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Preventing emergency department (ED) visits by older adults with cognitive impairment: what do we know about avoidable incidents? Results from a scoping review

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Title:

Preventing emergency department (ED) visits by older adults with cognitive impairment: what do we know about avoidable incidents? Results from a scoping review.

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Keywords:

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ABSTRACT

Objectives: Older cognitively impaired adults present a higher risk of hospitalization and mortality following a visit to the emergency department (ED). Better understanding of "avoidable" incidents is needed to prevent them and the associated ED presentations in community-dwelling adults. This study aimed to synthetize the actual knowledge concerning these incidents leading this population to ED presentation, as well as possible preventive measures to reduce them.

Design: A scoping review was performed according to the Arksey and O'Malley (2005) framework.

Methods: Scientific and gray literature published between 1996 and 2017 were examined in databases (MEDLINE, CINAHL, Ageline, SCOPUS, ProQuest Dissertations/theses, EBM Reviews, Healthstar), online library catalogues, governmental websites and published statistics. Sources discussing "avoidable" incidents leading to an ED presentation were included, and then extended to those discussing hospitalization and mortality, due to a lack of sources. Data (type, frequency, severity and circumstances of incidents, preventive measures) was extracted using a thematic chart, then analysed with content analysis.

Results: 67 sources were included in this scoping review. Five types of "avoidable" incidents (falls, burns, transport accidents, harm due to self-negligence, and due to wandering) emerged, and all but transport accidents were more frequent in cognitively impaired seniors. Differences regarding circumstances were only reported for burns, as scalding was the most prevalent mechanism of injury for this population, compared to flames for the general senior population. Multifactorial interventions and implications of other professionals (e.g. pharmacist, firefighters) were reported as potential interventions to reduce avoidable incidents. However, few preventive measures were specifically tested in this population.

Conclusions: Primary research that screens for cognitive impairment and involves actors (e.g. paramedics) to improve our understanding of "avoidable" incidents leading to ED visits is greatly needed. This knowledge is essential to develop preventive measures tailored to the needs of older cognitively impaired adults.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study provides an accurate overview of the current knowledge about "avoidable" incidents leading older adults, with and without cognitive impairment, to an ED presentation, as well as preventive measures that may be implemented to avoid these incidents.
- This study followed a rigorous method, guided by two experienced librarians, completed independently by at least two reviewers at each step, and reviewed by experienced researchers and stakeholders in the field.
- Some "avoidable" incidents were not discussed in this scoping review, as they were not differentiable from medical conditions (e.g. urinary tract infection due to dehydration).
- Considering the lack of sources focussing on ED presentation and avoidable incidents, sources discussing hospitalizations and mortalities were included for some types of incidents (e.g. burns) to better understand them.

INTRODUCTION

As the worldwide population ages, an increasing number of older adults (65+) are consulting at emergency departments (ED). In Canada, this population is 1.5 times more likely to visit the ED than the younger population.[1] Furthermore, among these older adults, between 21 to 42% present with cognitive impairment, which exacerbates the risk of negative outcomes following an ED visit, and reduces the probability of returning home.[2–6] Considering the high costs and negative consequences associated with this sub-population's use of ED and hospital healthcare services,[1] it is crucial to prevent potentially avoidable incidents leading to ED visits, especially in older adults with cognitive impairment.

Avoidable incidents, which may refer to unintentional injuries due to falls, motor vehicle traffic crashes, toxic substances, fire/hot objects, or other external causes,[7] represent a large proportion (over 20%) of ED visits by older adults.[8–11] Those with cognitive impairment often present judgment errors and self-neglect behaviors, which may put them at a higher risk of various avoidable injuries (e.g. burning themselves while cooking, due to forgetting to turn off electrical appliances, poisoning after eating spoiled food in the refrigerator, falls caused by failure to use walking aids).[12,13] Many preventive measures (e.g. fall prevention programs and driving classes for seniors) have been developed and implemented to reduce avoidable incidents in community-dwelling adults.[14–16] However, these preventive measures may not be tailored to the specific needs of older adults with cognitive impairment, as most were not developed for this vulnerable population, or may exclude it altogether.[17,18] As a result, little is known about best measures to implement to reduce avoidable incidents and ED visits in this sub-population. Increased knowledge about avoidable incidents leading older adults with cognitive impairment to ED presentations and the circumstances in which they occur, compared to the senior population in general, will help to identify appropriate preventive measures that could be implemented upstream.

This study aims at synthetizing the current knowledge related to avoidable incidents leading to ED presentations by older people with cognitive impairment living in the community, as well as potential preventive measures aiming at reducing them. More specifically, we aimed to identify (1) the type, frequency, and severity of avoidable incidents associated with presentations to the ED by older adults with cognitive impairment, compared to the general senior population, (2) the circumstances in which they occurred and (3) if they could have been avoided by safe and healthy environments or behaviors.

Results of this study could then be used by the Public Health actors in the province of Quebec (Canada), to promote safe and healthy environments and behaviours, which has been identified as a key priority for the upcoming years.[19]

METHODOLOGY

Scoping reviews are increasingly popular in health sciences research. Contrary to other reviews, scoping reviews include a wide variety of sources and study designs, enabling the exploration of emerging subjects, or scattered knowledge. As an initial step to identify priorities for the development of a comprehensive preventive approach, this method was preferred to other types of reviews, as it provides the opportunity to: (A) map the extent of the actual knowledge on a subject, (B) assess the possibility to conduct a systematic review, (C) synthesize and disseminate research results and (D) identify future primary researches to conduct to fully understand it.[20,21] Results of this study could be used by the Public Health actors in the province of Quebec (Canada) to help design preventive measures aiming at reducing avoidable incidents in the vulnerable sub-population of older adults with cognitive imparment. This project followed the six stages refined by Levac et al.[22] according to Arksey and O'Malley methodology.[23]

Step 1: Identifying the research question

This scoping review aimed to answer the main research question: "What is the actual knowledge on "avoidable" incidents leading to ED presentation by older adults living in the community, particularly those with cognitive impairment, in order to implement preventive measures that are tailored to their needs?" To our knowledge, there are no other scoping reviews on this topic. Four specific questions were identified in collaboration with the Regional Public Health Department (Dr. Généreux):

1) What are the main types of avoidable incidents associated with presentations to the ED by seniors with cognitive impairment, compared to the general senior population (e.g., fall-related injuries, food poisoning, heat stroke)?
2) Are they more or less frequent and serious compared to older adults without cognitive impairment?
3) Do they occur in specific circumstances (e.g., during the day/night, in the summer/winter, indoor/outdoor, when driving/cooking)?
4) Could they have been avoided by safe and healthy environments or behaviors?

For this review, incidents were defined as physical injuries to self or others, property loss, or property damage. More precisely, avoidable incidents referred to traumatic injuries (e.g., hip, wrist), poisoning (e.g., inadvertent medication overdose, biological substances) and some other consequences of external causes (e.g., frostbite, burn, heat stroke).[24]

Step 2: Identifying the relevant sources

Using a research strategy validated by two librarians (FL and KR), scientific and grey literature published in English and in French between 1996 and 2016 was explored through a variety of databases (MEDLINE, CINAHL, Ageline, Scopus, ProQuest Dissertation/theses, EBM Reviews, Healthstar), online library catalogue (Institut Universitaire de Gériatrie de Montréal (IUGM)), Google Scholar (100 first results) and Canadian government websites (Canadian Institute for Health Information, Canadian Community Health Survey, National Ambulatory Care Reporting System, Institut de la statistique du Québec). Controlled and natural keywords used in the research strategy are displayed in supplementary files. A total of 654 sources were found and exported to reference manager software (Zotero). Following the elimination of duplicates and non-English or French sources, 633 scientific sources remained (see figure 1). An update of the literature published until April 2017 was also completed, increasing the number of sources to 656.

Step 3: Selecting the studies

Screening was then completed independently by two members of the research team (MGR and BH) and/or two collaborators (ACLC and SS) according to our inclusion criteria. More precisely, sources were included if the participants were: (a) 65 years old and over, with or without cognitive impairment as documented by screening tests or categorized by the authors of the sources (seniors who were reported "independent" by authors were also categorized as older adults without cognitive impairment), (b) living in the community (house, private residence, senior housing or other structured environments), and (c) presenting to the ED because of an avoidable incident. As incidents occurring in seniors with cognitive impairment were rarely discussed in literature, sources from other hospital settings (e.g., hospitalization) were also included when too few sources focused on ED visits. Furthermore, sources were considered if they focused on strategies and preventive measures to avoid these incidents. After screening by title and abstract, 153 sources remained. Finally, 67 sources were included for complete analysis. Reasons for exclusion are presented in Figure 1.

Step 4: Charting the data

A data charting form was developed by the first author and validated by two members of the research team (BH and VP) and two collaborators (SS and ACLC). The form included data about: (1) the type, frequency and severity of incidents, (2) circumstances of incidents (time of the day/year, location, activities at the time of the incident, potential causes for the incident, if available), (3) preventive measures which may be implemented to prevent avoidable incidents for older adults with cognitive impairment, and (4) the selected sources (year of publication, sample population, country, type/research design). Data charting was then performed independently by two members of the research team (MGR and BH) and/or two collaborators (SS and ACLC) using the developed data charting form. To insure interrater agreement, four articles were analyzed independently by the first author and each of the reviewers, and compared to highlight the differences. Disagreements were then discussed and settled by consensus.

Step 5: Collecting, summarizing and reporting results

Descriptive numerical summary analysis was completed regarding: 1) the characteristics of included sources and sample population, 2) the main types of incidents, their frequency and severity, and 3) the circumstances surrounding these incidents (e.g., time, location). On the other hand, the reasons of incidents, as well as preventive measures that may be used to avoid incidents with seniors living with cognitive impairment, were analyzed using a content analysis.[25] The analysis was completely and independently performed by two members of the research team (MGR and BH), and disagreements were discussed. When an agreement could not be reached, the disagreement was discussed with a third member (VP).

Results were reported using descriptive statistics and narrative synthetisis, according to the main type of "avoidable" incidents emerging from literature.

Step 6: Consultation

Results were presented to stakeholders from the Regional Public Health Department in the province of Quebec (Canada), and researchers in gerontology and emergency department services. Using their feedback, results were then contextualized to the local healthcare system.

RESULTS

Overview of results

Study designs and definitions: Out of the 67 sources included in this scoping review, 29 were descriptive studies (43%), 10 were literature reviews, 4 were empirical studies, 4 were statistical papers, 4 were expert opinions, and 16 were documents from grey literature.

Population: 25 sources (37%) included participants with documented cognitive impairment, 6 sources included older adults without cognitive impairment as assessed by screening tests or reported as "independent in daily living activities" by authors, while 36 documents (54%) did not detail the cognitive status of older patients.

Setting: 24 sources included data from the ED (36%), 3 sources focused on the hospital care setting (e.g. hospitalizations) (4%), and 40 sources focused on the community (60%).

Types of incidents: The most commonly mentioned incidents were falls, which were mentioned in 49 papers (73%). Traffic accidents were mentioned in 14 papers (21%), followed by harm due to self-neglect (13%), burns (12%), and harm due to wandering (3%) (see figure 2). Preventive measures were discussed in 44 papers (66%).

Country of publication: Canadian and US studies dominated the review (n = 44; 66%), with 23 and 21 sources, respectively. Six were from the U.K., three from Australia and New-Zealand, two from France, and two from Sweden.

Year of publication: One third of the sources was published in 2013-2017 (n = 22; 33%), one quarter was published in 2008-2012 (n = 18; 27%) and another quarter was published between 2003 and 2007 (n = 18; 27%). The remaining (n = 9; 13%) were published before 2002. Included sources are displayed in Table 1.

TABLES

Tableau 1. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Albert M, McCaig L, Ashman J [8]	2013	USA	Statistics	ED	F	No	-	≥ 65	-	-
Ng W et al. [9]	2002	Japan	Descriptive study	ED	TA+B	No	813	≥ 65	• Cases of injury-related presentations in the elderly group.	
Canadian Institute for Health Information [10]	2010	Canada	Statistics	ED	General	No	-	≥ 65	• Ontario residents with an unplanned visit to the Emergency Department.	
Ontario Injury Prevention Resource Centre [11]	2007	Canada	Statistics	ED	F+TA	No	-	≥ 65	• Visiting an Emergency Department; or • Admitted to an acute care hospital.	
Tierney M, Charles J, Naglie G et al. [13]	2004	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Living alone; • Urban-dwelling.	• History of bipolar disorder or schizophrenia.
Shaw FE, Bond J, Richardson DA, et al. [26]	2003	UK	Empirical study	ED	F	Yes	274	≥ 65	• Cognitive impairment and dementia (Mini-MentalState Examination score< 24); • Presenting to the Emergency Department after a fall.	• Medical diagnosis that likely caused the fall; • Unfitness for investigation within 4 months; • Inability to walk or to communicate for reasons other than dementia.
Shaw F [27]	2003	UK	Author's opinion	C	F	Yes	-	Older adults	-	-
Gagnon C, Lafrance M [28]	2011	Canada	Literature review	C	F	No	-	≥ 65	-	-
Public Health Agency of Canada [29]	2011	Canada	Grey literature	C	F	No	-	Older adults	-	-
Raina P et al. [30]	1997	Canada	Literature review	H	F+TA	No	-	≥ 65	-	-
Public health agency of Canada [31]	2008	Canada	Grey literature	C	F	No	-	Older adults	-	-

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Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Owens P, Russo C, Spector W et al. [32]	2009	USA	Statistics	ED	F	No	-	≥ 65	-	-
Centers for Disease Control and Prevention [35]	2015	USA	Grey literature	C	F	No	-	Older adults	-	-
Abrantes K et al. [34]	2015	Brazil	Descriptive study	ED	F+TA	No	190	≥ 65	• Victims of some type of trauma (urban and rural); • Served by the Mobile Emergency Service team.	
Kara H, Bayir A, Ak A et al. [33]	2013	Turkey	Descriptive study	ED	F+TA	No	568	≥ 65	• Admitted to an Emergency Department of a tertiary care hospital.	-
Public Health Agency of Canada [36]	2005	Canada	Grey literature	C	F	No	-	Older adults	-	-
Lee V, Wong T, Lau C [37]	1999	Hong Kong	Descriptive study	ED	F+TA+B	No	100	≥ 65	• History of accidental injury at home within one week.	-
Yeo Y, Lee S, Lim C et al. [38]	2009	Singapore	Descriptive study	ED	F+TA	No	720	≥ 65	• Visiting the Emergency Department	• Immediate resuscitation; • Mental illness or violent behavior.
Aschkenasy M, Rothenhaus T [39]	2006	USA	Literature review	C	F+TA	No	-	≥ 65	-	-
Lee J, Sirois M, Moore L et al. [40]	2015	Canada	Descriptive study	ED	F+TA	Yes	1.286	≥ 65	• Independently perform the seven basic activities of daily living; • Emergency Department patients; • Discharged back home.	-
Amador S, Goodman C, King D et al. [41]	2014	UK	Descriptive study	C	F	Yes	133	≥ 65	• Documented diagnosis of dementia; or • Validated measure of cognitive function impairment.	• Admitted to hospital; • From long-term care facilities; • Unable to give consent.
Burns E [42]	2001	USA	Literature review	ED	F	No	-	≥ 65	-	• Lacked capacity to consent; • A consultee could not be identified
Ziminski C, Phillips L, Woods D [43]	2012	USA	Descriptive study	ED	F	Yes	18344	≥ 65	-	-

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						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Public Health Agency of Canada [44]	2014	Canada	Grey literature	C	F	No	-	Older adults	-	-
Whiteman C, Tillotson R, Denne N et al. [45]	2011	USA	Descriptive study	ED	F+TA	Yes	6,151	≥ 40	• Dementia and non-dementia group; • Presented for a major trauma visit.	-
Nourhashémi F, Andrieu S, Sastres N et al. [46]	2001	France	Descriptive study	ED	F	Yes	118	Older adults	• Patients with Alzheimer' disease	
Voisin T, Sourdet S, Cantet C et al. [47]	2009	France	Descriptive study	H	F	Yes	686	Older adults	• Alzheimer's disease; • Mild to moderate disease; • Mini- Mental State Examination score between 10 and 26; • Living in the community.	• Severe Alzheimer's disease; • Institutionalized at baseline; • A concomitant disorder that could affect the short-term prognosis.
Ministry of Health (British Columbia, Canada) [48]	2006	Canada	Grey literature	C	F	No	-	Older adults	-	• Confusional syndromes or slight or moderate cognitive disorders.
Kihlgren A, Wimo A, Mamhidir A [49]	2014	Sweden	Descriptive study	C	F	No	719	≥ 75	• Living permanently in a nursing home.	
Pfortmueller C, Kunz M, Lindner G et al. [50]	2014	Switzerland	Descriptive study	ED	F	No	6357	≥16 ≥75	• Admitted to the Emergency Department in relation to a fall.	
Timler D, Dworzyński M, Szarpak Ł et al. [51]	2015	Poland	Descriptive study	ED	F	No	301	≥ 65	• Patients whose diagnoses were coded with ICD-10 (International Statistical Classification of Diseases) codes S00–S09 which pertain to injuries of the head.	
Ministry of health planning, Office of the Provincial Health Officer, British Columbia [52]	2004	Canada	Grey literature	C	F	No	4066	≥ 65	• Treated and released in the Emergency Department	

Tableau 1. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Department of Health Promotion and Protection [53]	2007	Canada	Grey literature	C	F	No	-	Older adults	-	• Admitted to hospital for further treatment of their injuries.
Gyllencreutz L, Björnstig J, Rolfsman E et al. [54]	2015	Sweden	Descriptive study	C	F	No	216	≥ 65	• Fall as a pedestrian in a public area.	
Wilkins K, Park E [55]	2004	Canada	Grey literature	C	F	No	- Older adults	-	-	-
Douglas A, Letts L, Richardson J [56]	2011	Canada	Literature review	C	F+B+SN+W	Yes	16 sources	≥ 65	-	-
Taylor M, Delbaere K, Lord S et al. [57]	2014	Australia	Descriptive study	C	F	Yes	174	≥ 60	• Cognitive impairment; • Living in the community or a low-level care facility.	
Paniagua M, Malphurs J, Phelan E [58]	2006	USA	Descriptive study	ED	F	No	117	≥ 65	• Presenting to the Emergency Department during the 2 months of observation after having fallen.	• Recent stroke (within 18 months); • Progressive neurodegenerative disorders (excluding dementia).
Ouellet M, Sirois M, Beaulieu-Bonneau S et al. [59]	2016	Canada	Descriptive study	ED	F+TA	Yes	306	≥ 65	• Independent in basic activities of daily living; • Visit to the Emergency Department specifically for a minor traumatic injury; • Discharged home within 48 hours.	
Welmerink D, Longstreth W, Lyles M et al. [60]	2010	USA	Descriptive study	H	F	Yes	5,356	≥ 65	• Injury was the primary cause of hospitalization; • Presence of an E-code for falling: E880–E886, E888; • Available scores, for the baseline clinic visit, for 3MS (Modified Mini-Mental State Examination) and DSST (the Digit Symbol Substitution Test).	
Taylor M, Lord S, Brodaty H et al. [61]	2017	Australia	Empirical study	C	F	Yes	42	≥ 60	• A clinical diagnosis of dementia; • Living in the community;	• Living in long-term care; • Dementia or delirium or confusion at the visit; • Admission to any ward; • Inability to consent.
National Institute on Aging [62]	2009	USA	Grey literature	C	F	No	-	Older adults	-	-
Beaudoin F, Merchant R, Clark M	2016	USA	Empirical study	ED	SN	No	112	≥ 50	• Taking opioids.	

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Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
[63]										
Mahoney J, Shea T, Przybelski R et al. [64]	2007	USA	Empirical study	C	F	No	349	≥ 65	• Independently living; • History of 2 falls in the previous year; or 1 fall in the previous 2 years with injury or gait and balance problems.	• Cognitive impairment.
National Institute on Aging [65]	2002	USA	Grey literature	C	TA	Yes	-	Older adults	-	-
Alden N, Rabbitts A, Yurt R [66]	2005	USA	Descriptive study	C	B	Yes	36	Older adults	• Documented pre-existing dementia; • Suffered a burn injury.	
Ehrlich A, Kathpalia S, Boyarsky Y et al. [67]	2005	USA	Descriptive study	ED	B	No	77	≥ 65	• Treated in the Emergency Department for a burn diagnosis; • Subsequently discharged home.	
Lester P, Kohen I [69]	2008	USA	Author's opinion	C	B	No	-	Older adults	-	-
Lowton et al. [68]	2010	UK	Descriptive study	C	F+B	No	-	≥ 60	• Living in private or sheltered housing via two routes: 1) those in contact for the purposes of receiving a Home Fire Safety Visit 2) those attending Falls clinics	• Hospital admission; • Transfer to a burn center; • Elopement from the Emergency Department; • Chemical or non-thermal burn.
Elder A, Squires T, Busuttil A [70]	1996	Scotland	Descriptive study	C	B	No	1096	≥ 75	• Died in household fires.	
Tierney M, Snow W, Charles J et al. [71]	2007	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Cognitive impairment; • Living alone.	
Charles J, Naglie G, Lee J et al. [72]	2015	Canada	Descriptive study	C	SN	Yes	224	≥ 65	• Cognitive impairment (≤130 on the Dementia Rating Scale); • Living alone; • Having a PCP (Primary care physician).	• Living in a communal setting; • History of bipolar disorder or schizophrenia.
Barat I, Andreasen F, Damsgaard E [73]	2001	Denmark	Descriptive study	C	SN	Yes	348	≥ 75	-	-

Tableau 1. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Canadian Institute for Health Information [74]	2016	Canada	Grey literature	ED	SN	No	-	≥ 65	-	-
Tierney M, Charles J, Jaglal S et al.[75]	2001	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Suspected of having cognitive impairment; • Living alone.	
Rowe M, Feinglass N, Wiss M [76]	2004	USA	Literature review	C	W	Yes	-	Older adults	-	-
Dalsania P [79]	2006	USA	Grey literature	C	TA	Yes	-	Older adults	-	-
Booth V, Logan P, Harwood R et al. [82]	2015	UK	Literature review	C	F	Yes	7 sources	Older adults	-	-
Alldred D, Raynor D, Hughes C et al. [88]	2013	Australia, Canada, Netherlands Sweden, UK, USA	Literature review	C	SN	No	7653	≥ 65	• Living in institutionalized care facilities.	
Public Health Agency of Canada [89]	2009	Canada	Grey literature	C	TA	No	-	Older adults	-	-
Fuller G [90]	2000	USA	Author's opinion	C	F	No	-	Older adults	-	-
Al-Aama T [91]	2011	USA	Author's opinion	C	F	No	-	Older adults	-	-
Rapp K, Lamb S, Büchele G et al. [92]	2008	Germany	Descriptive study	C	F	Yes	365	≥ 60	• Living in a nursing homes; • >40% reported symptoms of low mood or cognitive impairment.	
Carpenter C, Avidan M, Wildes T et al. [93]	2014	USA	Literature review	ED	F	No	3 sources	≥ 65	-	-
Taylor M, Delbaere K, Close J et al. [94]	2012	Australia	Literature review	C	F	Yes	-	Older adults	-	-

Tableau 1. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Canadian Institute for Health Information [95]	2014	Canada	Grey literature	ED	F	No	1,537,239	≥ 65	• Living in a long-term care facility.	
Institut national de santé publique du Québec [96]	2017	Canada	Grey literature	C	F	No	-	Older adults	-	-

*Setting: C = Community; ED = Emergency Department; H = Hospital;
**Types of incidents are: B = burns; F = falls; SN = harm due to self-neglect; TA = traffic accidents; W = harm due to wandering;
***CI = did the study include participants with cognitive impairment?

Avoidable incidents:

Falls: Not surprisingly, falls emerged as the main type of incident among older adults, whether associated with an ED presentation and use of medical services, or not (30-80%),[26–31] and as the main cause of injury (e.g. fractures)[32] in this population.[31,33–35] Falls were also the main cause of hospitalizations (62-80%) and ED visits (59-85%) following an incident.[8,11,29–31,33,34,36–49] When comparing older adults, with and without cognitive impairment, the cognitively impaired were reported to fall more often (60-80%) than the non-impaired (30%),[26–31] as well as being hospitalized more often due to falls (around 19%) than the general senior population (14% of total hospitalizations).[46–48] Nonetheless, the difference between older adults, with and without cognitive impairment, in terms of ED visits following a fall compared to the total number of visits, is non-significant (11.1% vs 10.4% respectively).[43] Furthermore, seniors with cognitive impairment sustained more severe injuries, and were 3 times more at risk of fractures than those without cognitive impairment.[27]

In terms of circumstances, no difference was documented between the two sub-populations. Falls mainly occurred at home or nearby (47-74%).[29,31,36,38,41,44,50–53] The toilet was the most common site (29%), followed by the living room (18%) and the kitchen (14%).[37] Falls happened mostly during the day.[34,49,54] Ice and winter conditions were also associated with falls.[55]

Finally, many studies outlined the link between falls and the following factors: Cognitive impairment,[28,36,43,45,56–60] wandering,[56] poor physical condition,[28,29,33,36,37,57,61] medical conditions,[28,29,33,36–38,50,51,58] polymedication, and some types of medication,[28,34,57,58,62,63] living alone,[36,64] and hazards in the environment.[28,37,54]

Transport accidents : Traffic accidents were the second cause of ED visits (14-22.6%) and hospitalizations following an incident.[9,11,30,33,34,39] When comparing older adults, with and without cognitive impairment, those with cognitive impairment were significantly less hospitalized (3.5%) than those without (35% of total hospitalizations following an incident).[45]

In terms of circumstances, no difference pertaining to cognitive impairment was documented. Accidents mainly occurred during the day, on weekends (Friday to Sunday) and between May and August.[34] Meanwhile, approximately 60% of hospitalized older adults with cognitive impairment were driving at the time of the accident.[45]

Several factors were linked to a higher risk of traffic accidents, including cognitive impairment,[30,65] reckless behavior [65] and deteriorating physical condition.[30]

Burns: Burns emerged as the third cause of ED visits following an incident (2-3%),[9,37] and the third cause of home injuries.[56] Burns in cognitively impaired seniors were reported to cause more morbidity and mortality (25%) than in the general senior population (13.8%).[56,66] Differences were also noted regarding major burn mechanisms. The main major burn mechanism among cognitively impaired seniors was scalding (44.4%), followed by flame burns (36.1%) and contact (18%),[66] while flames or flash were the most common in the general senior population (51-81%), followed by scalding (11-30%) and contact (5-7%).[67]

In both sub-populations, most burns occurred at home.[66,67] Older adults with cognitive impairment mainly suffered burns while bathing (31%) and cooking (16%).[66] On the other hand, 27 to 40% of major burns and 68% of minor burns in older adults without cognitive impairment occurred in the kitchen.[67]

Many factors were associated with burns, such as physical condition,[67–69] cognitive impairment,[56,68,69] polymedication,[68] reckless behaviors,[67,69] and living alone.[68,70]

Harm due to self-neglect: In older adults with cognitive impairment, harm due to self-neglect was reported as an avoidable incident, with an incidence of 11 to 21%, of which 70% needed urgent care.[13,71,72] Major harm due to self-neglect included: failure to eat/drink, failure to follow instructions (treatment, medication or technical aids), failure to report a medical condition, and failure to maintain personal hygiene.[13,71,72] Furthermore, older adults with cognitive impairment were more at risk of noncompliance to medication than those without cognitive impairment.[56,73,74] Finally, harm due to self-neglect can be influenced by poly-medication [63,73] and cognitive impairment.[71,72,75]

Harm due to wandering: Older adults with cognitive impairment were more at risk to get lost and sufferfrom consequent harm (e.g. frostbite), regardless of their living arrangements, especially when left unattended. Around 13% were in an outing that they regularly took alone.[76]

Preventive measures:

Preventive measures identified through this scoping review are displayed in Table 2a (individual interventions) and Table 2b (environmental interventions). Most of them were applied to the general senior population, and not to the older adults with cognitive impairment. Identified prevention programs could be implemented in the person's micro-environment (at home) or macro-environment (community).

Measures to prevent falls were the most common theme. Home assessments and adaptations (n = 16), as well as physical exercise, (e.g. strength and balance exercises) (n = 15) were the most frequently described interventions, followed by medication review (n = 12), use of assistive devices (n = 11) and improved nutrition (e.g. food supplements) (n = 10). The second major theme pertained to preventive measures for traffic accidents (n = 6). Interventions included cognitive and physical screening in older adults by the physician, as well as environmental interventions, including government measures (e.g. regulations and preventive campaigns). Interventions to prevent burns were also environmental, such as home assessment and modifications targeting high-risk populations. In terms of self-neglect, interventions focused on noncompliance (e.g. walking aid, medication) and environmental interventions (surveillance and home visits targeting high-risk populations). Finally, preventive measures to reduce wandering mainly encompassed community involvement, (e.g. neighborhood and family), and special programs and plans to prevent or rapidly intervene after the incident.

Table 2a. Individual-level interventions organized by types of incidents

	Individual-level interventions		
	Physical/medical	Cognitive	Assistive devices
Falls	- Medication review and modification [27,28,35,36,44,52,53,79,90,91,94,96] Balance and strength exercises [27–29,35,36,53,57,61,62,79,82,90,92,94,96] - Better nutrition [29] and supplements [28,35,44,52,53,57,91,94,96] - Better sleep [62] - Management of chronic and acute conditions [27,53,79,94] including visual correction [28,35,44,53,79,91,94,96]	- Education on risks and prevention measures [27,37,52,53,79,92,95] - Education on dementia [46] - Fear of falling assessment [53]	- Mobility-aid devices [36,79,96] - Anti-slip shoes and devices [28,29,31,54,62,91] - Hip protectors [52–54]
Traffic accidents	- Recommendations to restrict or to stop driving [79] - Regular medical examination [38,65]	- Safety education programs for seniors [30]	
Burns		- High-risk behavior assessment [67]	
Harm due to self-neglect	- Medication review and modification [73,75,79,88]	- Education of patient on treatment and non-adherence prevention measures [73]	- Compliance aids (pill organizers, medication schemes) [73,75]
Harm due to wandering			- Identification bracelet [79]

Table 2b. Environmental interventions organized by types of incidents

	Environmental interventions		
	Physical	Social	Organizational
Falls	- Home assessment and adaptation [29,31,35,36,44,48,53,62,68,79,90–92,96] - Better roads and sidewalk maintenance, especially in winter [54]	- Education of caregivers and staff on risks and prevention measures [27,37,52,53,79,92,95] even entire communities [53] - Education of caregivers and staff on dementia [46]	- Improvement of building code and regulations [36] - Smartphone apps to report changes in the environment or surface conditions [54] - A public phone line to report falls and fall risks in the environment [36] - Multidisciplinary teams [96] and multifactorial interventions (e.g. PROFET*, MPI**) [93,96]
Traffic accidents	- Elderly-friendly environment / public amenities [30,38] - Increased stoplight and pedestrian crossing times, modified roadway markings [30]	- Education of staff and caregivers regarding risks, monitoring and supervision [65,79,89]	- Road safety campaigns [38,89] - Stricter law enforcement related to jay-walking [30] - Promoting alternatives to driving [38,52,65,79,89]
Burns	- Comprehensive home safety evaluation and modifications [29,67] - Home fire safety visits targeting vulnerable populations [68]	- Education for caregivers on dementia and on burn safety measures, including adequate assistance and supervision [66]	- Nursing home policies limiting smoking to under supervision and in determined locations [69] - Smoking cessation programs (social/emotional support, non-smoking related activities, pharmacological options) [69]
Harm due to self-neglect		- Frequent visits by staff or family members trained to identify problems associated with negligence [71]	- Case management for high-risk population [71]
Harm due to wandering		- Education of informal and formal caregivers [76] - Strategies including neighbors, formal-informal caregivers and law enforcement [76,79]	- Special programs (e.g. Safe Return) that help rapidly locate and return lost individuals [76] - Safety plans in formal care settings that prevent wandering [76]

*PROFET= Prevention of falls in the elderly trial; **MPI=Multifactorial personalized Intervention

DISCUSSION

In this scoping review, we aimed to examine literature about "avoidable" incidents leading older adults with cognitive impairment to ED presentations, in order to identify preventive measures that could be implemented to reduce such incidents. Five main types of incidents emerged from literature: falls, traffic accidents, burns, harm due to self-neglect, and harm due to wandering. Of those, most were more frequent in cognitively impaired seniors, as they may present judgment errors and unsafe behaviors.[12,13] The only exceptions were traffic accidents, which is not surprising, considering the lower number of cognitively impaired drivers, compared to older drivers without such impairment,[77,78] and falls, for which the difference of prevalence between the two sub-populations was non-significant. Nevertheless, when driving, cognitively impaired adults were at increased risk of experiencing an incident (whether or not associated with an ED presentation or hospitalization) than those without such an impairment [45,65,79] as they may be less fit for driving.[80,81] Moreover, falls emerged as the main type of incident for both sub-populations. This result is congruent with its actual importance in the scientific literature (73% of the sources reported in this scoping review), as well as its predominance in deployed preventive measures. In fact, in Canada, more than 50 community-based programs were developed and deployed with older adults in 2001 to prevent falls,[16] which seem far more numerous than programs for other types of incidents.

One of the main objectives of this scoping review was to document the circumstances under which the incidents occurred. Unfortunately, this description remains limited and focused only on the three main types of incident (falls, traffic accidents, and burns). Consequently, little is known about the activities carried out at the time of the incident. As this information could facilitate the development of preventive measures according to risk factors (e.g. reduce the risk of burns at bath time, adapt preventive measures according to the circumstances of traffic accidents), future studies in the ED should further detail the circumstances of incidents in seniors. Moreover, one of the main limitations of our study was the difficulty to differentiate harm due to incidents from other medical causes (e.g. infections, side effects to medication), as some medical conditions may be caused by "avoidable" incidents (e.g. bad hygiene caused by self-neglect can lead to infections; noncompliance to medication can lead to a variety of sides effects).[13,75] For this scoping review, we decided to exclude all medical conditions with unknown or unclear causes. Consequently, the prevalence of "avoidable" incidents, such as harm due to self-neglect and wandering, may be underestimated in the

cognitively-impaired population. In conclusion, better identification of these incidents among cognitively impaired seniors in the ED, as well as the circumstances under which they occurred, may help understand the cause of injuries and reduce the risk of further ones, as preventive measures may be put in place accordingly.

In total, 43 preventive measures were identified through this scoping review. Preventive measures mainly focused on environmental modifications (e.g. home and community physical environments, education to caregivers), modification of the person's habits (e.g. nutrition, medication, use of technical aids), government measures (e.g. safety programs with firefighters and the authorities, building regulations) and the involvement of a multidisciplinary team at the ED (e.g. pharmacist, occupational therapist, doctor). These interventions may represent a good starting point for Public Health Authorities to implement safe and healthy environments. Not suprisingly, most interventions aimed to reduce falls among older adults (n = 19), regardless of their cognitive level. Furthermore, only a few preventive measures were tested and evaluated among the cognitively impaired population, and results were often poorer than those obtained with older adults without cognitive impairment.[26,27,82] Potential preventive measures to reduce other types of incidents were also identified (e.g. home environment evaluation and modifications such as a water regulator to reduce the risk of burns, the recommendation to cease driving, education and supervision by caregivers to reduce self-negligence)[29,67,71,79] in older adults with cognitive impairment, but few were specifically tested in this sub-population. As these incidents represented the first, second and third causes of ED presentation for this population, further studies should focus on the development and implementation of new preventive measures to reduce these incidents. This knowledge could then be used by stakeholders to make an informed decision to promote public health policies (e.g. home and road safety programs), healthcare services (e.g. workshops focussing on the prevention of avoidable incidents) and future research (orienting primary research and systematic review) in order to improve the well-being of this population and reduce avoidable costs associated with ED presentations.

This study highlighted the need for primary studies, in the specific context of ED and for sub-groups of older adults with cognitive impairment. Considering the lack of knowledge, future primary research should focus on the screening and documentation of the circumstances and cognitive abilities of older adults presenting to the ED. A systematic screening of the cognitive abilities and the circumstances around ED presentation through the use of a short screening tool, such as the Six-Item

Screener (SIS),[83,84] or medical chart review, could help identify older adults with cognitive impairment. Implication of different actors in the screening process may also improve our understanding of "avoidable" incidents and of case management. In Ontario (Canada), a pilot study was performed with paramedics to develop a screening tool to help identify the circumstances surrounding the incident leading to ED presentation, as well as associated risk factors in the person's environment.[85] Results were positive, and further studies are ongoing. Finally, coroner's files could be used to better understand the circumstances surrounding "avoidable" incidents leading to death, which are the more severe cases. In summary, further primary studies are required, and should involve many actors (e.g. occupational therapists, pharmacists) in the ED, considering the complexity and multifactorial nature of avoidable incidents.

Using a rigorous method, this scoping review provided the advantage of exploring a variety of sources from a multitude of databases (e.g. statistics, national and provincial health organizations, scientific databases). Covalidation of sources inclusion, data charting and analyses were also completed to ensure valid interpretation of results. However, as previously mentioned, sources and causes of ED presentation and hospitalizations that may be associated with "avoidable" incidents (e.g. infections, medication side effects) were excluded from this scoping review. Prevalence of incidents for older adults, with and without cognitive impairment, may have been consequently underestimated. Considering the lack of knowledge concerning ED presentation and avoidable incidents, data and sources focussing on hospital medical services and mortality were included in this scoping review, and may affect our conclusions. Inclusion of these sources allowed us to explore the severity of incidents, as well as more severe cases, an aspect that is rarely discussed in literature. Furthermore, distinction between older adults, with and without cognitive impairment, may vary between included sources, as cognitive abilities were not always assessed. Therefore, some sources may have categorized older adults with mild cognitive impairment or who are undiagnosed, as older adults without cognitive impairment. Finally, the definition of ED presentation and the applicability of the study results may vary in different countries. This should be considered before using this knowledge in the Canadian healthcare system. Nonetheless, this study provides a better understanding of "avoidable" incidents leading older adults with cognitive impairment to ED presentation, demonstrates the need for primary research, and is a good starting point for the Regional Public Health Department to identify preventive measures to implement with this population.

CONCLUSION

This scoping review provided a detailed and comprehensive perspective of current knowledge regarding five types of "avoidable" incidents (falls, traffic accidents, burns, harm due to self-neglect, harm due to wandering) leading older adults, with and without cognitive impairment, to ED presentation, and the preventive measures that may be implemented to reduce these incidents. According to this review, little is known about the circumstances in which the incidents occurred, and some (e.g. frostbite, dehydration) were not specifically discussed. Furthermore, although many potential preventive measures were identified, only few were tested with older cognitively impaired adults. As a result, further studies are needed to test and implement preventive measures with this population, and consequently, to reduce further negative outcomes.

AUTHOR CONTRIBUTIONS

MGR and BH completed the literature review and the data extraction, assisted by two collaborators (Stéphanie Stocco and Annie-Claude Lemieux-Courchesne) and participated in the study design. MGR and BH analyzed and interpreted the results. MGR wrote the first draft of the manuscript with the help of BH. VP, NV, ME, MJS, and MG contributed to the study concept and design. Two collaborators (Kathy Rose and Francis Lacasse) were involved in the selection of relevant keywords and databases. The article was critically reviewed by NV, ME, MG, MJS and VP.

COMPETING INTERESTS

None declared.

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Not applicable.

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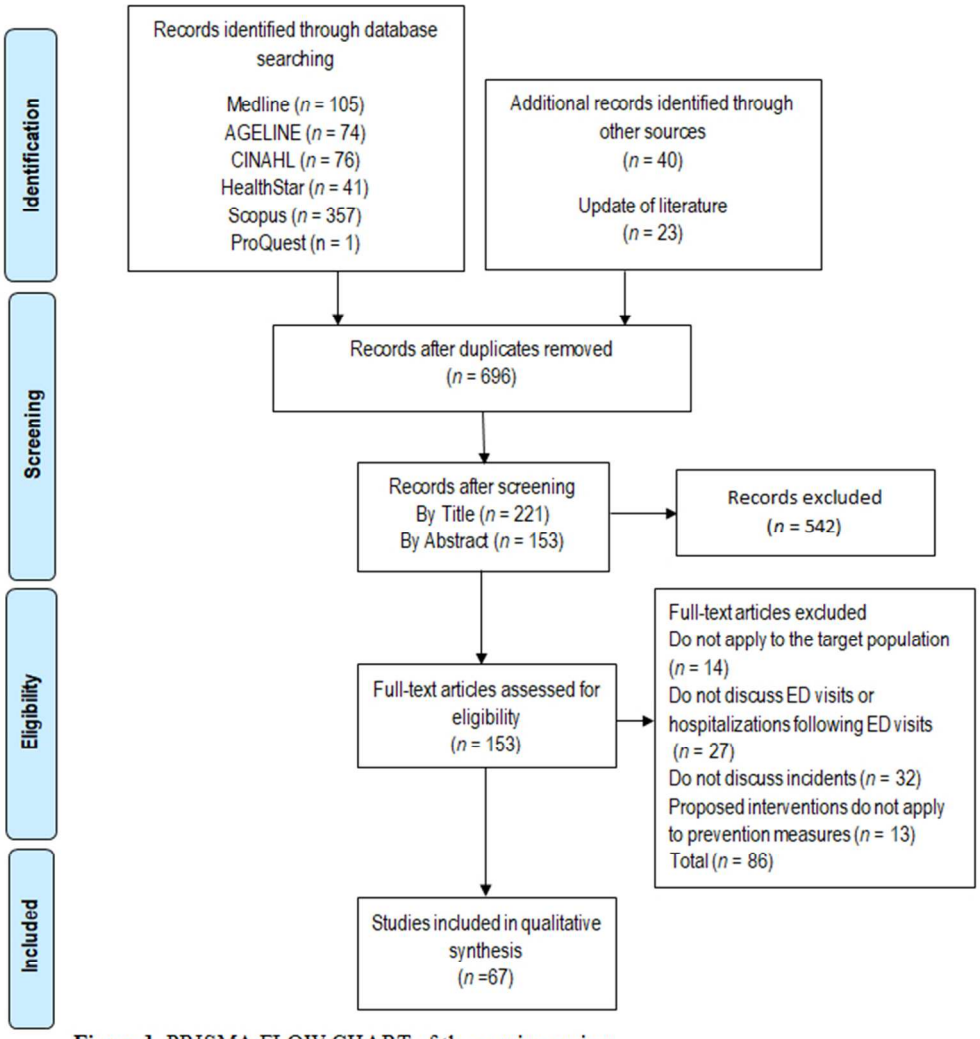

Figure 1. PRISMA FLOW CHART of the scoping review

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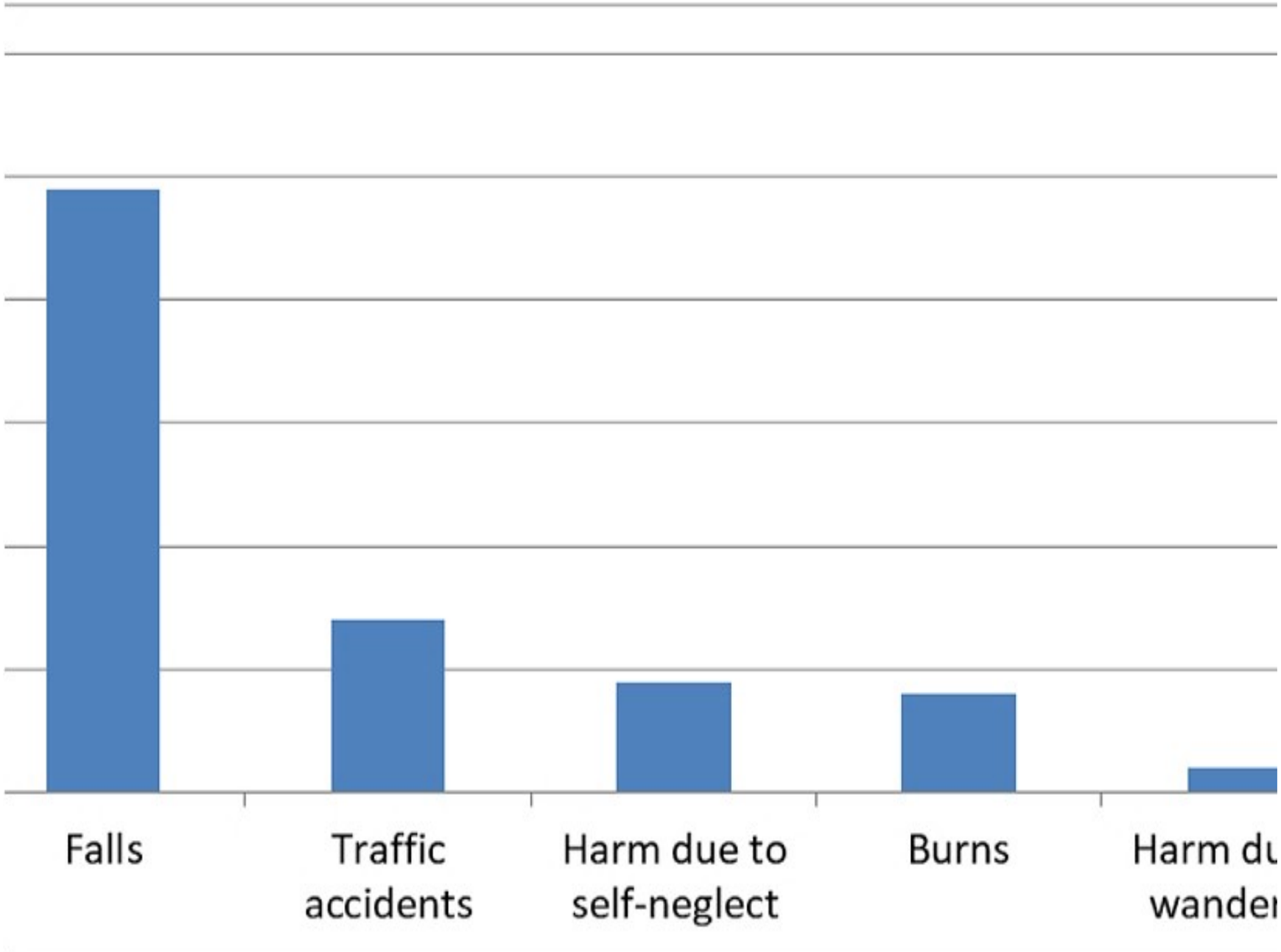
184x198mm (96 x 96 DPI)



2. Number of studies mentioning avoidable incidents

SUPPLEMENTARY FILES

Concept	Controlled and Natural Keywords
Avoidable Incident	"Accidental Injur*" OR "Unintentional injur*" OR "Traumatic Injur*" OR "Traumatic brain injur*" OR "Accidental Trauma*" OR "Unintentional trauma*" OR "Accidental Fall*" OR "Fall injur*" OR "Burn Injur*" OR "Car Accident*" OR "Traffic Accident*" OR "Automobile Accident*" OR "Pedestrian Accident*" OR Intoxication OR Poisoning OR "Heat Stroke*" OR Frostbite OR "Medication Error*" OR Wander* OR Self-neglect* OR "Home Accident*" OR TI Fall* OR TI Burn* OR TI Scald* OR TI Trauma OR Sprain* OR "Accident Prevention"
	Medline and CINAHL: MH "Wounds and Injuries+" OR MH "Accidental Falls" OR MH "Burns+" OR MH "Accidents" OR MH "Fires+" OR MH "Accidents, Home" OR MH "Accidents, Traffic" Medline MH "Accident Prevention" Ageline: DE Injuries OR DE Burns OR DE "Accidents+" OR DE "Fires"
Older adults	Senior* OR Elder* OR "Older Adult*" OR Old* People OR "Old Age" OR "Geriatric Patient*"
	Medline and CINAHL: MH "Aged+"
Emergency department presentations	"Emergency service*" OR "Emergency Department*" OR "Emergency Hospital Service*" OR "Emergency Unit*" OR "Hospital Service Emergency" OR "Emergency Ward*" OR "Emergency Attendance" OR Emergency N2 Admission* OR Emergency N2 Admitt* OR Emergency N2 Visit* OR Emergency N2 Utilization OR Emergency N2 Use OR "Accident and Emergency" OR "A&E"
	Medline: MH "Emergency Service, Hospital+" CINAHL: MH "Emergency Service+" Ageline: DE "Emergency Health Services"
Cognitive impairment	"Cognitive decline" OR "Cognitive* Impair*" OR "Cognitive Deficit*" OR "Cognitive Dysfunction*" OR "Cogniti* Disorder*" OR Dement* OR "Alzheimer* disease*"
	Medline and CINAHL: MH "Dementia+" OR MH "Cognition Disorders+" Ageline : DE "Cognitive Impairment" OR DE Dementia

BMJ Open

Preventing emergency department (ED) visits and hospitalizations of older adults with cognitive impairment compared to the general senior population: what do we know about avoidable incidents? Results from a scoping review

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Keywords:	Accident prevention, Emergency Department Visit, Older Adults, Cognitive Impairment

Title:

Preventing emergency department (ED) visits and hospitalizations of older adults with cognitive impairment compared to the general senior population: what do we know about avoidable incidents? Results from a scoping review.

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ABSTRACT

Objectives: Older cognitively impaired adults present a higher risk of hospitalization and mortality following a visit to the emergency department (ED). Better understanding of avoidable incidents is needed to prevent them and the associated ED presentations in community-dwelling adults. This study aimed to synthetize the actual knowledge concerning these incidents leading this population to ED presentation, as well as possible preventive measures to reduce them.

Design: A scoping review was performed according to the Arksey and O'Malley (2005) framework.

Methods: Scientific and gray literature published between 1996 and 2017 were examined in databases (MEDLINE, CINAHL, Ageline, SCOPUS, ProQuest Dissertations/theses, EBM Reviews, Healthstar), online library catalogues, governmental websites and published statistics. Sources discussing avoidable incidents leading to ED presentations were included, and then extended to those discussing hospitalization and mortality, due to a lack of sources. Data (type, frequency, severity and circumstances of incidents, preventive measures) was extracted using a thematic chart, then analysed with content analysis.

Results: 67 sources were included in this scoping review. Five types of avoidable incidents (falls, burns, transport accidents, harm due to self-negligence, and due to wandering) emerged, and all but transport accidents were more frequent in cognitively impaired seniors. Differences regarding circumstances were only reported for burns, as scalding was the most prevalent mechanism of injury for this population, compared to flames for the general senior population. Multifactorial interventions and implications of other professionals (e.g. pharmacist, firefighters) were reported as potential interventions to reduce avoidable incidents. However, few preventive measures were specifically tested in this population.

Conclusions: Primary research that screens for cognitive impairment and involves actors (e.g. paramedics) to improve our understanding of avoidable incidents leading to ED visits is greatly needed. This knowledge is essential to develop preventive measures tailored to the needs of older cognitively impaired adults.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This study provides an accurate overview of the current knowledge about avoidable incidents leading older adults, with and without cognitive impairment, to an ED presentation and hospitalization, as well as preventive measures that may be implemented to avoid these incidents.
- This study followed a rigorous method, guided by two experienced librarians, completed independently by at least two reviewers at each step, and reviewed by experienced researchers and stakeholders in the field.
- Some avoidable incidents were not discussed in this scoping review, as they were not differentiable from medical conditions (e.g. urinary tract infection due to dehydration).
- Considering the lack of sources focussing on ED presentation and avoidable incidents, sources discussing hospitalizations were included for some types of incidents (e.g. burns) to better understand them.

INTRODUCTION

As the worldwide population ages, an increasing number of older adults (65+) are consulting at emergency departments (ED). In Canada, this population is 1.5 times more likely to visit the ED than the younger population [1]. Furthermore, among these older adults, between 21 to 42% present with cognitive impairment, which exacerbates the risk of negative outcomes following an ED visit, and reduces the probability of returning home [2–6]. Considering the high costs and negative consequences associated with this sub-population's use of ED and hospital healthcare services [1], it is crucial to prevent potentially avoidable incidents leading to ED visits and hospitalizations, especially in older adults with cognitive impairment.

Avoidable incidents, which may refer to unintentional injuries due to falls, motor vehicle traffic crashes, toxic substances, fire/hot objects, or other external causes [7], represent a large proportion (over 20%) of ED visits by older adults [8–11]. Those with cognitive impairment often present judgment errors and self-neglect behaviors, which may put them at a higher risk of various avoidable injuries (e.g. burning themselves while cooking, due to forgetting to turn off electrical appliances, poisoning after eating spoiled food in the refrigerator, falls caused by failure to use walking aids) [12,13]. Many preventive measures (e.g. fall prevention programs and driving classes for seniors) have been developed and implemented to reduce avoidable incidents in community-dwelling adults [14–16]. However, these preventive measures may not be tailored to the specific needs of older adults with cognitive impairment, as most were not developed for this vulnerable population, or may exclude it altogether [17,18]. As a result, little is known about best measures to implement to reduce avoidable incidents and related ED visits in this sub-population. Increased knowledge about avoidable incidents leading older adults with cognitive impairment to ED presentations and the circumstances in which they occur, compared to the senior population in general, will help to identify appropriate preventive measures that could be implemented upstream.

This study aims at synthetizing the current knowledge related to avoidable incidents leading to ED presentations by older people with cognitive impairment living in the community, as well as potential preventive measures aiming at reducing them. More specifically, we aimed to identify (1) the type, frequency, and severity of avoidable incidents associated with presentations to the ED, by older adults with cognitive impairment, compared to the general senior population, (2) the circumstances in which they occurred and (3) if they could have been avoided by safe and healthy environments or behaviors.

METHODOLOGY

As an initial step to identify priorities for the development of a comprehensive preventive approach, a scoping review was completed using the six stages refined by Levac et al. [19] according to Arksey and O'Malley methodology [20]. This project's protocol was published in 2016 [21].

This scoping review first aimed to answer the main research question: "What is the actual knowledge on avoidable incidents leading to ED presentation by older adults living in the community, particularly those with cognitive impairment, in order to implement preventive measures that are tailored to their needs?" Four specific questions were then identified:

1) What are the main types of avoidable incidents associated with presentations to the ED by seniors with cognitive impairment, compared to the general senior population (e.g., fall-related injuries, food poisoning, heat stroke)?
2) Are they more or less frequent and serious compared to older adults without cognitive impairment?
3) Do they occur in specific circumstances (e.g., during the day/night, in the summer/winter, indoor/outdoor, when driving/cooking)?
4) Could they have been avoided by safe and healthy environments or behaviors?

For this review, incidents were defined as physical injuries to self or others, property loss, or property damage. More precisely, avoidable incidents referred to traumatic injuries (e.g., hip, wrist), poisoning (e.g., inadvertent medication overdose, biological substances) and some other consequences of external causes (e.g., frostbite, burn, heat stroke) [22].

Using a research strategy validated by two librarians (FL and KR), scientific and grey literature published in English and in French between 1996 and 2016 was explored through a variety of databases [21]. A total of 654 sources were found and exported to reference manager software (Zotero). Following the elimination of duplicates and non-English or French sources, 633 scientific sources remained (see figure 1). An update of the literature published until April 2017 was also completed, increasing the number of sources to 656. Screening was then completed independently by two members of the research team (MGR and BH) and/or two collaborators (ACLC and SS) according to our inclusion criteria. More precisely, sources were included if the participants were: (a) 65 years old and over, with or without cognitive impairment as documented by screening tests or

categorized by the authors of the sources (seniors who were reported "independent" by authors were also categorized as older adults without cognitive impairment), (b) living in the community (house, private residence, senior housing or other structured environments), and (c) presenting to the ED because of an avoidable incident [21]. As incidents occurring in seniors with cognitive impairment were rarely discussed in literature, sources from other hospital settings (e.g., hospitalization) were also included when too few sources focused on ED visits. Furthermore, sources were considered if they focused on strategies and preventive measures to avoid these incidents. After screening by title and abstract, 153 sources remained. Finally, 67 sources were included for complete analysis.

Data charting was performed independently by two members of the research team (MGR and BH) and/or two collaborators (SS and ACLC) using the data charting form developed according to the study's objectives [21]. To insure interrater agreement, four articles were analyzed independently by the first author and each of the reviewers. Descriptive numerical summary analysis and content analysis [23] were also independently performed by two members of the research team (MGR and BH), as described in the protocol [21]. Results were reported using descriptive statistics and narrative synthetisis, according to the main type of avoidable incidents emerging from literature. Finally, results were presented to stakeholders from the Regional Public Health Department in the province of Quebec (Canada), and researchers in gerontology and emergency department services.

RESULTS

Overview of results

Study designs and definitions: Out of the 67 sources included in this scoping review, 29 were descriptive studies (43%), 10 were literature reviews, 4 were empirical studies, 4 were statistical papers, 4 were expert opinions, and 16 were documents from grey literature.

Population: 25 sources (37%) included participants with documented cognitive impairment, 6 sources included older adults without cognitive impairment as assessed by screening tests or reported as "independent in daily living activities" by authors, while 36 documents (54%) did not detail the cognitive status of older patients.

Setting: 24 sources included data from the ED (36%), 3 sources only focused on the hospital care setting (e.g. hospitalizations) (4%), and 40 sources focused on the community (60%).

Types of incidents: The most commonly mentioned incidents were falls, which were mentioned in 49 papers (73%). Traffic accidents were mentioned in 14 papers (21%), followed by harm due to self-neglect (13%), burns (12%), and harm due to wandering (3%) (see figure 2). Preventive measures were discussed in 44 papers (66%).

Country of publication: Canadian and US studies dominated the review (n = 44; 66%), with 23 and 21 sources, respectively. Six were from the U.K., three from Australia and New-Zealand, two from France, and two from Sweden.

Year of publication: One third of the sources was published in 2013-2017 (n = 22; 33%), one quarter was published in 2008-2012 (n = 18; 27%) and another quarter was published between 2003 and 2007 (n = 18; 27%). The remaining (n = 9; 13%) were published before 2002. Included sources are displayed in supplementary files.

Avoidable incidents

Falls: Not surprisingly, falls emerged as the main type of incident among older adults, whether associated with an ED presentation and use of medical services, or not (30-80%) [24–29], and as the main cause of injury (e.g. fractures) [30] in this population [29,31–33]. Falls were also the main cause of hospitalizations (62-80%) and ED visits (59-85%) following an incident [8,11,27–29,31,32,34–47]. When comparing older adults, with and without cognitive impairment, the cognitively impaired were reported to fall more often (60-80%) than the non-impaired (30%) [24–29], as well as being hospitalized more often due to falls (around 19%) than the general senior population (14% of total hospitalizations) [44–46]. Nonetheless, the difference between older adults, with and without cognitive impairment, in terms of ED visits following a fall compared to the total number of visits, is non-significant (11.1% vs 10.4% respectively) [41]. Furthermore, seniors with cognitive impairment sustained more severe injuries, and were 3 times more at risk of fractures than those without cognitive impairment [25].

In terms of circumstances, no difference was documented between the two sub-populations. Falls mainly occurred at home or nearby (47-74%) [27,29,34,36,39,42,48–51]. The toilet was the most common site (29%), followed by the living room (18%) and the kitchen (14%) [35]. Falls happened mostly during the day [32,47,52]. Ice and winter conditions were also associated with falls [53].

Finally, many studies outlined the link between falls and the following factors: Cognitive impairment [26,34,41,43,54–58], wandering [54], poor physical condition [26,27,31,34,35,55,59], medical conditions [26,27,31,34–36,48,49,56], polymedication, and some types of medication [26,32,55,56,60,61], living alone [34,62], and hazards in the environment [26,35,52].

Transport accidents : Traffic accidents were the second cause of ED visits (14-22.6%) and hospitalizations following an incident [9,11,28,31,32,37]. When comparing older adults, with and without cognitive impairment, those with cognitive impairment were significantly less hospitalized (3.5%) than those without (35% of total hospitalizations following an incident) [43].

In terms of circumstances, no difference pertaining to cognitive impairment was documented. Accidents mainly occurred during the day, on weekends (Friday to Sunday) and between May and August [32]. Meanwhile, approximately 60% of hospitalized older adults with cognitive impairment were driving at the time of the accident [43].

Several factors were linked to a higher risk of traffic accidents, including cognitive impairment [28,63], reckless behavior [63] and deteriorating physical condition [28].

Burns: Burns emerged as the third cause of ED visits following an incident (2-3%) [9,35], and the third cause of home injuries [54]. Burns in cognitively impaired seniors were reported to cause more morbidity and mortality (25%) than in the general senior population (13.8%) [54,64]. Differences were also noted regarding major burn mechanisms. The main major burn mechanism among cognitively impaired seniors was scalding (44.4%), followed by flame burns (36.1%) and contact (18%) [64], while flames or flash were the most common in the general senior population (51-81%), followed by scalding (11-30%) and contact (5-7%) [65].

In both sub-populations, most burns occurred at home [64,65]. Older adults with cognitive impairment mainly suffered burns while bathing (31%) and cooking (16%) [64]. On the other hand, 27 to 40% of major burns and 68% of minor burns in older adults without cognitive impairment occurred in the kitchen [65].

Many factors were associated with burns, such as physical condition [65–67], cognitive impairment [54,66,67], polymedication [66], reckless behaviors [65,67], and living alone [66,68].

Harm due to self-neglect: In older adults with cognitive impairment, harm due to self-neglect was reported as an avoidable incident, with an incidence of 11 to 21%, of which 70% needed urgent care [13,69,70]. Major harm due to self-neglect included: failure to eat/drink, failure to follow instructions (treatment, medication or technical aids), failure to report a medical condition, and failure to maintain personal hygiene [13,69,70]. Furthermore, older adults with cognitive impairment were more at risk of noncompliance to medication than those without cognitive impairment [54,71,72]. Finally, harm due to self-neglect can be influenced by polymedication [61,71] and cognitive impairment [69,70,73].

Harm due to wandering: Older adults with cognitive impairment were more at risk to get lost and sufferfrom consequent harm (e.g. frostbite), regardless of their living arrangements, especially when left unattended. Around 13% were in an outing that they regularly took alone [74].

Preventive measures

Preventive measures identified through this scoping review are displayed in Table 1a (individual interventions) and Table 1b (environmental interventions). Most of them were applied to the general senior population, and not to the older adults with cognitive impairment. Identified prevention programs could be implemented in the person's micro-environment (at home) or macro-environment (community).

Measures to prevent falls were the most common theme. Home assessments and adaptations (n = 16), as well as physical exercise, (e.g. strength and balance exercises) (n = 15) were the most frequently described interventions, followed by medication review (n = 12), use of assistive devices (n = 11) and improved nutrition (e.g. food supplements) (n = 10). The second major theme pertained to preventive measures for traffic accidents (n = 6). Interventions included cognitive and physical screening in older adults by the physician, as well as environmental interventions, including government measures (e.g. regulations and preventive campaigns). Interventions to prevent burns were also environmental, such as home assessment and modifications targeting high-risk populations (e.g. using temperature controls to reduce risks of scalding). In terms of self-neglect, interventions focused on noncompliance (e.g. walking aid, medication) and environmental interventions (surveillance and home visits targeting high-risk populations). Finally, preventive measures to reduce wandering mainly encompassed community involvement, (e.g. neighborhood and family), and special programs and plans to prevent or rapidly intervene after the incident.

Table 1a. Individual-level interventions organized by types of incidents

	Individual-level interventions		
	Physical/medical	Cognitive	Assistive devices
Falls	- Medication review and modification [25,26,33,34,42,50,51,75–79] Balance and strength exercises [25–27,33,34,51,55,59,60,75,76,78–81] - Better nutrition [27] and supplements [26,33,42,50,51,55,76–78] - Better sleep [60] - Management of chronic and acute conditions [25,51,75,76] including visual correction [26,33,42,51,75–78]	- Education on risks and prevention measures [25,35,50,51,75,81,82] - Education on dementia [44] - Fear of falling assessment [51]	- Mobility-aid devices [34,75,78] - Anti-slip shoes and devices [26,27,29,52,60,77] - Hip protectors [50–52]
Traffic accidents	- Recommendations to restrict or to stop driving [75] - Regular medical examination [36,63]	- Safety education programs for seniors [28]	
Burns		- High-risk behavior assessment [65]	
Harm due to self-neglect	- Medication review and modification [71,73,75,83]	- Education of patient on treatment and non-adherence prevention measures [71]	- Compliance aids (pill organizers, medication schemes) [71,73]
Harm due to wandering			- Identification bracelet [75]

Table 1b. Environmental interventions organized by types of incidents

	Environmental interventions		
	Physical	Social	Organizational
Falls	- Home assessment and adaptation [27,29,33,34,42,46,51,60,66,75,77–79,81] - Better roads and sidewalk maintenance, especially in winter [52]	- Education of caregivers and staff on risks and prevention measures [25,35,50,51,75,81,82] even entire communities [51] - Education of caregivers and staff on dementia [44]	- Improvement of building code and regulations [34] - Smartphone apps to report changes in the environment or surface conditions [52] - A public phone line to report falls and fall risks in the environment [34] - Multidisciplinary teams [78] and multifactorial interventions (e.g. PROFET*, MPI**) [78,84]
Traffic accidents	- Elderly-friendly environment / public amenities [28,36] - Increased stoplight and pedestrian crossing times, modified roadway markings [28]	- Education of staff and caregivers regarding risks, monitoring and supervision [63,75,85]	- Road safety campaigns [36,85] - Stricter law enforcement related to jay-walking [28] - Promoting alternatives to driving [36,50,63,75,85]
Burns	- Comprehensive home safety evaluation and modifications [27,65] - Home fire safety visits targeting vulnerable populations [66]	- Education for caregivers on dementia and on burn safety measures, including adequate assistance and supervision [64]	- Nursing home policies limiting smoking to under supervision and in determined locations [67] - Smoking cessation programs (social/emotional support, non-smoking related activities, pharmacological options) [67]
Harm due to self-neglect		- Frequent visits by staff or family members trained to identify problems associated with negligence [69]	- Case management for high-risk population [69]
Harm due to wandering		- Education of informal and formal caregivers [74] - Strategies including neighbors, formal-informal caregivers and law enforcement [74,75]	- Special programs (e.g. Safe Return) that help rapidly locate and return lost individuals [74] - Safety plans in formal care settings that prevent wandering [74]

*PROFET= Prevention of falls in the elderly trial; **MPI=Multifactorial personalized Intervention

DISCUSSION

In this scoping review, we aimed to examine literature about avoidable incidents leading older adults with cognitive impairment to ED presentations in order to identify preventive measures that could be implemented to reduce such incidents. Furthermore, as incidents occurring in seniors with cognitive impairment were rarely discussed in literature, the search was extended to other hospital settings (e.g., hospitalization) when too few sources focused on ED visits.Five main types of incidents emerged from literature: falls, traffic accidents, burns, harm due to self-neglect, and harm due to wandering. Of those, most were more frequent in cognitively impaired seniors, as they may present judgment errors and unsafe behaviors [12,13]. The only exceptions were hospitalizations related to traffic accidents, and ED presentations related to falls, for which the difference of prevalence between the two sub-populations was not significant. Differences regarding hospitalizations following traffic accidents could be explained by a significantly lower number of cognitively impaired drivers compared to older drivers without such impairment, as the dementia diagnosis was strongly associated with driving cessation [86,87]. Nonetheless, when driving, cognitively impaired adults were at increased risk of experiencing an incident (whether or not associated with an ED presentation or hospitalization) than those without such impairment [43,63,75] and may be less fit for driving [88,89]. On the other hand, the difference of ED presentations related to falls between both sub-population was not significant. This could be explained by the fact that most studies in the ED were based on medical files analysis, which lacked a systematic review of cognitive status. As a result, the number of older adults with cognitive impairment or dementia may have been underestimated, therefore reducing the difference between both sub-population in terms of ED presentations following a fall. Nevertheless, falls emerged as the main type of incident for both sub-populations. This result is congruent with its actual importance in the scientific literature (73% of the sources reported in this scoping review), as well as its predominance in deployed preventive measures. In fact, in Canada, more than 50 community-based programs were developed and deployed with older adults in 2001 to prevent falls [16], which seem far more numerous than programs for other types of incidents.

One of the main objectives of this scoping review was to document the circumstances under which the incidents occurred. Unfortunately, this description remains limited and focused only on the three main types of incident (falls, traffic accidents, and burns). Consequently, little is known about the activities carried out at the time of the incident. As this information could facilitate the development

of preventive measures according to risk factors (e.g. adapt preventive measures according to the circumstances of traffic accidents), future studies in the ED should further detail the circumstances of incidents in seniors. Moreover, one of the main limitations of our study was the difficulty to differentiate harm due to incidents from other medical causes (e.g. infections, side effects to medication), as some medical conditions may be caused by avoidable incidents (e.g. bad hygiene caused by self-neglect can lead to infections; noncompliance to medication can lead to a variety of sides effects) [13,73]. For this scoping review, we decided to exclude all medical conditions with unknown or unclear causes. Consequently, the prevalence of avoidable incidents, such as harm due to self-neglect and wandering, may be underestimated in the cognitively-impaired population. In conclusion, better identification of these incidents among cognitively impaired seniors in the ED and hospital setting, as well as the circumstances under which they occurred, may help understand the cause of injuries and reduce the risk of further ones, as preventive measures may be put in place accordingly.

In total, 43 preventive measures were identified through this scoping review. Preventive measures mainly focused on environmental modifications (e.g. home and community physical environments, education to caregivers), modification of the person's habits (e.g. nutrition, medication, use of technical aids), government measures (e.g. safety programs with firefighters and the authorities, building regulations) and the involvement of a multidisciplinary team at the ED (e.g. pharmacist, occupational therapist, doctor). These interventions may represent a good starting point for Public Health Authorities around the world to implement safe and healthy environments. Not suprisingly, most interventions aimed to reduce falls among older adults (n = 19), regardless of their cognitive level. Furthermore, only few preventive measures were tested and evaluated among the cognitively impaired population, and results were often poorer than those obtained with older adults without cognitive impairment [24,25,80]. In fact, no significant reduction was observed between the intervention group and the control group in terms of fall rates, ED presentations and hospitalizations [24,62] Potential preventive measures to reduce other types of incidents were also identified (e.g. home environment evaluation and modifications such as using current technologies like temperature controls to reduce the risk of burns in the bath, the recommendation to cease driving, education and supervision by caregivers to reduce self-negligence) [27,65,69,75] in older adults with cognitive impairment, but few were specifically tested in this sub-population. For most of the preventive measures, outcomes were also not described, which reduce their applicability in the clinical setting.

As these incidents represented the first, second and third causes of ED presentation for this population, further studies should focus on the development and implementation of new preventive measures to reduce these incidents. This knowledge could then be used by stakeholders to make an informed decision to promote public health policies (e.g. home and road safety programs), healthcare services (e.g. workshops focussing on the prevention of avoidable incidents) and future research (orienting primary research and systematic review) in order to improve the well-being of this population and reduce avoidable costs associated with ED presentations and hospitalizations.

This study highlighted the need for primary studies, in the specific context of ED and for sub-groups of older adults with cognitive impairment. A systematic screening of the cognitive abilities and the circumstances around ED presentation through the use of a short screening tool, such as the Six-Item Screener (SIS) [90,91], or medical chart review, could help identify older adults with cognitive impairment. Implication of different actors in the screening process may also improve our understanding of avoidable incidents, circumstances of such incidents and case management. In Ontario (Canada), a pilot study was performed with paramedics to develop a screening tool to help identify the circumstances surrounding the incident leading to ED presentation, as well as associated risk factors in the person's environment [92]. Results were positive, and further studies are ongoing. Finally, coroner's files could be used to better understand the circumstances surrounding avoidable incidents leading to death, which are the more severe cases. In summary, further primary studies are required, and should involve many actors (e.g. occupational therapists, pharmacists) in the ED, considering the complexity and multifactorial nature of avoidable incidents.

Using a rigorous method, this scoping review provided the advantage of exploring a variety of sources from a multitude of databases (e.g. statistics, national and provincial health organizations, scientific databases). Covalidation of sources inclusion, data charting and analyses were also completed to ensure valid interpretation of results. The study has however some limitations. As previously mentioned, sources and causes of ED presentation and hospitalizations that may be associated with avoidable incidents (e.g. infections, medication side effects) were excluded from this scoping review. Prevalence of incidents for older adults, with and without cognitive impairment, may have been consequently underestimated. Considering the lack of knowledge concerning ED presentation and avoidable incidents, data and sources focussing on hospital medical services and mortality were included in this scoping review, and may affect our conclusions. Inclusion of these

sources allowed us to explore the severity of incidents, as well as more severe cases, an aspect that is rarely discussed in literature. Furthermore, distinction between older adults, with and without cognitive impairment, may vary between included sources, as cognitive abilities were not always assessed. Therefore, some sources may have categorized older adults with mild cognitive impairment or who are undiagnosed, as older adults without cognitive impairment. In accordance with the selected design, the quality of the studies was also not assessed [21], and some pertinent studies may not have been included in this scoping review. Consequently, our conclusion may have been affected by the biases of the included studies. Finally, the definition of ED presentation and the applicability of the study results may vary in different countries. This should be considered before using this knowledge in an identified healthcare system. Nonetheless, this study provides a better understanding of avoidable incidents leading older adults with cognitive impairment to ED presentation, demonstrates the need for primary research, and is a good starting point to identify preventive measures to implement with this population.

CONCLUSION

This scoping review provided a detailed and comprehensive perspective of current knowledge regarding five types of avoidable incidents (falls, traffic accidents, burns, harm due to self-neglect, harm due to wandering) leading older adults, with and without cognitive impairment, to ED presentation and related hospitalizations, and the preventive measures that may be implemented to reduce these incidents. According to this review, falls, traffic accidents and burns emerged as the three main types of avoidable incidents for both sub-population. However, little is known about the circumstances in which the incidents occurred, and some (e.g. frostbite, dehydration) were not specifically discussed in the literature. Considering the lack of knowledge, future primary research should focus on the screening and documentation of the circumstances and cognitive abilities of older adults presenting to the ED by involving many actors. Furthermore, although many potential preventive measures were identified, only few were tested with older cognitively impaired adults. Consequently, thought this scoping review aimed to reduce the rate of avoidable incidents leading to an ED presentation, too little information was available to identifiy the best measures to attain this objective. As a result, further studies are needed to test and implement preventive measures with this population, and consequently, to reduce further negative outcomes (i.e. prevalence of ED

presentations and hospitalizations related to avoidable incidents in cognitively impaired seniors, as well as their severity).

AUTHOR CONTRIBUTIONS

MGR and BH completed the literature review and the data extraction, assisted by two collaborators (Stéphanie Stocco and Annie-Claude Lemieux-Courchesne) and participated in the study design. MGR and BH analyzed and interpreted the results. MGR wrote the first draft of the manuscript with the help of BH. VP, NV, ME, MJS, and MG contributed to the study concept and design. Two collaborators (Kathy Rose and Francis Lacasse) were involved in the selection of relevant keywords and databases. The article was critically reviewed by NV, ME, MG, MJS and VP.

COMPETING INTERESTS

None declared.

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DATA SHARING STATEMENT

Not applicable.

FIGURE LEGENDS

Figure1:

Summary of evidence search and selection.

Selection process for studies to be included in the scoping review in compliance with PRISMA (Preffered Reporting Items for Systematic reviews and Meta-Analyses) standards.

Figure2:

Falls (the first bar at left) are the most commonly mentioned type of avoidable incidents (mentioned in 49 out of 67 total studies).

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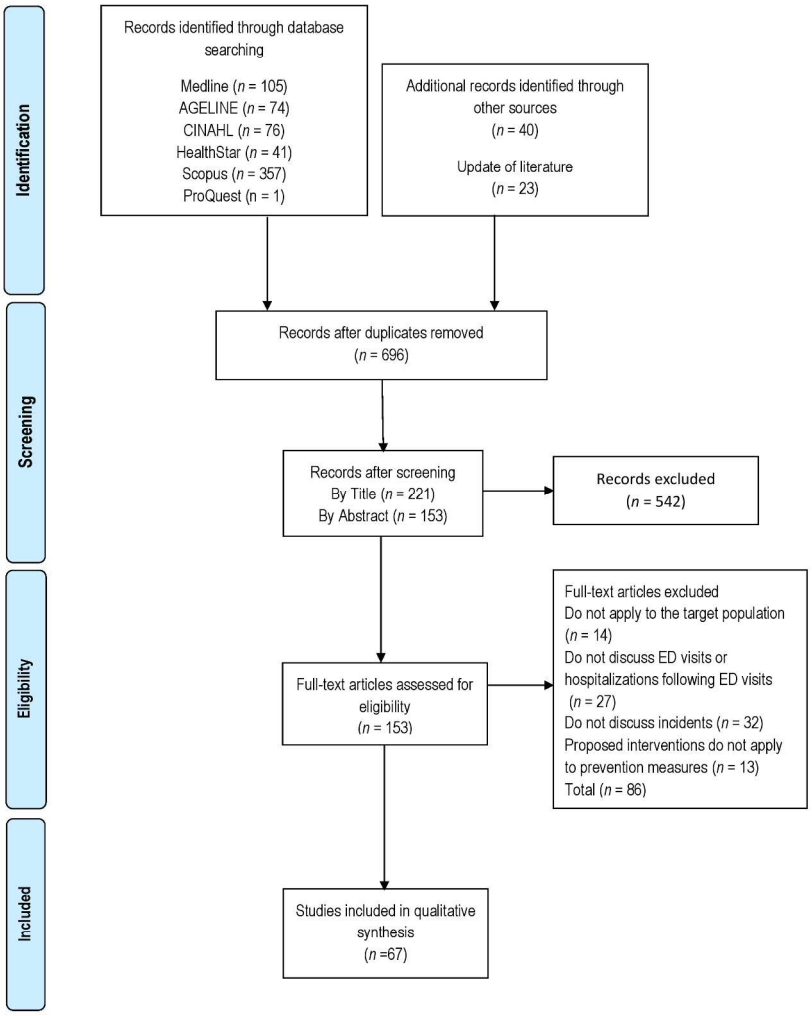

Figure 1. PRISMA FLOW CHART of the scoping review

Summary of evidence search and selection.
Selection process for studies to be included in the scoping review in compliance with PRISMA (Preffered Reporting Items for Systematic reviews and Meta-Analyses) standards.

215x279mm (300 x 300 DPI)

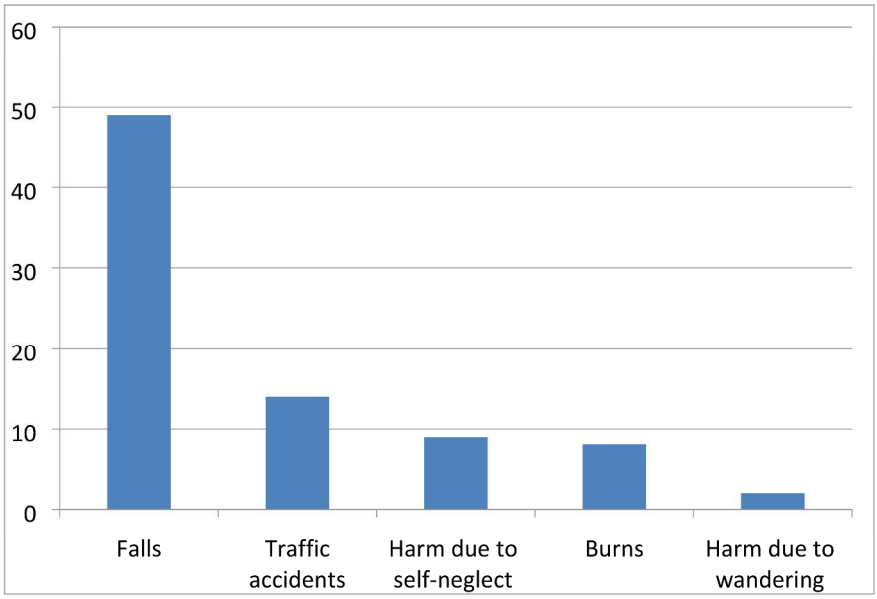

Figure 2. Number of studies mentioning avoidable incidents

Falls (the first bar at left) are the most commonly mentioned type of avoidable incidents (mentioned in 49 out of 67 total studies).

279x215mm (300 x 300 DPI)

Supplementary files. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Albert M, McCaig L, Ashman J [8]	2013	USA	Statistics	ED	F	No	-	≥ 65	-	-
Ng W et al. [9]	2002	Japan	Descriptive study	ED	TA+B	No	813	≥ 65	• Cases of injury-related presentations in the elderly group.	
Canadian Institute for Health Information [10]	2010	Canada	Statistics	ED	General	No	-	≥ 65	• Ontario residents with an unplanned visit to the Emergency Department.	
Ontario Injury Prevention Resource Centre [11]	2007	Canada	Statistics	ED	F+TA	No	-	≥ 65	• Visiting an Emergency Department; or • Admitted to an acute care hospital.	
Tierney M, Charles J, Naglie G et al. [13]	2004	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Living alone; • Urban-dwelling.	• History of bipolar disorder or schizophrenia.
Shaw FE, Bond J, Richardson DA, et al. [24]	2003	UK	Empirical study	ED	F	Yes	274	≥ 65	• Cognitive impairment and dementia (Mini-MentalState Examination score< 24); • Presenting to the Emergency Department after a fall.	• Medical diagnosis that likely caused the fall; • Unfitness for investigation within 4 months; • Inability to walk or to communicate for reasons other than dementia.
Shaw F [25]	2003	UK	Author's opinion	C	F	Yes	-	≥ 65	-	-
Gagnon C, Lafrance M [26]	2011	Canada	Literature review	C	F	No	-	≥ 65	-	-
Public Health Agency of Canada [27]	2011	Canada	Grey literature	C	F	No	-	≥ 65	-	-
Raina P et al. [28]	1997	Canada	Literature review	H	F+TA	No	-	≥ 65	-	-
Public health agency of Canada [29]	2008	Canada	Grey literature	C	F	No	-	≥ 65	-	-

Supplementary files. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Owens P, Russo C, Spector W et al. [30]	2009	USA	Statistics	ED	F	No	-	≥ 65	-	-
Centers for Disease Control and Prevention [31]	2015	USA	Grey literature	C	F	No	-	≥ 65	-	-
Abrantes K et al. [32]	2015	Brazil	Descriptive study	ED	F+TA	No	190	≥ 65	• Victims of some type of trauma (urban and rural); • Served by the Mobile Emergency Service team.	
Kara H, Bayir A, Ak A et al. [33]	2013	Turkey	Descriptive study	ED	F+TA	No	568	≥ 65	• Admitted to an Emergency Department of a tertiary care hospital.	-
Public Health Agency of Canada [34]	2005	Canada	Grey literature	C	F	No	-	≥ 65	-	-
Lee V, Wong T, Lau C [35]	1999	Hong Kong	Descriptive study	ED	F+TA+B	No	100	≥ 65	• History of accidental injury at home within one week.	-
Yeo Y, Lee S, Lim C et al. [36]	2009	Singapore	Descriptive study	ED	F+TA	No	720	≥ 65	• Visiting the Emergency Department	• Immediate resuscitation; • Mental illness or violent behavior.
Aschkenasy M, Rothenhaus T [37]	2006	USA	Literature review	C	F+TA	No	-	≥ 65	-	-
Lee J, Sirois M, Moore L et al. [38]	2015	Canada	Descriptive study	ED	F+TA	Yes	1.286	≥ 65	• Independently perform the seven basic activities of daily living; • Emergency Department patients; • Discharged back home.	-
Amador S, Goodman C, King D et al. [39]	2014	UK	Descriptive study	C	F	Yes	133	≥ 65	• Documented diagnosis of dementia; or • Validated measure of cognitive function impairment.	• Admitted to hospital; • From long-term care facilities; • Unable to give consent.
Burns E [40]	2001	USA	Literature review	ED	F	No	-	≥ 65	-	• Lacked capacity to consent; • A consultee could not be identified
Ziminski C, Phillips L, Woods D [41]	2012	USA	Descriptive study	ED	F	Yes	18344	≥ 65	-	-
Public Health Agency of Canada [42]	2014	Canada	Grey literature	C	F	No	-	≥ 65	-	-

Supplementary files. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Whiteman C, Tillotson R, Denne N et al. [43]	2011	USA	Descriptive study	ED	F+TA	Yes	6,151	≥ 40	• Dementia and non-dementia group; • Presented for a major trauma visit.	-
Nourhashémi F, Andrieu S, Sastres N et al. [44]	2001	France	Descriptive study	ED	F	Yes	118	≥ 60	• Patients with Alzheimer' disease	
Voisin T, Sourdet S, Cantet C et al. [45]	2009	France	Descriptive study	H	F	Yes	686	≥ 60	• Alzheimer's disease; • Mild to moderate disease; • Mini- Mental State Examination score between 10 and 26; • Living in the community.	• Severe Alzheimer's disease; • Institutionalized at baseline; • A concomitant disorder that could affect the short-term prognosis.
Ministry of Health (British Columbia, Canada) [46]	2006	Canada	Grey literature	C	F	No	-	≥ 65	-	• Confusional syndromes or slight or moderate cognitive disorders.
Kihlgren A, Wimo A, Mamhidir A [47]	2014	Sweden	Descriptive study	C	F	No	719	≥ 75	• Living permanently in a nursing home.	
Pfortmueller C, Kunz M, Lindner G et al. [48]	2014	Switzerland	Descriptive study	ED	F	No	6357	≥16 ≥75	• Admitted to the Emergency Department in relation to a fall.	
Timler D, Dworzyński M, Szarpak Ł et al. [49]	2015	Poland	Descriptive study	ED	F	No	301	≥ 65	• Patients whose diagnoses were coded with ICD-10 (International Statistical Classification of Diseases) codes S00–S09 which pertain to injuries of the head.	
Ministry of health planning, Office of the Provincial Health Officer, British Columbia [50]	2004	Canada	Grey literature	C	F	No	4066	≥ 65	• Treated and released in the Emergency Department	
Department of Health Promotion and Protection [51]	2007	Canada	Grey literature	C	F	No	-	≥ 65	-	• Admitted to hospital for further treatment of their injuries.
Gyllencreutz L, Björnstig J, Rolfsman E et al. [52]	2015	Sweden	Descriptive study	C	F	No	216	≥ 65	• Fall as a pedestrian in a public area.	

Supplementary files. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Wilkins K, Park E [53]	2004	Canada	Grey literature	C	F	No	Older adults	≥ 65	-	-
Douglas A, Letts L, Richardson J [54]	2011	Canada	Literature review	C	F+B+SN+W	Yes	16 sources	≥ 65	-	-
Taylor M, Delbaere K, Lord S et al. [55]	2014	Australia	Descriptive study	C	F	Yes	174	≥ 60	• Cognitive impairment; • Living in the community or a low-level care facility.	
Paniagua M, Malphurs J, Phelan E [56]	2006	USA	Descriptive study	ED	F	No	117	≥ 65	• Presenting to the Emergency Department during the 2 months of observation after having fallen.	• Recent stroke (within 18 months); • Progressive neurodegenerative disorders (excluding dementia).
Ouellet M, Sirois M, Beaulieu-Bonneau S et al. [57]	2016	Canada	Descriptive study	ED	F+TA	Yes	306	≥ 65	• Independent in basic activities of daily living; • Visit to the Emergency Department specifically for a minor traumatic injury; • Discharged home within 48 hours.	
Welmerink D, Longstreth W, Lyles M et al. [58]	2010	USA	Descriptive study	H	F	Yes	5,356	≥ 65	• Injury was the primary cause of hospitalization; • Presence of an E-code for falling: E880–E886, E888; • Available scores, for the baseline clinic visit, for 3MS (Modified Mini-Mental State Examination) and DSST (the Digit Symbol Substitution Test).	
Taylor M, Lord S, Brodaty H et al. [59]	2017	Australia	Empirical study	C	F	Yes	42	≥ 60	• A clinical diagnosis of dementia; • Living in the community;	• Living in long-term care; • Dementia or delirium or confusion at the visit; • Admission to any ward; • Inability to consent.
National Institute on Aging [60]	2009	USA	Grey literature	C	F	No	-	≥ 65	-	-
Beaudoin F, Merchant R, Clark M [61]	2016	USA	Empirical study	ED	SN	No	112	≥ 50	• Taking opioids.	
Mahoney J, Shea T, Przybelski R et al. [62]	2007	USA	Empirical study	C	F	No	349	≥ 65	• Independently living; • History of 2 falls in the previous year; or 1 fall in the previous 2 years with injury or gait and balance problems.	• Cognitive impairment.
National Institute on Aging [63]	2002	USA	Grey literature	C	TA	Yes	-	≥ 65	-	-
Alden N, Rabbitts A, Yurt R [64]	2005	USA	Descriptive study	C	B	Yes	36	≥ 50	• Documented pre-existing dementia; • Suffered a burn injury.	

Supplementary files. The studies included in the scoping review

Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Ehrlich A, Kathpalia S, Boyarsky Y et al. [65]	2005	USA	Descriptive study	ED	B	No	77	≥ 65	• Treated in the Emergency Department for a burn diagnosis; • Subsequently discharged home.	
Lester P, Kohen I [66]	2008	USA	Author's opinion	C	B	No	-	≥ 65	-	-
Lowton et al. [67]	2010	UK	Descriptive study	C	F+B	No	-	≥ 60	• Living in private or sheltered housing via two routes: 1) those in contact for the purposes of receiving a Home Fire Safety Visit 2) those attending Falls clinics	• Hospital admission; • Transfer to a burn center; • Elopement from the Emergency Department; • Chemical or non-thermal burn.
Elder A, Squires T, Busuttil A [68]	1996	Scotland	Descriptive study	C	B	No	1096	≥ 75	• Died in household fires.	
Tierney M, Snow W, Charles J et al. [69]	2007	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Cognitive impairment; • Living alone.	
Charles J, Naglie G, Lee J et al. [70]	2015	Canada	Descriptive study	C	SN	Yes	224	≥ 65	• Cognitive impairment (≤130 on the Dementia Rating Scale); • Living alone; • Having a PCP (Primary care physician).	• Living in a communal setting; • History of bipolar disorder or schizophrenia.
Barat I, Andreasen F, Damsgaard E [71]	2001	Denmark	Descriptive study	C	SN	Yes	348	≥ 75	-	-
Canadian Institute for Health Information [72]	2016	Canada	Grey literature	ED	SN	No	-	≥ 65	-	-
Tierney M, Charles J, Jaglal S et al.[73]	2001	Canada	Descriptive study	C	SN	Yes	139	≥ 65	• Suspected of having cognitive impairment; • Living alone.	
Rowe M, Feinglass N, Wiss M [74]	2004	USA	Literature review	C	W	Yes	-	≥ 48	• Persons with dementia	-
Dalsania P [75]	2006	USA	Grey literature	C	TA	Yes	-	≥ 65	-	-
Booth V et al. [76]	2015	UK	Literature review	C	F	Yes	7 sources	≥ 60	-	-

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Authors	Year of publication	Country	Study design	Setting*	Types of incidents**	Participants				
						CI***	Sample size	Age	Inclusion criteria	Exclusion criteria
Alldred D, Raynor D, Hughes C et al. [77]	2013	Australia, Canada, Netherlands Sweden, UK, USA	Literature review	C	SN	No	7653	≥ 65	• Living in institutionalized care facilities.	
Public Health Agency of Canada [78]	2009	Canada	Grey literature	C	TA	No	-	≥ 65	-	-
Fuller G [79]	2000	USA	Author's opinion	C	F	No	-	≥ 65	-	-
Al-Aama T [80]	2011	USA	Author's opinion	C	F	No	-	≥ 65	-	-
Rapp K, Lamb S, Büchele G et al. [81]	2008	Germany	Descriptive study	C	F	Yes	365	≥ 60	• Living in a nursing homes; • >40% reported symptoms of low mood or cognitive impairment.	
Carpenter C, Avidan M, Wildes T et al. [82]	2014	USA	Literature review	ED	F	No	3 sources	≥ 65	-	-
Taylor M, Delbaere K, Close J et al. [83]	2012	Australia	Literature review	C	F	Yes	-	≥ 65	-	-
Canadian Institute for Health Information [84]	2014	Canada	Grey literature	ED	F	No	1,537,239	≥ 65	• Living in a long-term care facility.	
Institut national de santé publique du Québec [85]	2017	Canada	Grey literature	C	F	No	-	≥ 65	-	-

*Setting: C = Community; ED = Emergency Department; H = Hospital;
**Types of incidents are: B = burns; F = falls; SN = harm due to self-neglect; TA = traffic accidents; W = harm due to wandering;
***CI = did the study include participants with cognitive impairment?