Use of emergency departments by older people from residential care: a population based study

SHARYN L. INGARFIELD1, JUDITH C. FINN2,3, IAN G. JACOBS1, NICHOLAS P. GIBSON1, C. D’ARCY J. HOLMAN2, GEORGE A. JELINEK1, LEON FLICKER4

1Emergency Medicine, School of Primary, Aboriginal and Rural Health Care, The University of Western Australia, Australia
2School of Population Health, The University of Western Australia, Australia
3Centre for Nursing Research, Sir Charles Gairdner Hospital, Australia
4Western Australian Centre for Health & Ageing, The University of Western Australia, Australia

Address correspondence to: Judith C Finn. Tel: (+61) 8 6488 7375; Fax: (+61) 8 6488 1188. Email: judith.finn@uwa.edu.au

Abstract

Objective: to investigate the differences between emergency department (ED) presentations of older people who do and do not live in residential care facilities (RCFs).

Design: a population-based retrospective cohort study. ED records linked to ambulance and hospital morbidity records.

Setting: public EDs in Perth, Western Australia.

Subjects: all patients 65 years and older who presented to EDs between 1 January 2003 and 31 December 2006 (n = 97,161).

Measurements: patient demographic and clinical characteristics. Logistic regression was used to model the effect of living in RCFs on the likelihood of a particular ED diagnosis, hospital admission and in-hospital death.

Results: the age–sex standardised rate of ED presentation for those living in RCFs was 1.69 times that of community dwellers. Compared to community dwellers, people from RCFs were older (mean age 84.7 years vs. 76.0 years, P < 0.001) and a lower proportion were male (28.7% vs. 46.7%, P < 0.001). Adjusting for age and sex revealed that people from RCFs were more likely to be diagnosed with pneumonia/influenza (OR 1.94, 95% confidence interval (CI) = 1.72–2.19), urinary tract infections (OR 1.72, 95% CI 1.49–1.98) or hip fractures (OR 1.16, 95% CI 1.03–1.32); less likely to be diagnosed with circulatory system diseases (OR 0.69, 95% CI 0.64–0.75) or neoplasms (OR 0.47, 95% CI 0.31–0.72); more likely to be admitted (OR 1.13, 95% CI 1.06–1.20) and to die in hospital (OR 1.57, 95% CI 1.40–1.75).

Conclusion: there are different patterns of ED presentations and hospital admissions of older people who do and do not live in RCFs. The appropriateness of these differences is uncertain.

Keywords: emergency medicine, aged, residential facilities, elderly

Introduction

Population ageing has major implications for the delivery of health care and support services. Older Australians (those over 65 years) have higher rates of hospital admission and longer hospital stays than the general population [1]. Also, an increasing number of older people live in residential aged care facilities (RCFs). In Australia, these facilities, which are subsidised and licensed by government, may offer high or low levels of care, or a combination, and were previously known as nursing homes and hostels (assisted living facilities). In 2006 in Australia, there were 151,737 permanent residents in aged care compared with 131,170 in 1998, a 16% increase [2]. Furthermore, in 2006, 69% required ‘high care’ which had risen from 58% in 1998 [2].

There is limited evidence from other countries that people living in RCFs utilise hospital services more frequently than other older people, with up to twice the hospitalisation rates [3] and a longer average length of hospital stay [4]. Further, hospital admissions of people in RCFs may be more likely for pneumonia or hip fracture and less likely for cardiovascular or neoplastic disease [4]. The few Australian studies have focussed on small numbers of patients from RCFs presenting at single institutions and have not included comparison groups [5,6]. The lack of information at the population level reflects a lack of data systems that link hospital and residential care data.

The Emergency Care, Hospitalisation and Outcomes Study [7] links Western Australian (WA) data from the Emergency Department Information System (EDIS) to the St John Ambulance (SJA) Patient Care database and the Hospital Morbidity Data System (HMDS). Using the ambulance records to identify patients transferred from RCFs and the links to the other population-based data sets, we compared
the characteristics of emergency department (ED) presentations and outcomes of older people living in RCFs and those living in the community.

Methods

This was a retrospective cohort study that used an extract of EDIS linked to the SJA database and the HMDS. The extract contained all ED records from the eight Perth public hospital EDs, of patients presenting between 1 January 2003 and 31 December 2006.

Data linkage

Probabilistic matching identified all ambulance and EDIS records relating to the same individual [8]. A pair of ambulance and EDIS records was then accepted as relating to the same episode of care if the same hospital was recorded in both records and the destination arrival time in the ambulance record was within 2 h either side of the presentation time in the EDIS record.

The Western Australian Data Linkage Unit also used probabilistic matching to link EDIS to HMDS records [8]. If the admission time in the morbidity record was after the ED presentation time and within 2 h of the ED departure time, then we accepted that the morbidity and ED records related to the same episode of care. In cases where the dates and times matched but the hospitals did not, we assumed that an inter-hospital transfer occurred and the morbidity record was still accepted as an admission following that ED presentation.

Cohort selection

Patients aged 65 years or older who presented in 2003–06 at one of Perth’s public hospital EDs formed the study cohort. The cohort was restricted to the first ED attendance during this time period to avoid the problems of a correlated data set with multiple attendances per patient.

Patients from RCFs could not be identified reliably from EDIS or HMDS records. We therefore identified patients from the ambulance records, assuming that those residing in RCFs would be transported to the ED by ambulance. The ambulance database recorded the type of facility and its address in a ‘transfer from’ field, as well as the patient’s residential address. If the ‘transfer from’ address matched the residential address, then we classified the patient as living in a RCF.

Data analysis

The EDIS data included patient characteristics at presentation, diagnoses coded to ICD-10 and instances of death in the ED. The HMDS data included length of hospital stay and instances of in-hospital death.

The data were analysed using the SPSS statistical package, version 16.0.1 (SPSS Inc., Chicago, IL, USA). We compared categorical outcome variables using a χ² test and continuous variables using Student’s t-test or the Mann–Whitney U test. Logistic regression modelled the effect of living in a RCF on the likelihoods of an ED diagnosis of injury (ICD codes S00-S99, T00-T14), hip fracture (ICD code S72), pneumonia/influenza (ICD codes J10-J18), urinary tract infection (ICD code N39.0), neoplasms (ICD codes C00-C96, D00-D48) or diseases of the circulatory system (ICD codes I00-I99), after controlling for age, sex and their interaction if significant. The likelihoods of hospital admission and in-hospital death were modelled controlling for age, sex and ED diagnosis of injury, pneumonia/influenza and diseases of the circulatory system. All significant covariates at univariate analysis were directly entered in the multivariate model. A Box-Tidwell term (age × ln[age]) [9] accounted for non-linearity in the effect of age. Unadjusted and adjusted odds ratios (ORs) are reported with 95% confidence intervals (CIs).

Age- and sex-adjusted rates for the RCF and non-RCF groups were calculated by the direct standardisation method using the 2001 Australian population [10] as the standard. For each age and sex stratum, the number of people in RCFs in Perth was estimated from 2002 figures (personal communication, Commonwealth Department of Health and Ageing, 2002) as more recent numbers were not available. The number of people not in RCFs was calculated by subtracting the number of people in RCFs from the estimated Perth population for 2002 [11]. CIs for the adjusted rates were calculated using a normal approximation and standard errors by the method described by Breslow and Day [12]. Average annual rates are reported per 100,000.

Results

A total of 97,161 patients aged 65 years or older who presented to the ED of the study hospitals during 2003–2006 were included in the study. Of these, 6,167 (6.3%) were living in a RCF.

Characteristics of patients

Two RCF patients and 740 non-RCF patients were dead on arrival at the ED and 23 non-RCF patients were triaged as direct admissions. Excluding these two types of presentations, of the 6,165 RCF patients, 17.2% were triaged to receive immediate resuscitation (category 1, Australasian Triage Scale) or other emergency care (category 2), 80.3% were triaged as urgent (category 3) or semi-urgent (category 4) and 2.5% were triaged as non-urgent (category 5). Of the 90,231 non-RCF patients, 22.6% were triaged into categories 1–2, 73.6% into categories 3–4 and the remaining 3.7% into category 5.

The RCF and non-RCF sub-cohorts differed in a number of other characteristics, as shown in Table 1. RCF patients were older compared to non-RCF patients (mean age 84.7 years, vs. 76.0 years, P < 0.001) and a larger percentage of RCF patients died in hospital (7.8% vs. 3.5%, P < 0.001). Of those alive at ED discharge, 65.0% of the RCF patients and 54.5% of the non-RCF patients were admitted to hospital (P < 0.001). A lower percentage of RCF patients had single-day admission (17.1% vs. 22.8%).
and diseases of the circulatory (17.2%), digestive (7.8%) and signs and abnormal clinical and laboratory findings (17.5%) diagnoses related to injuries (23.8%) followed by symptoms, signs, and abnormal clinical and laboratory findings (12.9%) and diseases of the circulatory (12.5%), respiratory (11.5%) and digestive (7.4%) systems. Hip fracture was the most common diagnosis in the injury category.

Similar diagnoses were recorded for the non-RCF patients. An ED diagnosis was recorded in 84,954 (93.4%) records of non-RCF patients. Of these, the most frequent diagnoses related to injuries (23.8%) followed by symptoms, signs and abnormal clinical and laboratory findings (12.9%) and diseases of the circulatory (12.5%), respiratory (11.5%) and digestive (7.4%) systems. Hip fracture was the most common diagnosis in the injury category.

Age and sex standardised rates

The age–sex standardised rate of ED presentation for those living in RCFs was 1.69 times that of community dwellers (Table 2). Adjusted rates of injury, hip fracture, pneumonia/influenza and urinary tract infection were higher, and circulatory system diseases and neoplasms were lower for people in RCF than for those in the general community (Table 2).

Logistic regression results

After controlling for the effects of age and sex, RCF patients were less likely to be diagnosed with circulatory system diseases or neoplasms. In contrast, RCF patients were more likely to be diagnosed with pneumonia/influenza, urinary tract infections or hip fracture than non-RCF patients (Table 3). However, after adjusting for sex, the odds ratio for being diagnosed with hip fracture for RCF patients decreased as age increased (65–74 years, 2.9% vs. 1.1%, OR 2.70, 95% CI 1.67–4.35; 75–84 years, 5.7% vs. 3.0%, OR 1.80, 95% CI 1.47–2.20; 85+ years, 6.7% vs. 6.3%, OR 0.99, 95% CI 0.85–1.16).

After controlling for the effects of age, sex and a diagnosis of injury, pneumonia/influenza or diseases of the circulatory system, RCF patients were more likely to be admitted and die in hospital than non-RCF patients (OR 1.13, 95% CI 1.06–1.20; OR 1.57, 95% CI 1.40–1.75, respectively).

Discussion

The known predictors of placement in RCFs include chronic illness associated with cognitive and physical impairment [13–15]. Therefore, it is not surprising that in our study, older residents from RCFs had a higher rate of ED presentation than community dwellers. Further, logistic regression showed that those from RCFs had a higher degree of morbidity indicated by a higher likelihood of hospital admission and in-hospital death.

Differences in rates of particular ED diagnoses between RCF and non-RCF groups were evident and, even when performing logistic regression analysis on the cohort, the differences in diagnostic categories persisted. It was reassuring that both methods of analysis indicated similar patterns of difference in ED diagnoses between the two groups, although the magnitude of the differences varied.

Recent data from the Australian Institute of Health and Welfare show that while diseases of the circulatory system are the most common principal diagnoses in older people admitted to hospital, this diagnosis is less frequent in those admitted from RCFs [16]. An earlier American study found similar results [4]. In our study, which included non-admitted and admitted patients, those from RCFs had a lower likelihood of an ED diagnosis relating to circulatory system disease. The reasons for this are unclear. It is unlikely that older people in RCFs have a lower incidence of these diseases. Possible explanations include acute onset of symptoms and a higher incidence of death occurring before transfer to ED, or RCF staff adopting a less intensive approach, with these conditions managed by the residents’ general practitioners within the facility. Finally, residents of aged care facilities, often with severe cognitive impairment, may not complain of symptoms to the same degree as community dwelling individuals and the signs may not be as obvious as with other diseases such as respiratory infections. Further investigation is needed to determine whether appropriate and sufficient medical care is in place to identify and manage these types of conditions in the residential care environment.

Pneumonia/influenza was diagnosed twice as frequently in patients presenting to EDs from RCFs as in those from the general community. This may reflect a higher degree of morbidity in RCFs or a higher likelihood of contact with RCF staff. It may also be that RCF staff are more aware of the diagnosis or more likely to record it.

Table 1. Comparison between RCF patients and non-RCF patients, by patient characteristic and outcome

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<th>RCF patients</th>
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<tr>
<td>Mean age in years ± standard deviation</td>
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<td>Number of men (%)</td>
<td>1/76 (28.7)</td>
<td>42.481 (46.7)*</td>
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<td>Nighttime presentations (6 pm–6 am) (%)</td>
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*Difference between RCF and non-RCF patients.

Proportions based on number of patients minus those dead on arrival at ED.

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aSex not documented in seven cases.

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Hospital use by people in residential care

Table 2. Estimated age and sex standardised average annual rates of ED presentations and ED diagnoses for those people aged 65 years and older in Perth living in RCFs and those living in the general community (per 100,000)

<table>
<thead>
<tr>
<th>ED presentation/diagnosis</th>
<th>RCF (95% CI)</th>
<th>Non-RCF (95% CI)</th>
<th>Ratio of adjusted rates RCF/non-RCF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any ED presentation</td>
<td>23,918 (22,370–25,498)</td>
<td>14,190 (14,097–14,285)</td>
<td>1.69</td>
</tr>
<tr>
<td>Injury</td>
<td>4,338 (3,706–4,983)</td>
<td>2,635 (2,595–2,676)</td>
<td>1.65</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>836 (607–1,076)</td>
<td>369 (354–385)</td>
<td>2.27</td>
</tr>
<tr>
<td>Circulatory system diseases</td>
<td>2,142 (1,753–2,538)</td>
<td>2,280 (2,243–2,318)</td>
<td>0.94</td>
</tr>
<tr>
<td>Pneumonia–influenza</td>
<td>1,723 (1,286–2,169)</td>
<td>421 (405–437)</td>
<td>4.09</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>1,049 (726–1,380)</td>
<td>281 (268–295)</td>
<td>3.73</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>68 (34–102)</td>
<td>157 (147–167)</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table 3. Logistic regression analysis of the likelihood of a particular ED diagnosis for RCF versus non-RCF patients

<table>
<thead>
<tr>
<th>ED diagnosis</th>
<th>RCF patients (n = 5,783) (%)</th>
<th>Non-RCF patients (n = 84,215) (%)</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury</td>
<td>1,379 (23.8)</td>
<td>16,660 (19.8)</td>
<td>1.27 (1.19–1.35)</td>
<td>1.02 (0.95–1.09)</td>
</tr>
<tr>
<td>Hip fracture</td>
<td>345 (6.0)</td>
<td>2,200 (2.6)</td>
<td>2.37 (2.10–2.66)</td>
<td>1.16 (1.03–1.32)</td>
</tr>
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<td>Circulatory system diseases</td>
<td>723 (12.5)</td>
<td>14,617 (17.4)</td>
<td>0.68 (0.63–0.74)</td>
<td>0.69 (0.64–0.75)</td>
</tr>
<tr>
<td>Pneumonia–influenza</td>
<td>377 (6.5)</td>
<td>2,671 (3.2)</td>
<td>2.13 (1.91–2.38)</td>
<td>1.94 (1.72–2.19)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>261 (4.5)</td>
<td>1,759 (2.1)</td>
<td>2.22 (1.94–2.53)</td>
<td>1.72 (1.49–1.98)</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>24 (0.4)</td>
<td>1,023 (1.2)</td>
<td>0.34 (0.27–0.51)</td>
<td>0.47 (0.31–0.72)</td>
</tr>
</tbody>
</table>

*Records with missing sex, missing ED diagnosis and records of those dead on arrival were excluded from the logistic regression analysis.

vaccinated against influenza but only ~25% against pneumococcal disease [18]. However, the survey was conducted prior to the introduction of the National Pneumococcal Vaccination Program for older Australians in 2005, so higher immunisation rates for pneumococcal disease are now likely. Continued surveillance of immunisation rates is needed along with monitoring the effectiveness of relevant vaccines in the older and chronically ill population.

Injury was the most common ED diagnosis in both groups of patients studied, but the higher frequency in patients from RCFs was probably due to their older age as the rate of fracture hospitalisation had been shown to increase from around 65 years of age [19]. Patients from RCFs were more likely to be diagnosed with hip fracture than those from the community, but the difference found was not as large as in other studies [20, 21]. Possible explanations are the different type of RCF population in our study, which consisted of a mixture of low and high care dependent patients, or our more stringent adjustment for the non-linear effect of age. It is also likely that RCF staff do not refer patients to hospital with less severe injuries. Of interest is our finding that as age advances the effect of living in residential care on the occurrence of hip fractures decreases. This has also been suggested by others [20, 21].

Diagnoses coded to neoplasms were uncommon reasons for presenting to the ED. However, after controlling for age and sex, those from RCFs were around one-half as likely to have this diagnosis. It would be useful to determine if the reasons for presentation were for complication of the underlying illness or for control of symptoms such as pain management. The latter could be undertaken in RCFs as part of normal care thus avoiding the necessity for ED assessment. It is also likely that neoplastic disease is treated less aggressively in patients residing in RCFs because of those patients considerable co-morbidity.

Our study has some limitations. To identify our patients of interest, we assumed that all patients from RCFs were transported to the ED by ambulance. However, it is possible that a small number of patients from low care facilities arrived by other transport. If this were the case, then their low care status would only serve to dilute the differences observed between the RCF and non-RCF groups. It was impossible to determine the level of care classification for the RCF patients because it is common for RCFs to provide both low and high care places. We might expect that some differences would be seen in older people with differing levels of care dependence.

Despite these limitations, this study highlighted differences between ED presentations and outcomes of older people living in RCFs and those living in the community. The next step is to investigate why these differences exist, including whether there are adequate resources and appropriate organisation of health care for those older members of our community living in RCFs.

**Key points**

- For older people who present to EDs in public hospitals, those from residential care were older and more likely to be female than those from the community.
- Even after adjustment for these factors those from residential care had a different pattern of presentations—they were more likely to be diagnosed with pneumonia/influenza, urinary tract infections and hip fractures and less likely to be diagnosed with circulatory system...
diseases and neoplasms. They were more likely to be admitted to hospital and die there.

- Whether these differences in care practices are appropriate, or represent under-treatment of those older people from residential care, is unknown.

**Conflicts of interest**

The authors have no financial, personal or other conflicts of interest to report.

**Funding**

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**Ethical approval**

We had ethical approvals from the Western Australian Confidentiality of Health Information Committee and the Human Research Ethics Committee of The University of Western Australia.

**References**

11. Epidemiology Branch, HIC, Department of Health Western Australia. Rates calculator (version 9.3.1).

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