Injury-Related Emergency Department Presentations Among Residential Aged Care Residents in Victoria, Australia

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Abstract
Objective: This study aimed to quantify and describe the characteristics of emergency department (ED) injury presentations and subsequent hospital admissions among residents of residential aged-care facilities (RACFs) in Victoria, Australia between 2008 and 2018.

Methods: This study comprised a single jurisdiction population-based study of consecutive injury-related ED presentations of RACFs residents using the Victorian Emergency Minimum Dataset (VEMD).

Results: The rate of ED injury presentations per 100,000 population decreased by .8% per year over 10 years (P = .03); however, the rate per 100,000 RACF bed days increased by .6% per year (P = .05). The proportion of presentations subsequently admitted to hospital increased 4.0% per year (P<.0001). The majority of presentations were due to falls (82.5%), with fracture(s) being the most common injury type (34.0%).

Discussion: The increased rate of ED visits and hospital admissions in RACFs residents highlights the need to design specialized emergency care services and/or provide better direct access to hospital care for this vulnerable population.

Keywords
emergency department, injury, nursing home, residential aged care

Introduction
With the continuing growth in the ageing population in Australia (Australian Bureau of Statistics (ABS), 2018), the demand for emergency care and hospital admissions is dramatically increased, as older people aged 65 years and older are generally the major users of health services (Albert et al., 2013). There is some evidence of an increase in the rate of emergency department (ED) presentations by older Australians in recent years, which is growing faster than the concomitant growth in the older population (Burkett et al., 2017). A substantial increase in ED presentations by older people is also expected by 2050 (Burkett et al., 2017), with significant impacts on the future provision of health services (Chu et al., 2001).

In Australia, over 230,000 people live permanently in residential aged-care facilities (RACFs) (also known as nursing home and long-term care facilities) (Report on Government Services, 2020). RACFs residents represent one of the most vulnerable and frail populations with multiple comorbidities including cognitive and physical impairments, which increase their risk of injuries and premature death (Ibrahim et al., 2017; Mitchell et al., 2019b). Compared to community dwellers, people residing in RACFs have higher demands for emergency services and hospital admissions (Ingarfield et al., 2009) and nearly half require return visits within the first year of their initial visit (Gruner et al., 2018).

A large proportion of ED presentations by RACFs residents are for injuries (Albert et al., 2013; Bobian et al., 2017; Ingarfield et al., 2009). The mechanism of these injuries includes falls, poisoning, burns and other external causes which are associated with poor health outcomes (Mitchell et al., 2015; Neuman et al., 2014; Rapp et al., 2012). Fall-related injuries are a major reason for hospitalizations among RACFs residents, particularly in people with dementia

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(Mitchell et al., 2019a). In 2018–2019, 10.5% of Australian RACFs residents had a hospitalization or ED presentation due to fall (Royal Commission, 2021).

Further research focusing on RACFs residents is required to inform the development of prevention strategies to reduce ED presentations and subsequent hospital admissions and initiatives to optimize care. This would also improve residents’ longer-term health outcomes and reduce demand on ED/hospital services. Some previous studies have examined the rate of ED presentations among community-dwelling populations, which may not be an accurate representation of the people living in RACFs. This study aimed to quantify and describe the characteristics of ED injury presentations and subsequent hospital admissions among Victorian RACFs residents during 2008–2018.

**Methods**

**Study Design and Setting**

This study comprised a single jurisdiction population-based retrospective analysis of consecutive injury-related ED presentations of older persons living in Victorian RACFs. The study was conducted in accordance with the guidelines for Reporting of studies Conducted using Observational Routinely collected Data (RECORD).

The population of Australia was 25.6 million in 2020 with 6,661,700 people living in the second most populous State, Victoria (Australian Bureau of Statistics, 2021). Over 15% of the Victoria’s population are aged ≥65 years (Department of Health and Human Services Victoria, 2019) and has approximately 50,113 residents accommodated in 763 RACFs (Australian Institute of Health and Welfare, 2021). This equates to almost 5% of older population in Victoria using permanent residential aged care.

**Data Sources**

The primary data source for this study was the Victorian Emergency Minimum Dataset (VEMD), an ongoing surveillance dataset capturing all presentations to Victorian public hospitals with a designated ED service. There are 38 such public hospitals with emergency departments that contribute to the VEMD.

The data for this research was provided by the Victorian Agency for Health Information. Victorian population data by year, age group and sex were sourced from the Australian Bureau of Statistics, Australian Demographic Statistics (Creative Commons Attribution 2.5 Australia, 2018). Residential aged care bed day occupancy data (“occupied bed days”) by year, age group and sex were sourced from the Australian Institute of Health and Welfare (Source: AIHW National Aged Care Data Clearinghouse) (Australian Institute of Health and Welfare & National Aged Care Data Clearinghouse, 2018).

**Case Identification**

Injury-related ED presentations were identified from the VEMD, through the Victorian Injury Surveillance Unit (VISU) from July 1, 2008 to June 30, 2018. Injury case selection and injury coding was based on injury surveillance variables in the VEMD – these are coded according to the National Minimum Data Standards for Injury Surveillance (www.health.vic.gov.au/archive-hdss/archive/index-vemd.htm).

**Eligibility Criteria**

Cases were included where the patient was aged ≥65 years, their location of usual accommodation was recorded as a RACF and the injuries were recorded as having occurred in the RACFs. Planned return visits and pre-arranged admissions to hospital as well as patients deceased on arrival were excluded from the study.

**Statistical Analysis**

RACFs injury presentations were described in terms of overall numbers and annual frequencies and examined by age group, sex, injury type, intent and cause of injury. To better understand the time trend relative to the ageing of the population, the injury rate was calculated as the number of injury presentations per year per 100,000 Victorian population, by age group. The injury rate was also calculated as the number of injury presentations per year per 100,000 Victorian RACF-occupied bed days (respite and permanent occupied bed days, combined), to better understand the time trend relative to RACF occupancy, that is, exposure. Time trends were modelled using Poisson regression models with the log of the population as model offset. The results are presented as the modelled % change in rate per year, calculated as: percentage change = (e^α−1) x100% where α is the parameter estimate of year, in the Poisson model. A trend was considered to be statistically significant if the P-value of the slope of the regression model was less than .05. Data analyses were performed using Statistical Analysis Software (SAS, Institute Inc Cary, NC, USA), version 9.4.

**Results**

The population of older people (aged ≥65 years) in Victoria increased steadily from 721,564 in 2008/09 to 972,437 in 2017/18. However, the RACFs bed days per 100,000 population decreased from 20.2 to 17.5 over 10 years. The decrease in bed days per population was statistically significant (1.4% per year, P<.0001), modelled adjusting for age group and sex (Figure 1).

There were 25,264 ED injury presentations among Victorian RACFs residents during 2008–2018. Of these, 17,790 (70.4%) were female. The absolute number of ED injury presentations increased slightly from 2150 in 2008/09 to 2793 in 2017/18 (Table 1). The rate of ED injury
presentations per 100,000 Victorian population decreased .8% per year during the 10-year period ($P = .03$), modelled adjusting for age group and sex. However, the rate of ED presentations per 100,000 RACF bed days increased .6% per year ($P = .05$). The rate of ED injury presentations increased with age, with the highest rates of 1693 and 1001 per 100,000 population in females and males aged $\geq 85$ years, respectively (Table 2).

Table 2. ED Injury Presentations by RACFs Residents and Subsequent Admission to Hospital in Victoria From 2008 to 2018.

| Year    | ED injury presentations $n$ | Admission to hospital per ED presentations $n$ (%) | ED injury presentations per 100,000 population | ED injury presentations per 100,000 bed days |
|---------|-----------------------------|--------------------------------------------------|-----------------------------------------------|---------------------------------------------|
| 2008/09 | 2150                        | 1095 (50.9)                                      | 298.0                                         | 14.7                                        |
| 2009/10 | 2378                        | 1241 (52.2)                                      | 320.1                                         | 15.9                                        |
| 2010/11 | 2349                        | 1364 (58.1)                                      | 306.8                                         | 15.4                                        |
| 2011/12 | 2563                        | 1568 (61.2)                                      | 322.9                                         | 16.6                                        |
| 2012/13 | 2617                        | 1594 (60.9)                                      | 317.3                                         | 16.7                                        |
| 2013/14 | 2611                        | 1588 (60.8)                                      | 305.8                                         | 16.4                                        |
| 2014/15 | 2434                        | 1618 (66.5)                                      | 275.8                                         | 15.0                                        |
| 2015/16 | 2550                        | 1709 (67.0)                                      | 279.4                                         | 15.4                                        |
| 2016/17 | 2819                        | 2024 (71.8)                                      | 298.9                                         | 16.7                                        |
| 2017/18 | 2793                        | 2038 (73.0)                                      | 287.2                                         | 16.4                                        |
| Grand total | 25,264                    | 15,839 (62.7)                                     | 300.3                                         | 15.9                                        |

Note. ED = Emergency Department; RACFs = Residential Aged Care Facilities.

The majority of ED injury presentations were due to falls ($n = 20,833, 82.5\%)$. Most injuries were recorded as unintentional ($n = 23,179, 91.7\%)$. Fracture was the most common type of injury among RACFs residents ($n = 8,591, 34.0\%$), followed by open wounds ($n = 4,428, 17.5\%$) and superficial injury ($n = 3,798, 15.0\%$) (Table 3).

Fractures were more frequent among females ($n = 6,603, 37.1\%$ vs. $n = 1,988, 26.6\%$), while open wound was more frequent in males ($n = 1,605, 21.5\%$ vs. $n = 2,823, 15.9\%$). Dislocation, sprain and strain comprised 10.9\% of all injury types ($n = 2742$). Head/face/neck ($n = 8,442, 33.4\%$) and lower limbs ($n = 8,366, 33.1\%$) were the most frequent injury locations. Almost, 5% of injuries occurred in multiple regions of body ($n = 1375$) (Table 3).

Almost 63% of ED injury presentations ($n = 15,839$) required admission to hospital for treatment (Table 1). The
rate of admissions was significantly greater in females \((n = 11,330, 63.7\% \text{ vs. } n = 4,509, 60.3\%, P<.0001)\) (Table 2). The proportion of ED presentations that were subsequently admitted to hospital increased over time \((4.0\% \text{ per year, } P<.0001)\), modelled adjusting for age group and sex.

| Gender | Males | Females |
|--------|-------|---------|
| Age (years) | | |
| 65–74 | 830 (11.1) | 934 (5.3) |
| 75–84 | 2572 (34.4) | 4539 (25.5) |
| ≥85 | 4072 (54.5) | 12,317 (69.2) |
| Sub total male | 7474 (29.6) | 17,790 (70.4) |

Note. ED = Emergency Department; RACFs = Residential Aged Care Facilities.

Discussion

This study examined the frequency and nature of injury-related ED presentations among Victorian RACFs residents between 2008 and 2018. Our findings showed a slight decrease in the rate of ED presentations per Victorian population per year over 10 years, whereas the annual rate of presentations per RACF bed days showed a 6% increase. ED presentations were more common in females and increased with older age irrespective of gender. The most common injuries were from unintentional falls resulting in fractures. Over 10 years, the annual proportion of ED presentations admitted to hospital was significantly increased.

Despite slight changes in the rate of ED presentations among RACFs residents over a 10-year period, the rate of subsequent hospital admissions increased by over 22%. A previous study showed that within 1 year, over half of the presentations to six EDs in New South Wales, Australia, by RACFs residents were admitted to hospital \((\text{Arendts et al., 2012})\). In the present study, RACFs residents aged ≥85 years accounted for the highest rates of ED injury presentations. A 26% increase in ED presentations in people aged ≥85 years was reported in a previous study, which was significantly greater than individuals aged 65–85 years \((\text{Burkett et al., 2017})\).

Falls are common among aged population living in RACFs and sometimes result in serious injuries and death \((\text{Rapp et al., 2012})\). Consistent with the existing literature \((\text{Gruneir et al., 2010; Jacobs et al., 2018})\), falls-related injuries such as fracture were the leading cause of ED injury visits and hospitalizations among RACFs residents. The rate of falls, fall-related injuries and hospitalizations was higher in RACFs residents than those residing in the community \((\text{Australian Institute of Health and Welfare, 2019; Harvey et al., 2017})\).

Considering the high costs of ED visits and or hospitalization, as well as, the long-term health implications associated with injuries, developing strategies to prevent falls is of great importance. In addition, ED and hospital settings are a challenging and stressful environment for frail older people especially those with multiple chronic comorbidities which put them at risk of iatrogenic disease and poor health outcomes \((\text{Sanon et al., 2019})\). Preventive strategies that reduce injuries, ED visits and hospital admissions are vital to address the cascade of adverse health outcomes. Effective prevention strategies that reduce the risk of falls in RACFs include exercise and resistance training interventions \((\text{Hewitt et al., 2018; Sherrington et al., 2017})\). A recent systematic review and meta-analysis showed that multifactorial programmes such as falls risk assessment, medication review, environmental assessment, exercise and staff education reduce the number of falls in residential aged care settings \((\text{Gulka et al., 2020})\).

In addition, high quality ED-based care services, focusing on older patients with the greatest needs, may reduce ED revisits and subsequent hospitalizations. Geriatric Emergency Department Intervention \((\text{GEDI})\) is an innovative model of care for elderly people. GEDI is a multidisciplinary team-led, patient-centred care ED intervention, developed to improve the care of frail elderly people presenting to the ED. This model of care is associated with a decreased ED length of stay, lower rate of hospitalizations and reduced health-care cost \((\text{Sanon et al., 2019; Wallis et al., 2018})\). The results of this study appear counter-intuitive. First, the growth in the rate of injuries remains small despite RACFs residents having
Table 3. Injury Causes and Types and Body Regions Injured in Residential Aged Care Facilities Residents ≥65 years in Victoria, by Sex, 2008–2018.

| Cause                                | Male n (%) | Female n (%) | Total n (%) |
|--------------------------------------|------------|--------------|-------------|
| Fall                                 | 6031 (80.7)| 14,802 (83.2)| 20,833 (82.5)|
| Other or undetermined intent         | 541 (7.2)  | 1283 (7.2)   | 1824 (7.2)  |
| Unspecified unintentional            | 232 (3.1)  | 565 (3.2)    | 797 (3.2)   |
| Other specified unintentional        | 262 (3.5)  | 405 (2.3)    | 667 (2.6)   |
| Hit/struck/crush                      | 155 (2.1)  | 336 (1.9)    | 491 (1.9)   |
| Poisoning                            | 40 (0.5)   | 92 (0.5)     | 132 (0.5)   |
| Intentional inflicted by other        | 46 (0.6)   | 51 (0.3)     | 97 (0.4)    |
| Cutting/piercing                     | 29 (0.4)   | 66 (0.4)     | 95 (0.4)    |
| Medical injury – all                  | 48 (0.6)   | 41 (0.2)     | 89 (0.4)    |
| Foreign body – natural orifice        | 32 (0.4)   | 51 (0.3)     | 83 (0.3)    |
| Intentional self-inflicted            | 30 (0.4)   | 45 (0.3)     | 75 (0.3)    |
| Fires/burns/scalds                    | 7 (0.1)    | 15 (0.1)     | 22 (0.1)    |
| Natural/environment/animals           | 7 (0.1)    | 11 (0.1)     | 18 (0.1)    |
| Transport                             | 6 (0.1)    | 10 (0.1)     | 16 (0.1)    |
| Machinery                             | *          | *            | *           |
| Choking/suffocate                     | *          | *            | *           |
| Drowning/near drowning                | *          | *            | *           |
| Explosions/firearms                   | *          | *            | *           |
| Recorded intent                       |            |              |             |
| Unintentional                         | 6809 (91.1)| 16370 (92.0) | 23,179 (91.7)|
| Other and undetermined intent         | 589 (7.9)  | 1324 (7.4)   | 1913 (7.6)  |
| Assault, maltreatment and neglect     | 46 (0.6)   | 51 (0.3)     | 97 (0.4)    |
| Intentional self-harm                 | 30 (0.4)   | 45 (0.3)     | 75 (0.3)    |
| Body region                           |            |              |             |
| Head/face/neck                        | 2945 (39.4)| 5497 (30.9)  | 8442 (33.4) |
| Lower extremity                       | 2105 (28.2)| 6261 (35.2)  | 8366 (33.1) |
| Upper extremity                       | 960 (12.8) | 2891 (16.3)  | 3851 (15.2) |
| Trunk                                 | 690 (9.2)  | 1444 (8.1)   | 2134 (8.5)  |
| Multiple body regions                 | 411 (5.5)  | 964 (5.4)    | 1375 (5.4)  |
| Unspecified body region               | 236 (3.2)  | 505 (2.8)    | 741 (2.9)   |
| Body region not relevant              | 127 (1.7)  | 228 (1.3)    | 355 (1.4)   |
| Injury type                           |            |              |             |
| Fracture                              | 1988 (26.6)| 6603 (37.1)  | 8591 (34.0) |
| Open wound                            | 1605 (21.5)| 2823 (15.9)  | 4428 (17.5) |
| Superficial injury                    | 1199 (16)  | 2599 (14.6)  | 3798 (15.0) |
| Other and unspecified injury          | 1249 (16.7)| 2430 (13.7)  | 3679 (14.6) |
| Dislocation, sprain and strain        | 768 (10.3) | 1974 (11.1)  | 2742 (10.9) |
| Intracranial injury                   | 283 (3.8)  | 508 (2.9)    | 791 (3.1)   |
| Injury to muscle and tendon           | 178 (2.4)  | 449 (2.5)    | 627 (2.5)   |
| Poisoning or toxic effects            | 61 (0.8)   | 137 (0.8)    | 198 (0.8)   |
| Foreign body                          | 34 (0.5)   | 60 (0.3)     | 94 (0.4)    |
| Injury to blood vessels                | 27 (0.4)   | 64 (0.4)     | 91 (0.4)    |
| Injury to internal organs             | 34 (0.5)   | 29 (0.2)     | 63 (0.2)    |
| Crushing injury                       | 13 (0.2)   | 45 (0.3)     | 58 (0.2)    |
| Eye injury- excluding foreign body    | 17 (0.2)   | 36 (0.2)     | 53 (0.2)    |
| Burns                                 | 8 (0.1)    | 14 (0.1)     | 22 (0.1)    |
| Other and unspecified effects of external causes | * | * | * |
| Injury to nerves and spinal cord      | *          | *            | *           |
| Traumatic amputation                  | *          | *            | *           |
| Total number of injuries              | 7,474      | 17,790       | 25,264      |

Note. * number less than 10.
increasing frailty. Second, growth in the rate of hospitalization is substantial despite an environment of greater constraints in health-care resource and promotion of hospital substitution programmes. Potential explanations for the increasing hospital admission rates are that the severity of injuries has worsened or the ability of RACFs to manage post-injury care of residents has declined. Alternatively, there could be more clinical interventions available for older people requiring hospitalization or changing expectations of where care is delivered following injury should be in the hospital.

**Strengths and Limitations**

The results of this study are potentially generalizable to jurisdictions in other states and territories in Australia, as the health and aged care systems are similar. However, transferring these findings to jurisdictions in rural and remote areas should be done with caution. Our findings may be generalizable to high-income countries with similar characteristics in population, health and aged care systems. The results are not transferable to the population of older people who are community dwellers due to differences in demographics, comorbidities, frailty and functional status compared with the RACFs residents.

Limitations are inherent to using a routine administrative data source and include under-reporting, misclassification, missing data, overestimation and inconsistencies in data collection. Strengths of this study were the novelty of research evaluating the ED injury presentations among RACFs residents over a 10-year period throughout the state of Victoria and including the whole population of hospitals.

**Implications**

Results of this study have important implications for the healthcare policy and research and contribute to existing body of research. In contrast with previous studies on RACFs residents our study includes the whole population of a jurisdiction, over a 10 year period, using uniform, standardized data sources investigating health care outcomes. The high number of injuries in RACFs residents is an emerging challenge for caregivers, health-care providers, administrators and policy makers. Understanding the patterns of ED visits will inform designing effective interventions addressing RACFs special needs and safety to prevent incidents and subsequent injuries. This study highlights the need to design specialized emergency care services and/or providing direct access to hospital care for this vulnerable population. Changes are needed to deliver an optimal care and mitigate the risk and burden of injuries. Further studies are required to inform development of new models of emergency care and service delivery for RACFs residents to reduce morbidity, mortality and health-care utilization.

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