for HC, we defined patient safety as the absence of harm to clients and their family, and to unpaid caregivers from healthcare provided in the client's home, as well as the actions taken to prevent or reduce this harm. Client safety is usually assessed by measuring the incidence of AEs. An adverse event is defined by the WHO as an injury caused by medical management or complication rather than by the underlying disease itself, and one that results in either prolonged healthcare, disability at the time of discharge from care or both. An adverse outcome is defined as a consequence of an AE and generally includes prolonged healthcare, a resulting disability or death. The adverse outcome may be partially or totally attributable to healthcare received. Attribution is often difficult to determine because much of the care provided is unobserved and is provided by unpaid caregivers. To minimize the threat of detection bias, we developed

specific operational definitions and inclusion/exclusion criteria for AE incidence rates (see Appendix 1 available online at http://longwoods.com/content/23473).

Study design, setting and cohort

A retrospective cohort design was used to determine the incidence and types of AEs among Canadian HC clients. The cohort consisted of the population of HC clients who received publicly funded HC services between January 1, 2008 and December 31, 2009 from the provinces of Nova Scotia, Ontario and British Columbia, and the WRHA. The WRHA is responsible for providing healthcare to more than 700,000 people living in the city of Winnipeg as well as the surrounding rural municipalities of East and West St. Paul and the town of Churchill, located in northern Manitoba (WRHA 2013). It is the only jurisdiction in Manitoba currently collecting RAI-HC data. In British Columbia, data were available for Fraser Health region, Vancouver Island and Northern Health. All patients aged 18 or older admitted for HC services classified as acute, maintenance, rehabilitation and long-term support were included. We excluded palliative clients because we expected the clinical course of their medical condition to be different from these other types of HC clients, and this difference could have had an influence on the AE incidence rates in our study. Exclusion of palliative clients is also consistent with the approach taken by Hirdes and colleagues (2004) in the development of HC quality indicators and is routinely done for quality indicators using the MDS 2.0 in nursing homes (Jones et al. 2010).

RAI-HC data were used to identify the occurrence of AEs for long-stay HC clients who were eligible for a RAI-HC assessment, and the DAD was used to identify the occurrence of AEs associated with hospitalization for short- and long-stay clients. RAI-HC data were available for the WRHA, Ontario and Nova Scotia, but not for British Columbia; the DAD was available for British Columbia, the WRHA and Ontario, but not for Nova Scotia.

Ethical issues, data access and linkage

The study received ethics approval from the University of Toronto Research Ethics Review Board. The HC population was identified from the HCRS data. The HCRS consisted of three parts: episode information, RAI-HC assessment (for long-stay clients) and health service utilization data (e.g., the number of scheduled visits). The episode data provide information on the case open date, discharge date and client region for short- and long-stay clients. The RAI-HC (Hirdes et al. 2004) assessments are completed on a periodic basis, including at admission for clients expected to be on service for 60 days or longer, then annually or biannually depending on the jurisdiction, and also when the client's condition changes. The RAI-HC, including its psychometric properties, has been well described (Landi et al. 2000; Morris et al. 1997). All HC clients were identified from the episode data in HCRS, and their records were linked to the DAD to identify AEs associated with hospitalization.

DATA LINKAGE

De-identified client-level data were obtained from the Canadian Institute for Health Information (CIHI) and from the WRHA through linkable data cuts. At CIHI, the health card number, the province issuing the number, the birth year and the birth month were used to do the linkage. The data were prepared by identifying HC clients in jurisdictions where there were available HCRS data sources in 2008 and 2009, and the health card numbers were then used to identify health service records in the DAD for 2008 and 2009. All assembled records then had a common encryption algorithm applied to the health card numbers so that person-level linkage could be done by our researchers without any real-world identifiers being released. A similar record linkage procedure was used for the WRHA data.

DETERMINATION OF AEs AND INCIDENCE RATES

Case screening for AEs was based on previous literature (Doran et al. 2009a; Madigan 2007; Sears et al. 2013; Zed et al. 2008). The cohort for determining an AE was operationally defined as HC clients who were in a HC program during 2008 or 2009 either with or without a RAI-HC assessment. This number was used as the denominator for the calculation of an incidence rate. Two methods were used to identify clients with an AE to be included in the numerator of the incidence rate: (a) clients were followed forward from their case open date until an AE was identified in the DAD and (b) RAI-HC clients with specific RAI-HC AE items were used. The ICD-10 codes in the DAD data were used to identify AEs associated with hospitalization. We restricted the analysis to pre-admission conditions for all indicators except suicide/attempted suicide, where numbers were small and post-admission conditions were also examined. The case-screening period included 30 days after discharge from the HC program. For incidence rate calculation, multiple occurrences of the same incident type were counted only once during the same reporting period. This approach is consistent with that of the Canadian AE hospital study (Baker et al. 2004).

Analysis

Two incidence rates were calculated for AEs: (a) the percentage of clients experiencing a new AE associated with hospitalization per year and (b) the percentage of clients experiencing a new AE determined by the RAI-HC assessment data per year. For each rate, the unadjusted, age- and sex-standardized incidence rates of AEs were calculated. The Ontario HC population was used as the reference population to standardize for age and sex. For each rate, the overall incidence rate was calculated by determining the number of clients with at least one AE of any type divided by the number of clients who were in the HC program during the calendar year. Logistic regression analysis was used to determine the association between risk factors and the likelihood of experiencing any AE. Risk factors were identified from previous literature (Doran et al. 2009b; Madigan 2007; Sears et al. 2013). The variables entered into the regression model are summarized in Table 1. These variables were determined from the RAI-HC, which restricted this part of the analysis to long-stay clients who were eligible for a RAI-HC assessment from Ontario and the WRHA.

TABLE 1. Client safety risk factors entered into the regression model

Risk Factors	Safety Risk Factor
Client characteristics	Decline in activities of daily living CHESS[A] Depression Rating Scale (DRS)[B] Age at assessment Sex (female) Number of medical illnesses Caregiver distress
Current medical diagnoses	Congestive heart failure (CHF); peripheral vascular disease; dementia or Alzheimer's disease; Parkinsonism; psychiatric diagnosis; cancer diagnosis; emphysema, chronic obstructive pulmonary disease (COPD), asthma; renal failure; urinary tract infection in last 30 days
Client living situation	Lives alone Unsafe housing
Healthcare management factors	Polypharmacy Nursing service intensity in last 7 days Personal support worker (PSW) service intensity in last 7 days Home care days Anxiolytic/hypnotic in last 7 days Hospital discharge within 30 days before RAI assessment

[A] The CHESS score is Changes in Health, End-Stage Disease, Signs and Symptoms (Hirdes et al. 2003).

[B] The Depression Rating Scale (Burrows et al. 2000).

Results

Characteristics of the population of home care clients

The demographic characteristics of the HC population for Ontario, the WRHA, British Columbia and Nova Scotia are summarized in Table 2 (shown online at http://longwoods.com/content/23473). Ontario HC clients were on average younger than those in the other jurisdictions. The majority of HC clients in all regions were female, and the average number of months in the HC program in 2009 ranged from 4.9 in Ontario to 7.3 in British Columbia.

Adverse events

The unadjusted and standardized incidence rates for AEs associated with hospitalization for the three regions are reported in Table 3 (shown online at http://longwoods.com/content/23468). Injurious falls, injuries from other than falls and medication-related incidents were the most frequent AEs associated with hospitalization. Examples of injuries from other than falls include burns and contusions, exposure to inanimate force, exposure to animate mechanical force, accidental drowning, exposure to electrical current and contact with heat and hot substances. Examples of medication-related incidents include accidental poisoning, adverse effect at therapeutic dose, overdose and haemorrhagic disorder due to circulating anticoagulants. Sepsis/bacteraemia and delirium were ranked among the top five events. There were slightly higher overall rates for the WRHA and British Columbia compared to Ontario.

Table 4 presents the unadjusted and age- and sex-standardized rates of AEs determined from the RAI-HC assessments for Nova Scotia, Ontario and the WRHA. New caregiver distress was the most frequent of the AEs. Ontario clients experienced higher incidence

of new pressure or stasis ulcers or stage worsening compared to Nova Scotia and WRHA clients, while Ontario clients experienced lower incidence of any new injury. The overall incidence rate for AEs determined from RAI-HC data was approximately 4% for the three regions (see Table 4 online at http://longwoods.com/content/23473).

Risk factors

The risk factors that were found to be significantly associated with experiencing any AE associated with hospitalization are summarized in Table 5. Age and sex, although not significant, were included in the model because previous research has indicated association between these variables and prevalence of AEs (Baker et al. 2004; Doran et al. 2009b). The adjusted odds ratios (OR) are presented, which take into account the other variables in the model. Hospital discharge within the past 30 days was associated with significantly increased odds of experiencing an AE. Polypharmacy, nursing service intensity in last seven days, peripheral vascular disease, CHF, ADL decline and number of medical illnesses were also associated with increased odds of experiencing an AE.

TABLE 5. Risk factors associated with any AE during hospitalization in 2009 for Ontario and WRHA HC clients

Characteristic	Without any AE		With an AE			
	No.	%	No.	%	OR	CI
Female (y vs. n)	89,647	66.8	9,092	63.8	0.944	0.81, 1.10
Age at assessment (≥ 75 vs. <75 years)	89,530	66.7	9,539	66.9	1.138	0.96, 1.34
No. with illnesses (2/3/4 vs. 0/1)	77,594	57.8	7,524	52.8	1.322	1.01, 1.73
No. with illnesses (5+ vs. 0/1)	36,794	27.4	5,154	36.2	1.543	1.15, 2.07
ADL hierarchy (≥1 vs. 0)	43,682	32.5	5,573	39.1	1.609	1.39, 1.86
Congestive heart failure (y vs. n)	15,106	11.3	2,359	16.6	1.232	1.01, 1.49
Peripheral vascular disease (y vs. n)	9,261	6.9	1,433	10.1	1.332	1.01, 1.76
Nursing service intensity in last 7 days (> 0 vs. = 0 hours)	34,306	25.6	5,505	38.6	1.685	1.44, 1.96
Polypharmacy (≥9 vs. <9 meds)	64,126	47.8	8,208	57.6	1.257	1.08, 1.46
Hospital discharge within 30 days before RAI (y vs. n)	17,592	13.1	4,137	29.0	2.489	2.11, 2.94

Note: After backwards selection, *p*-value=0.3 for goodness-of-fit test

Discussion

The overall incidence rate of AEs associated with hospitalization ranged from 6% in Ontario to almost 9% in British Columbia and the WRHA. The overall incidence for AEs determined through the RAI-HC data was approximately 4% for all regions. Caution should be exercised in comparing rates between regions for a variety of reasons. Some of the variations observed could be explained by differences in the HC populations that were not accounted for by age and sex standardization. There are differences in how HC is defined or operationalized in different jurisdictions in Canada (Canadian Home Care Association 2013a). Eligibility and types of services can differ from province to province, which may affect the risk profile of the HC clients from region to region. Availability of community services may have influenced hospital utilization rates and affected whether AEs were treated in hospital or in the community, thus influencing our ability to detect AEs in this study.

The subgroup of clients who contributed RAI-HC data represents long-stay clients, those expected to be on service for 60 days or longer. Comparing rates for RAI-HC data yielded similar rates for the three regions included in this analysis.

We found that injurious falls, injuries from other than fall and medication-related incidents were the most frequent types of AEs associated with hospitalization. Between 2% to 3% of HC clients had falls that resulted in injuries associated with hospitalization. Approximately one in three Canadians aged 65 and older will fall each year (Health Canada 2002), and unintentional falls will account for 84% of all hospitalizations due to injury in this population (CIHI 2009). Effective policies and strategies are needed to target the prevention of falls that could result in injuries. In Canada, resources such as the interRAI Clinical Assessment Protocol (CAP) (CIHI 2008) and the Registered Nurses' Association of Ontario best practice guidelines (RNAO 2005, 2011) are available and should be integrated into clinical practice. The interRAI CAPs and RNAO best practice guidelines provide clinicians with evidence-based recommendations for planning and delivering care. For example, the CAPs that have been developed for HC provide guidance in the assessment of, and care planning for, functional performance, cognition, mental health, social life and clinical issues (e.g., falls, pain, pressure ulcers). Each CAP has goals for care that include the possibility of problem resolution, reducing risk or increasing potential for improvement.

In our study, the incidence of medication-related AEs associated with hospitalization was 2%. Although comparative data for hospitalization rates were not found in other published sources, a prospective study of medication-related ED visits reported a 12% rate (Zed et al. 2008), and another study reported a 4.7% rate (Hohl et al. 2010). Improvement in medication management in HC is clearly a high-priority safety issue.

The incidence of new caregiver distress ranged between 6% and 11%, and this rate is within the range of the 6% rate reported by CIHI (2004). In the context of the RAI-HC, caregiver distress reflects caregivers' inability to continue their caregiving activities and their expressions of distress, anger or depression. As HC clients and unpaid caregivers do whatever it takes to keep the client at home, the challenges become more stressful for both. If the needs

of the caregivers are not adequately addressed, the clients are at risk for re-admission to acute or long-term care facilities at increased cost (Bryan 2010).

One of the recommendations from a Canadian symposium on AEs in community care was the need for improved understanding of the variables associated with the occurrences of AEs, including assessing patient risk (Masotti et al. 2009). This study helps to advance such understanding. The first 30 to 60 days following admission to HC is a post-acute period in which there is a transition of care from hospital to HC. CIHI (2012) reported that one in 12 patients is readmitted to hospital within 30 days of discharge. Our study confirms that the first 30 days post–hospital discharge is a high-risk period for HC clients. This transition is the point at which HC personnel should screen for risk and intervene to reduce risk of AEs for HC clients. We also observed that clients with more medical illnesses and those requiring increased service intensity over the past seven days were at increased risk of experiencing an AE. The relationship between service intensity and AEs likely reflects instability in the client's medical condition resulting in increased risk.

Our study found that polypharmacy was associated with increased risk of AEs. The incidence of potential drug interactions increases with increased drug use, and these interactions have been associated with hospitalizations in previous research (Delafuente 2003; Hanlon et al. 1997). Drug interactions have also been shown to cause a decline in functional abilities in older people (Delafuente 2003), compounding the risk of AEs such as falls. Prudent use of medications and vigilant drug monitoring are essential to avoid AEs among elderly HC clients.

ADL decline is an indicator of frailty, and it was associated with increased risk of AEs in this study. A systematic review of home-based nursing health promotion for older people found that preventive home visits were most effective for individuals who were not limited in basic ADL (Markle-Reid et al. 2006). The authors of that review suggested that a preventive intervention may work best at early and reversible stages in the continuum of health to disability. Our study underscores the importance of instituting such interventions in order to reduce the risk of AEs in HC.

Strengths and limitations

The present study was a large, population-based investigation of AEs among HC clients in Canada. The data in this study were obtained from a well-established secondary health database and the RAI-HC instrument, a highly reliable and validated assessment tool (Landi et al. 2000). Although there are a few published studies pertaining to HC safety, to our knowledge this is the first study of HC settings that investigated AEs associated with hospitalization.

Because periodic assessment with the RAI-HC does not allow all events to be detected, our results likely underreport actual experience. It was particularly challenging to capture data for some types of events of interest, for example, non-recognition or non-reporting of medication errors (Hohl et al. 2010). Injuries that do not leave visible marks, or pressure ulcers that require personal examination, are examples of AEs in HC that are likely to be underreported, both through RAI-HC assessment and by encounters with hospitals. There were differences

in the data sources available for provinces/regions in Canada, which limited our ability to include Nova Scotia in the hospitalization rates and British Columbia in the RAI-HC rates. Our study did not include AEs associated with an ED visit because of lack of comparative data for the provinces/regions. There was no way to determine from the DAD whether an AE we identified as a pre-admission condition to hospitalization was the primary reason for the hospitalization. Furthermore, there was no way to determine from the data whether the AEs observed were due to the "plans or actions taken during the provision of health care" or if they were due to underlying disease, client behaviour, injury or other causes. Lastly, it is important to note that AEs do not always demonstrate inappropriate or inadequate home care.

Implications for healthcare leaders and health policy

Injurious falls, injuries from other than fall and medication-related events were the most frequent AEs associated with hospitalization. New caregiver distress was the most frequent AE identified through the RAI-HC data. Strategies designed to improve the safety of the HC environment need to focus on reducing the risk of falls and other injuries, improving the management of medications in the home, promoting recognition of early signs and symptoms of sepsis/bacteraemia and delirium followed by prompt intervention. We need to strengthen supports and resources for informal caregivers through education and assessment of their risk for caregiver distress. The RAI-HC, which has Clinical Assessment Protocols based on practice guidelines, could be used to help manage HC clients and their caregivers who are at risk of AEs (CIHI 2008). That tool was designed to be an assessment system to inform and guide care planning in the HC environment (Landi et al. 2000), and it can be used to guide a comprehensive assessment of safety risks such as physical and cognitive functioning, informal support services, environmental assessment and medications (Morris et al. 1997). Implementation of the full clinical capabilities of the RAI-HC in Canada should be a priority.

Patient outcomes are influenced not only by formal healthcare providers but also, to a significant extent, by the quality of care that is provided by informal caregivers. A significant proportion of caregivers were found to have new caregiver distress, with notable differences in rates across the country. In order to build a safe and sustainable HC system, HC needs to encompass care for the informal caregivers because they are the people on whom the system relies for much of the care delivered to clients.

Conclusion

The overall incidence rate of AEs associated with hospital visits for the HC client population ranged from 6% to 9%, and the rate was 4% for AEs determined from the RAI-HC data. This study provides new data about safety outcomes detected through the RAI-HC assessment and the potential role of the RAI-HC with regard to its use in detecting AEs among HC clients.

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TABLE 2. Demographic characteristics of all home care clients identified in home care episode data and RAI-HC clients identified in RAI-HC data, 2009

Characteristics		Nova Scotia	Ontario	Winnipeg Region	British Columbia
A. All home care clients identified in home care episode data					
Number of home care clients		–	387,885	22,766	27,463
Age in years, mean (±SD, median)		–	68.3 (±18.5, 73.0)	74.6 (±16.9, 80.0)	73.6 (±17.1, 79.0)
Female		–	58.8%	63.2%	60.2%
Client group assignment at intake	Acute HC	–	41.8%	–	32.8%
	Maintenance HC	–	27.5%	–	35.2%
	Rehabilitation HC	–	23.1%	–	8.5%
	Long-term support HC	–	6.7%	–	19.2%
	Unknown HC	–	0.9%	–	4.3%
Average number of months in HC program in 2009, mean (±SD, median)		–	4.9 (±4.4, 3.0)	6.9 (±4.8, 7.4)	7.3 (±4.7, 8.6)
Average number of months in HC program since intake for clients who were discharged from HC in 2009, mean (±SD, median)		–	17.4 (±29.40, 4.3)	28.8 (±33.2, 15.2)	16.2 (±13.4, 13.6)
B. RAI-HC clients identified in RAI-HC data					
Number of RAI-HC clients		13,053	138,737	9,751	
Diseases	Congestive heart failure	12.9%	18.3%	13.8%	–
	Chronic obstructive pulmonary disease	20.5%	25.0%	18.6%	–
	Coronary artery disease	25.6%	34.0%	17.8%	–
	Dementia	21.2%	25.8%	18.1%	–
	Diabetes	27.9%	36.4%	23.3%	–
	Hypertension	59.5%	67.3%	59.0%	–
	Stroke	15.8%	25.3%	16.4%	–
Incontinence	Bladder incontinence	27.6%	27.5%	26.3%	–
	Bowel incontinence	10.3%	8.9%	6.8%	–
Scales	Cognitive Performance Scale (CPS 3+)[A]	15.7%	10.2%	9.0%	–
	Depression Rating Scale (DRS 3+)[B]	11.0%	14.1%	9.4%	–
	CHESS[C] 2+	37.3%	30.4%	27.3%	–
IADL & ADL	Instrumental activities of daily living (IADL 4+)[D]	78.5%	69.3%	76.6%	–
	Activities of daily living (ADL 1+)[E]	40.8%	34.8%	33.7%	–
	ADL decline	40.4%	37.2%	34.3%	–
MAPLe[F]	1	24.2%	23.0%	23.8%	–
	2	9.5%	13.3%	15.7%	–
	3	29.8%	31.9%	29.5%	–
	4	23.6%	23.3%	23.2%	–
	5	12.9%	8.5%	7.8%	–
Mobility aids		51.6%	60.2%	56.2%	–
Polypharmacy (≥9 medications)		41.1%	49.1%	42.2%	–

[A] The Cognitive Performance Scale (Morris et al. 1994). CPS 3+: separates those with intact to mild cognitive impairment from those with moderate or greater impairment.

[B] The Depression Rating Scale (Burrows et al. 2000). DRS 3+ was drawn from the findings of the original work by Burrows and colleagues to be a threshold for depressive illness.

[C] The CHESS score is Changes in Health, End-Stage Disease, Signs and Symptoms (Hirdes et al. 2003).

[D] Instrumental Activities of Daily Living (Morris et al. 2000). A score of 4 or more means that the individual has great difficulty (little or no involvement) with the activity (e.g., meal preparation, housework, phone use).

[E] Activities of Daily Living (Morris et al. 1999). A score of 1+ represents the need for at least supervision in one or more of four ADL areas (personal hygiene, toilet use, locomotion, eating) and has been used as the major organizing cut-point for risk in the MAPLe algorithm.

[F] The MAPLe score is the Method for Assigning Priority Levels (MAPLe) algorithm for long-term care home placement using data based on the RAI-HC (Hirdes et al. 2008).

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TABLE 3. Unadjusted and age- and sex-standardized incidence rates of adverse events identified as pre-admission conditions in Discharge Abstract Data

Adverse Events	Ontario	Winnipeg Region		British Columbia	
	Unadjusted % (n*/N†) 2008 2009	Unadjusted % (n*/N†) 2008 2009	Standardized %‡ 2008 2009	Unadjusted % (n*/N†) 2008 2009	Standardized %‡ 2008 2009
Injurious fall	1.75 (6,680/380,962) 1.71 (6,629/387,885)	2.52 (536/21,241) 2.29 (522/22,804)	2.92 2.97	2.71 (855/31,531) 3.64 (1,001/27,463)	2.54 3.11
Injury from other than fall	0.97 (3,685/380,962) 0.97 (3,755/387,885)	1.36 (289/21,241) 1.31 (299/22,804)	1.39 1.53	1.20 (378/31,531) 1.61 (441/27,463)	1.17 1.53
Medication-related	2.03 (7,751/380,962) 2.07 (8,027/387,885)	1.91 (405/21,241) 2.00 (455/22,804)	2.05 2.38	2.42 (763/31,531) 2.77 (760/27,463)	2.39 2.76
Sepsis / bacteraemia	0.98 (3,726/380,962) 1.08 (4,188/387,885)	1.18 (251/21,241) 1.06 (241/22,804)	1.20 1.12	1.08 (342/31,531) 1.30 (358/27,463)	1.09 1.33
Delirium	0.68 (2,579/380,962) 0.77 (3,004/387,885)	0.82 (175/21,241) 1.14 (261/22,804)	1.05 1.54	1.21 (381/31,531) 1.66 (457/27,463)	1.11 1.39
Deep-vein thrombosis	0.29 (1,097/380,962) 0.28 (1,083/387,885)	0.22 (46/21,241) 0.30 (68/22,804)	0.25 0.39	0.28 (89/31,531) 0.21 (58/27,463)	0.28 0.22
Diabetic foot ulcer	0.23 (868/380,962) 0.22 (846/387,885)	0.34 (73/21,241) 0.37 (84/22,804)	0.25 0.30	0.26 (83/31,531) 0.25 (70/27,463)	0.27 0.31
Pressure ulcer (stage 2+)	0.06 (245/380,962) 0.06 (241/387,885)	0.10 (22/21,241) 0.08 (18/22,804)	0.06 0.04	0.10 (32/31,531) 0.09 (24/27,463)	0.11 0.11
Pulmonary embolus	0.16 (612/380,962) 0.15 (599/387,885)	0.12 (26/21,241) 0.13 (30/22,804)	0.10 0.16	0.16 (49/31,531) 0.13 (36/27,463)	0.16 0.14
Venous leg ulcer	0.02 (68/380,962) 0.02 (69/387,885)	0.01 (2/21,241) 0.00 (1/22,804)	0.00 0.00	0.02 (5/31,531) 0.05 (14/27,463)	0.02 0.06
Suicide / suicide attempt	0.05 (203/380,962) 0.05 (189/387,885)	0.06 (13/21,241) 0.07 (16/22,804)	0.01 0.08	0.06 (18/31,531) 0.12 (32/27,463)	0.06 0.14
Other	0.15 (579/380,962) 0.16 (603/387,885)	0.06 (12/21,241) 0.06 (13/22,804)	0.04 0.05	0.25 (80/31,531) 0.16 (45/27,463)	0.27 0.18
Overall rate	6.04 (23,026/380,962) 6.14 (23,814/387,885)	7.13 (1,514/21,241) 7.24 (1,650/22,804)	7.71 8.72	7.85 (2,476/31,531) 9.45 (2,596/27,463)	7.63 8.85

* n = Number of home care clients with adverse event; i.e., the numerator of the incidence rate

† N = Number of home care clients who are at risk of adverse event; i.e., the denominator of the incidence rate

‡ For these jurisdictions, the Ontario home care population was used as the reference population to standardize for age and sex.

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TABLE 4. Unadjusted and age- and sex-standardized incidence rates of adverse events identified in RAI-HC

Adverse Events	Ontario	Nova Scotia		Winnipeg Region	
	Unadjusted % (n*/N†)	Unadjusted % (n*/N†)	Standardized %‡	Unadjusted % (n*/N†)	Standardized %‡
New or worsening pressure ulcer (clients with at least one follow-up RAI-HC assessment without Stage 4 pressure ulcer at the previous assessment)	1.03 (738/71,864) 1.16 (869/75,196)	0.59 (32/5,433) 0.55 (30/5,412)	0.58 0.50	0.59 (33/5,628) 0.64 (33/5,163)	0.62 0.70
New or worsening stasis ulcer (clients with at least one follow-up RAI-HC assessment without Stage 4 stasis ulcer at the previous assessment)	0.82 (591/71,896) 0.86 (644/75,216)	0.33 (18/5,433) 0.30 (16/5,414)	0.33 0.29	0.52 (29/5,630) 0.39 (20/5,164)	0.53 0.39
Any new injury (clients with at least one follow-up RAI-HC assessment without injury at the previous assessment)	2.34 (1,471/62,886) 2.33 (1,548/66,374)	4.11 (197/4,794) 4.11 (196/4,769)	4.05 4.00	3.20 (156/4,874) 3.02 (136/4,499)	3.17 2.98
New caregiver distress§ (caregiver distress present at the follow-up RAI-HC assessment with no caregiver distress at the previous assessment)	5.96 (3,663/61,456) 6.84 (4,350/63,596)	10.35 (447/4,317) 11.28 (487/4,316)	10.33 11.33	7.30 (347/4,755) 7.61 (336/4,413)	7.04 7.39
Overall	3.75 (2,699/71,979) 3.93 (2,960/75,300)	4.45 (242/5,434) 4.36 (236/5,415)	4.39 4.19	3.76 (212/5,631) 3.56 (184/5,166)	3.77 3.55

* n = Number of home care clients with harmful incident; i.e., the numerator of the incidence rate

† N = Number of home care clients who are at risk of harmful incident; i.e., the denominator of the incidence rate

‡ For these jurisdictions, the Ontario home care population was used as the reference population to standardize for age and sex.

§ New caregiver distress was not included in calculation of the overall rate for clients.

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Appendix 1

Adverse events technical definitions for incidence rate calculation

Adverse Event	Technical Definition
Injurious fall presenting pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had a fall-related injury recorded as a pre-admission condition for any overnight hospitalization. **Inclusions/Exclusions:** The date of registration in admission to a hospital should be within a home care episode including the 30-day extension after discharge. A fall code (W0 or W1) must be present to be considered an injurious fall. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Injury from other than fall pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had a non–fall-related injury recorded as a pre-admission condition for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded. A fall code (W0 or W1) must not be present, together with the injury codes, in order to be considered a non–fall-related injury.
Medication-related event pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had any medication-related event recorded as a pre-admission condition for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Sepsis / bacteraemia pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had sepsis/bacteraemia recorded as a pre-admission condition for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Delirium pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients with delirium recorded as a pre-admission condition for any overnight hospitalization in a general hospital. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Deep-vein thrombosis pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had deep-vein thrombosis recorded as a pre-admission condition for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Diabetic foot ulcer pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had a diabetic foot ulcer present as the main diagnosis (not a post-admission condition) recorded for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to hospital should be within a home care episode, including the 30-day extension after discharge. According to the 2012 Canadian Coding Standards, if a post-admission co-morbidity qualifies as the most responsible diagnosis (MRDx), it must be recorded as both the MRDx and as a Diagnosis Type=2. So, if the main diagnosis is a diabetic foot ulcer code and the same code appears as a Type 2 secondary diagnosis, the main diagnosis is considered to be a post-admission condition and is therefore removed from the numerator. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Pressure ulcer (Stage 2+) pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had a pressure ulcer (Stage 2, 3 or 4) present as the main diagnosis (not a post-admission condition) recorded for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. According to the 2012 Canadian Coding Standards, if a post-admission co-morbidity qualifies as the most responsible diagnosis (MRDx), it must be recorded as both the MRDx and as a Diagnosis Type=2. So, if the main diagnosis is a pressure ulcer code, and the same code appears as the secondary diagnosis with a Type=2, the main diagnosis is considered to be a post-admission condition and is therefore removed from the numerator. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Pulmonary embolus pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had pulmonary embolus present as the main diagnosis (not a post-admission condition) recorded for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. According to the 2012 Canadian Coding Standards, if a post-admission co-morbidity qualifies as the most responsible diagnosis (MRDx), it must be recorded as both the MRDx and as a Diagnosis Type=2. If the main diagnosis is the pulmonary embolus code, and the same code appears as the secondary diagnosis with a Type=2, the main diagnosis is considered to be a post-admission condition and is therefore removed from the numerator. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Venous leg ulcer pre-hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had venous leg ulcer present as the main diagnosis (not a post-admission condition) recorded for any overnight hospitalization. **Inclusions/Exclusions:** The date of admission to a hospital should be within a home care episode, including the 30-day extension after discharge. According to the 2012 Canadian Coding Standards, if a post-admission co-morbidity qualifies as the most responsible diagnosis (MRDx), it must be recorded as both the MRDx and as a Diagnosis Type=2. If the main diagnosis is a venous leg ulcer code, and the same code appears as the secondary diagnosis with a Type=2, the main diagnosis is considered to be a post-admission condition and is therefore removed from the numerator. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
Suicide/suicide attempt during hospitalization	**Indicator Definition:** Number of non–end-of-life home care clients who had intentional self-harm or intentional self-poisoning recorded for any overnight hospitalization in a general hospital. **Inclusions/Exclusions:** The date of registration in ED or admission to a hospital should be within a home care episode, including the 30-day extension after discharge. Hospitalizations with a date of admission that coincided with the date of case open were excluded.
New or worsening pressure ulcer	**Indicator Definition:** Number of non–end-of-life home care clients who developed a new Stage 2+ pressure ulcer at follow-up assessment (T2), or had a more advanced pressure ulcer than the baseline assessment (T1). **Inclusions/Exclusions:** Clients with two consecutive RAI-HC assessments (T1, T2) must belong to the same HC episode. Clients with a Stage 4 pressure ulcer at baseline assessment (T1) were excluded because Stage 4 is the highest stage that an ulcer can be coded and are not eligible for worsening. Clients were excluded if the period between the two consecutive assessments was less than 7 days or greater than 15 months. The calendar year of the T2 assessment was used to assign the pairs to each year for the yearly rate calculation. Clients with pairs of RAI-HC assessments were excluded if end-of-life status was identified at T1 or T2, or if the T2 assessment was done during a hospitalization.
New or worsening stasis ulcer	**Indicator Definition:** Number of non–end-of-life home care clients who developed a new Stage 2+ stasis ulcer at follow-up assessment (T2) or had a more advanced stasis ulcer than the baseline assessment (T1). **Inclusions/Exclusions:** Clients with two consecutive RAI-HC assessments (T1, T2) must belong to the same HC episode. Clients with a Stage 4 stasis ulcer at baseline assessment (T1) were excluded because Stage 4 is the highest stage that an ulcer can be coded and is not eligible for worsening. Clients were excluded if the period between the two consecutive assessments was less than 7 days or greater than 15 months. The calendar year of the T2 assessment was used to assign the pairs to each year for the yearly rate calculation. Clients with pairs of RAI-HC assessments were excluded if end-of-life status was identified at T1 or T2, or if the T2 assessment was done during a hospitalization.
Any new injury	**Indicator Definition:** Number of non–end-of-life home care clients with any of four types of injury (hip fracture, other fractures, unexplained injuries/broken bones or burns, second- or third-degree burns) recorded at the follow-up assessment (T2) but not recorded at the prior assessment (T1). **Inclusions/Exclusions:** Clients having at least two consecutive RAI-HC assessments (T1, T2) were included if the period between the two consecutive assessments was at least 7 days but not greater than 15 months, and the two consecutive assessments should belong to the same home care episode. The calendar year of the T2 assessment was used to assign the pairs to each year for the yearly rate calculation. Pairs were excluded if end-of-life status was identified at T1 or T2, or if the T2 assessment was done during a hospitalization.
New caregiver distress	**Indicator Definition:** Number of non–end-of-life home care clients with caregiver distress recorded at the follow-up assessment (T2) but not recorded at the prior assessment (T1). **Inclusions/Exclusions:** Clients having at least two consecutive RAI-HC assessments (T1, T2) were included if the period between the two consecutive assessments was at least 7 days but not greater than 15 months, and the two consecutive assessments should belong to the same home care episode. The calendar year of the T2 assessment was used to assign the pairs to each year for the yearly rate calculation. Pairs were excluded if end-of-life status was identified at T1 or T2, or if the T2 assessment was done during a hospitalization. If there were no primary or secondary informal helpers at the time of either T1 or T2 RAI-HC assessment, then the assessment pair (T1, T2) was excluded.