A longitudinal cohort study evaluating the impact of a geriatrician-led residential care outreach service on acute healthcare utilisation

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Abstract

Background: over the last decade, high demand for acute healthcare services by long-term residents of residential care facilities (RCFs) has stimulated interest in exploring alternative models of care. The Residential Care Intervention Program in the Elderly (RECIPE) service provides expert outreach services to RCFs residents, interventions include comprehensive care planning, management of inter-current illness and rapid access to acute care substitution services.

Objective: to evaluate whether the RECIPE service decreased acute healthcare utilisation.

Design: a retrospective cohort study using interrupted time series analysis to analyse change in acute healthcare utilisation before and after enrolment.

Setting: a 300-bed metropolitan teaching hospital in Australia and 73 RCFs within its catchment.

Subjects: there were 1,327 patients enrolled in the service with a median age of 84 years; 61% were female.

Methods: data were collected prospectively on all enrolled patients from 2004 to 2011 and linked to the acute health service administrative data set. Primary outcomes change in admission rates, length of stay and bed days per quarter.

Results: in the 2 years prior to enrolment, the mean number of acute care admissions per patient per year was 3.03 (SD 2.9) versus post 2.4 (SD 3.3), the service reducing admissions by 0.13 admissions per patient per quarter ($P = 0.046$). Prior to enrolment, the mean length of stay was 8.6 (SD 11.0) versus post 3.5 (SD 5.0), a reduction of 1.5 days per patient per quarter ($P = 0.003$).

Conclusions: this study suggests that an outreach service comprising a geriatrician-led multidisciplinary team can reduce acute hospital utilisation rates.

Keywords: geriatrician outreach teams, aged care nursing, nursing outreach, residential aged care facilities, advance care plans, acute healthcare utilisation, acute healthcare substitution services, older people

Introduction

Over the last decade, high demand for acute healthcare services by long-term residents of residential care facilities (RCFs) has stimulated interest in exploring alternative models of care for this patient population [1, 2]. One Australian study found that RCF residents made up $\approx 18\%$ of the over 65-year-old age group presenting to emergency department (ED) [3]. RCF residents have been found to have the highest population-attributable risk of 30-day readmission (12.9%) [4], and a previous study by our group found 6-month readmission rate of 40% [5]. High ED usage and subsequent hospitalisation may also place residents at increased risk of complications and adverse events [6]. The reported proportion of potentially avoidable ED presentations by RCF residents ranges from 13 [3] to 23% [6], with
the top four reasons for presentation being chronic heart failure (23%), dehydration (13%), chronic obstructive pulmonary disease (6%) and cardiac arrhythmias (5%) [7]. A lack of early intervention for acute inter-current illness has also been identified as a factor influencing the high demand for acute care [6, 8].

Health service evaluations have shown that interventions to structure and standardise clinical practice in RCFs [9] and increased access to expert aged care clinicians can decrease acute care transfer [10, 11]. In contrast, condition-specific interventions have not resulted in the same decreases in acute care demand [11]. This difference may reflect illness complexity in frail, older adults such that a holistic approach to care is more effective. Interventions that improve access to primary care management of inter-current illness may also decrease the need for ED transfer [12, 13]. High mortality rates among recently hospitalised RCF residents highlight the need for better access to RCF-based palliative care services; however, a lack of trained staff has been reported to be a barrier to widespread implementation of a palliative care approach in RCFs [5, 8, 14–17].

The Residential Care Intervention Program in the Elderly (RECIPE) service was established in 2002, to provide expert comprehensive assessment and management by geriatricians and aged care nurse specialists to RCF residents who are at imminent risk of requiring acute care management. The aim of the service is to provide residents with a choice to have optimal care within their own home, thereby decreasing ED transfers and the need for inpatient admission. Patients receive a tailored care plan including advanced care planning (ACP) and a written advanced directive (AD) if appropriate. Once enrolled, patients were offered additional visits for management of inter-current illness as required. In 2002, a comprehensive health service evaluation demonstrated that it was feasible and acceptable to provide a post-discharge outreach service to RCF residents [5]. Due to the small sample size, this initial study was not able to demonstrate a reduction in acute care utilisation following service enrolment. To address this gap in the evidence, we conducted a retrospective cohort study to evaluate whether the RECIPE service decreased acute healthcare utilisation.

Methods

Study design

A retrospective cohort study evaluating the long-term impact of a geriatrician-led, multidisciplinary model of care for patients in RCF on acute health utilisation using interrupted time series analysis techniques. Ethics approval was obtained from the institutional human research ethics committee. The RECIPE team consists of specialist geriatricians and aged care nurses and has the capacity to make referrals to other clinical disciplines such as palliative care and allied health as required (Figure 1).

Subjects

There were 1,327 patients enrolled in the service from September 2004 to June 2011 who were included in this analysis.

Setting

Northern Health is a 300-bed, outer metropolitan teaching hospital catering for a community of ~728,000 people in Victoria, Australia. The RECIPE provided outreach services to a total of 73 RCFs within the health service catchment.

Outcomes

The primary outcome for this study was within patient change in acute healthcare utilisation following enrolment in the RECIPE service. Acute healthcare utilisation was measured by mean admission rate per patient, mean length of stay (LOS), mean annual bed days per patient and time from enrolment to first readmission. Secondary outcome measures were patient mortality and the impact of patient age, sex and co-morbidity scores on mortality and acute healthcare utilisation.
Measures

Data were collected prospectively on all enrolled patients, and data linkage was performed between the RECIPE service data set and the acute health service administrative data set (Victorian Admitted Episodes Dataset (VAED) to obtain data on all ED attendances and acute inpatient admissions between 2002 and 2013). At a patient level, ED attendance rates, inpatient admission rates, LOS and total annual bed days were calculated for the 2 years prior to enrolment in the RECIPE service and for 4-year post-enrolment, or until the patient died or was lost to follow-up. Data were collected on date of death or last date of contact with the health service (ambulatory care or inpatient care) from all health service data sets. To measure trends in acute health utilisation over time, utilisation rates per patient were calculated per quarter (quarters 1–8 refer to pre-enrolment and quarter 9 onwards post-enrolment).

Co-morbidities

Administrative data were used to classify patients’ primary reasons for enrolment according to ICD-10 codes [18]. The Charlson comorbidity index (Charlson) [19] and the Elixhauser comorbidity scores [20] were calculated based on primary and secondary ICD-10 diagnoses codes from acute care admissions in the 2 years prior to enrolment [21]. For regression analysis, the Charlson index was dichotomised (0 or 1 versus 2), and age was dichotomised at the cohort median of 84 years.

Statistical analysis

Categorical data were summarised using means and percentages and continuous data using mean, standard deviation (SD) and range. Cox proportional hazards regression models were used to determine whether age, sex or comorbidity status was predictive of patient survival. Interrupted time series was used to analyse change in acute healthcare utilisation over time and whether there were any statistically significant changes in these trends following RECIPE enrolment. The study considered the mean number of inpatient admissions, bed days and LOS for each patient within each quarter over a 6-year period. Data for each patient were centred to consider a consistent profile of hospital utilisation, with the RECIPE enrolment date designated as the last day of the 8th quarter. Therefore, quarters 1–8 reflect the 2 years prior to enrolment and quarters 9–24 reflect the 4 years following enrolment. The trends only consider those patients known to be alive or in the health service catchment area at some point during each quarter. Since the precise date of entry to the community were not available for each individual, a 5-year look-back period from the RECIPE enrolment date was used to confirm the presence of the patient via an inpatient admission, ED attendance or outpatient appointment. If no prior encounters were identified, then the patient was not included in the count for that quarter, as it was assumed that the patient was not a resident at an aged care facility within the community at that time. Death dates were extracted from the hospital administrative databases. For those patients with no known date of death, the patient was not included in the quarter count unless they had an encounter in any of the following quarters. These assumptions would have the effect of increasing the rates of hospital utilisation, particularly in the early and later stages of the 6-year analysis period, thus potentially providing a conservative assessment of the impact of the RECIPE service. The changes in the proportions of three binary variables (Charlson Score ≥2, age >84 years and gender) were also considered to describe the case mix of patients within each quarter.

Auto-Regressive Integrated Moving Average (ARIMA) processes [22] were considered, although examination of autocorrelation and partial autocorrelation plots indicated no strong evidence of autocorrelation. The trends in average admissions and bed days indicated steady positive growth prior to the RECIPE service, with a steady increasing trend in LOS. Due also to the limited number of pre-RECIPE observations and lack of autocorrelation, simple interrupted time series analysis with no autoregressive or moving average processes was adopted. Akaike’s Information Criterion (AIC) and Bayesian Information Criterion (BIC) [23] were used to identify the model of best fit, with the aim to minimise the values of each of these criteria. Quarter 8 was excluded from the analysis to remove the short-term high rates of average admissions and bed days for patients in the 3-month period prior to enrolment in the RECIPE service. The variables of Charlson Score ≥2, age >84 years and gender were used to adjust the trends in hospital utilisation, to account for a higher proportion of patients with higher Charlson Score and age passing away in the quarters immediately following their enrolment in the RECIPE service. The impact of RECIPE was considered in both constant and trend (linear, log) formats to reflect the possibility of both an instantaneous shift and progressive increasing/decreasing change in average admissions, bed days or LOS following enrolment.

Statistical analyses were performed with Stata, version 12.1 (StataCorp, College Station, TX, USA), with a P value of <0.05 considered to indicate statistical significance.

Results

There were 1,327 patients enrolled in the service with a median age of 84 years; 61% were female. The average number of new patients enrolled each year between 2004 and 2011 was 167. The majority were referred to the service during an acute care admission and 1,139 (86%) had at least one ED attendance or inpatient admission to the local health service in the 2 years prior to enrolment (Figure 1). The other 188 (14%) of patients were referred from the community and enrolled in the RCF. The top 10 reasons for the index admission prior to enrolment were respiratory disorders and infections (23%), central nervous system disorders (13%), other infections (12%), cancer (4%), endocrine (7%), functional...
risk of mortality (Supplementary data, Figure S3 available in CI, 1.07 (Figure 2, Panel 1) and bed days (Panel 2) per patient per steep increase in the mean for inpatient admissions utilisation

Table 1 and quarterly utilisation patterns pre (quarters 1 association with the trend in mean admissions as well as improving the overall fit of the model.

The analysis identified an increasing rate in mean bed days of 0.535 per patient per quarter over the eight quarter period prior to enrolment (Figure 2, Panel 2). This equates to an increase of 2.14 bed days per patient per year. The service had a constant impact from quarter 9 onwards, reducing mean patient bed days by just over 4 bed days per quarter (P = 0.042). This equates to an average reduction in annual bed days per patient of 12 days. The inclusion of the Charlson and age variables was found to improve the overall fit of the model to the trend in mean bed days, despite each variable just failing to be statistically significantly (P values of 0.110 and 0.071, respectively).

The service was found to have a statistically significant impact on mean LOS from quarter 9 onwards (Figure 2, Panel 3), reducing LOS for each patient admission by just over 1.5 days per quarter (P = 0.003). The inclusion of the Charlson and age variables was found to be significantly associated with the trend in mean LOS, thus improving the overall fit of the model to the trend of mean LOS (P values of 0.020 and <0.001, respectively).

Discussion

This study demonstrates that a geriatrician-led outreach service for RCF patients who are at high risk of acute care readmission may have a sustained impact on acute healthcare utilisation. One of the key impacts was an observed reduction in the mean number of admissions and bed days per quarter which also included an observed reduction in the mean LOS per admission. This study confirms that a multifaceted model of care that includes disease management, ACP, rapid assessment services and acute care substitution services is associated with a decrease acute care demand by long-term RCF residents [24, 25].

The demographics and reasons for index admission were comparable to previous reports of healthcare utilisation by RCF residents in the Australian population [3, 26] with respiratory and other infections, trauma, hip fractures and functional decline being common. One aspect that contributed to the success of the RECIPE model of care was rapid access to medical and nursing review for management of acute inter-current illness [9, 11], this appears to have alleviated some of the problems associated with limited access to primary care physicians over extended hours. Enrolment in the RECIPE service also allowed patients to have rapid access to acute care substitution services which may have contributed to the decrease in acute care LOS [24–26].

Table 1. Baseline characteristics, survival and acute healthcare utilisation

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1327</td>
</tr>
<tr>
<td>Age (years) at referral (Mean (SD))</td>
<td>84 (SD = 8.01)</td>
</tr>
<tr>
<td>Gender Male (M): Female (F)</td>
<td>M 513 (39%): F 814 (61%)</td>
</tr>
<tr>
<td>Charlson Score</td>
<td>2.14 (SD = 2.38)</td>
</tr>
<tr>
<td>Elixhauser Score</td>
<td>8.05 (SD = 8.33)</td>
</tr>
<tr>
<td>Died during Follow-up (N %)</td>
<td>968 (73%)</td>
</tr>
<tr>
<td>Survival time (days) (Mean (SD))</td>
<td>311 (SD = 382)</td>
</tr>
<tr>
<td>Died in hospital (N %)</td>
<td>262 (20%)</td>
</tr>
<tr>
<td>Deceased (average age)</td>
<td>85 (SD = 7.62)</td>
</tr>
</tbody>
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Acute healthcare utilisation

<table>
<thead>
<tr>
<th>(Mean (SD))</th>
<th>Pre-RECIPE</th>
<th>Post-RECIPE</th>
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<tr>
<td>ED presentations per patient</td>
<td>1.99 (SD = 2.13)</td>
<td>1.71 (SD = 2.62)</td>
</tr>
<tr>
<td>Inpatient admissions per patient</td>
<td>3.03 (SD = 2.93)</td>
<td>2.36 (SD = 3.25)</td>
</tr>
<tr>
<td>Length of stay per admission (days)</td>
<td>8.59 (SD = 11.03)</td>
<td>3.45 (SD = 4.95)</td>
</tr>
<tr>
<td>Total annual bed days</td>
<td>30.01 (SD = 41.08)</td>
<td>12.20 (SD = 21.25)</td>
</tr>
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</table>

decline and psychosocial issues (4%), acute renal failure (3%) and other (5%).

Mortality

Mortality was high with 968 (73%) of residents dying during follow-up and a mean survival time of 311 (SD 382) days. Overall, 262 (20%) were documented to have died in hospital. Multivariate Cox regression analysis demonstrated that age ≥84 years (hazards ratio (HR) 1.54, 95% confidence interval (CI), 1.36–1.76, P < 0.001), male sex (HR 1.29, 95% CI, 1.13–1.47, P < 0.001) and Charlson index ≥2 (HR 1.21, 95% CI, 1.07–1.37, P = 0.002) are associated with an increased risk of mortality (Supplementary data, Figure S3 available in Age and Ageing online).
As previously reported, RCF residents presenting to ED had high 1-year mortality rates following discharge [5]. A previous study by our group demonstrated an increase in community-based palliative care provision with no increase in mortality [27]. One of the future challenges faced by the service is increasing capacity to deliver this type of program effectively to RCFs across the whole health service catchment [16].

Evaluation of multifaceted interventions for older adults with complex needs who also have high short-term mortality is challenging. The primary limitation of this study is the lack of a valid control group; without this it has been assumed that the observed trend in bed days and admissions estimated over the quarter 1–7 period would continue at the same forecast rate over the 4-year follow-up period (i.e. quarters 9–24) if the service was not introduced. While the exclusion of the quarter 8 value nullifies the effect of the steep increase in trend immediately prior to RECIPE enrolment, in reality there may be a natural tapering in the forecast trend in the absence of any intervention. An ideal study design would involve a randomised controlled trial methodology, although recent guidelines for the evaluation of complex interventions at the end of life have recommended that observational study designs may be appropriate for this context [28, 29].

**Conclusion**

This study suggests that an outreach service comprising a geriatrician-led team may have a significant impact on reducing acute hospital utilisation rates. Components of the intervention include a multifaceted model of care that includes disease management, ACP, rapid assessment services and acute care substitution services.

**Key points**

- Multifaceted outreach model for RCF residents can reduce acute healthcare utilisation.
- High mortality of RCF patients means that advanced care planning is an important part of the intervention.
- Increasing access to aged care specialist physicians and nurses can improve patient outcomes.

**Conflicts of interest**

None declared.
A. F. Hutchinson et al.

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Supplementary data

Supplementary data mentioned in the text are available to subscribers in Age and Ageing online.

References

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