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ORIGINAL RESEARCH

Effect of the Geriatric Emergency Department Intervention on outcomes of care for residents of aged care facilities: A non-randomised trial

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Abstract

Objective: As the population of Australia ages, EDs will experience an increasing frequency of presentations of older adults from residential aged care facilities (RACFs). These presentations are often complex and time consuming in the chaotic and potentially hazardous ED environment. The Geriatric Emergency Department Intervention (GEDI) model was developed to optimise the care of frail older adults, especially RACF residents, in the ED. The aim of the present study was to evaluate the effectiveness of the GEDI model on the primary outcomes of disposition (admission, discharge or death) and ED length of stay for residents of RACFs, presenting to an ED in regional Queensland, Australia.

Methods: GEDI is a nurse-led, physician-championed, innovative model delivered by advanced practice nurses with expertise in gerontology. This quasi-experimental pragmatic study compared outcomes for RACF residents who presented to a regional Queensland ED during three time periods: pre-GEDI, interim GEDI and post-GEDI implementation of the GEDI model. Outcomes included disposition, ED length of stay, ED re-presentation and mortality.

Results: A significant increase in the likelihood of discharge from ED (hazard ratio 1.15, 95% confidence interval 1.05–1.26) and reductions in ED length of stay (hazard ratio 1.49, 95% confidence interval 1.24–1.78) were evident for RACF residents following the implementation of the GEDI intervention. There were no differences in mortality, ED re-presentation or in-hospital length of stay between the three time periods.

Conclusion: There is a paucity of evidence to support the implementation of nurse-led teams in EDs designed to target older adults living in RACFs. The GEDI model was effective in reducing ED length of stay while increasing the likelihood of safe discharge for RACF residents.

Key words: *advanced practice nursing, emergency care, emergency department, nursing home, outcome.*

Key findings

- The GEDI is a physician-championed, nurse-led model designed to improve care and reduce unnecessary hospitalisation of frail older adults.
- The GEDI model decreases the ED length of stay for RACF residents.
- The GEDI model increased the likelihood of safe ED discharge for RACF residents.

Introduction

In Australia, the demographic shift towards older age has led to one in 10 people aged over 70 living permanently in residential aged care facilities (RACFs).[1] Around one in five ED presentations made by older adults are from a RACF.[2] RACF residents are a vulnerable cohort, particularly if admitted, as they are at a higher risk of morbidity and mortality.[2,3] Also when compared to older adults living in the community, they have longer ED lengths of stay (LoS) as well as higher admission, re-admission and ED re-presentation rates.[2]

Older people living in RACFs frequently experience cognitive impairment, polypharmacy and other complex medical comorbidities.[4] Despite these complexities, management of the frail older adult continues to be caught up in the 'one size fits all' model of care currently seen in many EDs.[5] This often leads to unnecessary invasive investigations, high rates of admission and re-admission, delayed and fragmented care and longer ED LoS.[2,6–8] If

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admitted, RACF residents suffer high rates of iatrogenic hospital acquired complications such as falls, urosepsis and delirium.[6] Systematic reviews of studies on admission avoidance strategies and ED interventions for older adults have highlighted a lack of evidence, related to the optimal model of care in ED, especially for patients presenting from RACFs.[9,10] The aim of the present study was to evaluate the effectiveness of the Geriatric Emergency Department Intervention (GEDI) model on the primary outcomes of disposition (admission, discharge or death) and ED LoS for residents of RACFs, presenting to an ED in regional Queensland, Australia.

Methods

Study design

The present study, focusing on RACF residents, is a planned *a priori* sub-group analysis of a larger study that evaluated the effectiveness of the GEDI models service delivery for adults aged 70 and over.[11] A detailed methodology can be found in the study protocol and Implementation Toolkit published elsewhere.[12,13] In summary, a quasi-experimental study design[14] was used to compare outcomes for RACF patients, aged 70 years and older, over a period of 4.8 years, in a regional ED, in Queensland, Australia. The 4.8 year study was divided into three time periods namely the pre-GEDI intervention period, when no GEDI were available (1 January 2012 to 31 December 2012), an interim GEDI period when GEDI was under development (1 January 2013 to 31 August 2015) and a post-GEDI intervention period when the final GEDI model was fully implemented (1 September 2015 to 31 August 2016).

Setting

The setting for the present study was the ED of a regional hospital, in Queensland, Australia. Annually, there are 52 000 presentations to this ED and 20% of these presentations are adults aged 70 years and over. Of these older adults approximately 14% are transferred from an RACF. Prior to the introduction of the intervention 58% of RACF patients were admitted and 42% were discharged from the ED.

Intervention

The GEDI model is a multidisciplinary nurse-led, physician-championed, innovative intervention delivered in the ED by advanced practice nurses with a minimum of 5 years post registration experience and specialist expertise and/or education in gerontology who understand the unique demands of the ED environment.[12,15] The primary aim of the GEDI model is to deliver high-quality continuity of care for older adults from RACFs who present to the ED. Where appropriate, hospital admission is avoided and discharge is facilitated, however, if admission is unavoidable ED medical management and the ED process of admission is fast-tracked.

The GEDI nurses assist the primary ED nurses and physicians as a sub-specialty unit based in the ED. They also receive community referrals from the primary care team, RACF staff and the ambulance service regarding potential or current transfers to hospital. In ED they receive referrals either directly from ED staff or via routine electronic record system rounding. Frailty screening of patients was initially trialled but found to be of limited benefit for these experienced clinicians.

The GEDI team work in two split 8-h shifts starting at 07.00 hours and 21.00 hours Monday to Friday and one 8-h shift on the weekend commencing at 08.00 hours. The basic cost to implement the service is 2.4 full time equivalent advanced practice nurses and 0.125 full time equivalent ED physician. GEDI are involved in the care of all patients over the age of 70; however, they prioritise all patients presenting from an RACF, targeting those most likely to be discharged back to their facility first, followed by those with more complex conditions possibly requiring hospital admission. The GEDI work in consultation with the ED physicians and undertake targeted geriatric assessments to assist in problem formulation. Further to this they fast track diagnostic processes and guide ED staff on appropriate investigations and interventions, for example CT head scans in falls patients. As part of the multidisciplinary team they will assist the ED with hands on care (e.g. wound care, indwelling catheter management, etc.) and/or liaise with appropriate allied health, community or RACF services. In particular, if discharge is appropriate, they will ensure a patient-centred shared decision-making process occurs, and where possible/appropriate involve the family or primary carer.

If admission is required, the GEDI will co-ordinate with the inpatient teams and ensure the RACF resident is admitted under the most appropriate team. The GEDI will also refer directly to the inpatient teams such as stroke, orthogeriatrics and geriatrics bypassing the usual ED doctor-centric referral pathways. When admission is not required, they communicate all planned care/treatment to the primary care GP, family and RACF staff and arrange appropriate transfer home thus facilitating safe discharge.

Finally, the GEDIs also provide an ongoing staff development programme for ED staff. They provide in-service education sessions and opportunistic bedside teaching on the GEDI model, geriatric syndromes, cognitive assessment and care pathways in the department. Further to this the ED staff are offered temporary GEDI positions to enhance their geriatric skill sets through immersive training.

Data collection and analysis

Data related to all presentations made by people aged 70 years and older, to the study site ED, were extracted from coded, state-based Health Service databases, namely Emergency Department Information Service (Healthcare Group, CSC) and the Hospital Based Corporate Information System and linked by the hospitals Financial, Information and Costing Service. As no identifier for people residing in a RACF existed, systematic identification of place of residence (i.e. RACF) was based on the patient's residential

address. This ensured exclusion of independent living residents as the study RACFs had separate identifiable addresses. Once the ED and hospital database information were linked and RACF status confirmed, personal identifiers were removed prior to analysis.

Variables

Independent variables used to describe the sample and build multivariable models for outcomes were demographic characteristics (age, sex), ED characteristics (date, season, time of day, mode of arrival, Australasian Triage Score (ATS),[16] major diagnostic category (MDC) (ICD-10 code mapped to 25 MDC), calendar time (the variable 'calendar time' was created to adjust for changes to practice that occur over time independent of the intervention scaled from per day to per 100 days to show meaningful change. This ensures confounding factors such as changes to departmental staffing or streaming practices are accounted for.), and GEDI intervention periods.

The primary outcome variables used to evaluate the effectiveness of GEDI were: disposition (coded as discharged home, admitted to hospital or died) and ED LoS (time spent in ED, in minutes). Secondary outcomes were: in-hospital LoS (time spent in hospital, in days), all cause in-hospital mortality within 30 days of ED presentation, ED re-presentations for the same cause up to 28 days, and ED re-presentation for any cause up to 28 days.

Statistical analysis

An independent statistician not involved in the study design or data collection, provided statistical summaries and analysis using R software (version 3.1.4).[17] Descriptive statistics were used to compare the characteristics over the study time periods including frequencies, percentages, measures of central tendency and distribution. Survival analysis was used to jointly model LoS and disposition, with the three destinations (discharged home, admitted to hospital or death) as competing risks. Survival analysis for ED re-presentations used out-of-hospital mortality as a competing risk. All models adjusted for patient level factors of gender, age, ATS, MDC for trauma and cardiac, season, day of the week and time of presentation. Due to a relatively small percentage of patients with an ATS of 1 or 5, ATS scores of 4 and 5 were combined, and ATS 1 and 2 were combined.

Pre-post designs are vulnerable to confounding by other changes over time that may be attributed to the intervention.[14] Season was adjusted using a sinusoid with an annual cycle to control for the winter peak in morbidity.[18] The survival analysis used Cox proportional hazard survival models. The models' residuals were checked for outliers and correlation over time. Cook's influential statistic was calculated, and large outliers were examined. The variance inflation factor was calculated and variables with a score above five were removed on the basis that they are co-linear. The key outcome was the mean effect of the intervention together with 95% confidence intervals. Cumulative incidence plots were used to compare the competing events in the three GEDI periods over time.

Ethical approval

The study received Human Research Ethics Committee approval from the Queensland Department of Health (HREC/14/QPCH/220) and the University of the Sunshine Coast (HREC/A/15/718). Australian Clinical Trials Registration Number (ACTRN) is 12615001157561.

Results

Sample characteristics

A total of 5991 ED presentations from RACFs occurred over the study period (pre-GEDI, n = 1209; interim GEDI, n = 3324; and post-GEDI, n = 1458). Table 1 summarises the baseline characteristics of the sample including age, sex, ATS, season, time and mode of arrival and MDC over the three time periods. Day of week and ATS category differed significantly over the three time periods, but these differences were not clinically meaningful. Age, mode of arrival and MDC were similar across each time period (Table 1). Most patients presented to the ED between 07.00 hours and 21.00 hours. Winter was consistently the most common season for presentation between time periods (Table 1).

Primary outcomes

The cumulative incidence plots show that patients who presented during the interim GEDI and post-GEDI intervention periods were more likely to be discharged and were generally discharged sooner than those in the pre-GEDI period (Fig. 1).

The hazard ratios (HRs) and 95% confidence intervals (CIs) for all the variables included in the multiple variable survival model for discharge are presented in Figure 2. When controlling for all other variables, the HR for discharge for those patients presenting in the post-GEDI intervention period was 1.15 (95% CI 1.05–1.26). A HR over one indicates an increased likelihood of discharge. Trauma (HR 1.25, 95% CI 1.18–1.33) and calendar time (HR 1.02, 95% CI 1.01–1.04 per 100 days) were also significant predictors of discharge. An ATS of 3 (HR 0.88, 95% CI 0.83–0.95) and arriving by ambulance (HR 0.76, 95% CI 0.66–0.87) were significant factors resulting in a lower likelihood of discharge directly from the ED (Fig. 2).

Survival analysis examining the predictors for ED LoS indicates that patients who presented during the interim GEDI and post-GEDI intervention periods had reduced ED LoS. As with the disposition analysis when controlling for all other variables the HR for ED LoS for those patients presenting in the post-GEDI intervention period was 1.49 (95% CI 1.24–1.78) and 1.44 (95% CI 1.30–1.60) for the interim GEDI intervention period. Trauma (HR 1.24, 95% CI 1.17–1.31) and calendar time (HR 1.03, 95% CI 1.01–1.04) were also significant predictors of a shorter ED LoS.

TABLE 1. *Characteristics of participants in the three time periods*

Characteristics	Pre-GEDI, *n* = 1209	Interim GEDI, *n* = 3324	Post-GEDI, *n* = 1458
Age at transfer to ED (years), mean (SD)	85 (7)	86 (7)	86 (7)
Gender (female), *n* (%)	727 (60)	2074 (62)	844 (58)
Triage score, *n* (%)			
ATS 1 and 2	290 (24)	786 (24)	293 (20)
ATS 3	613 (51)	1739 (52)	740 (51)
ATS 4 and 5	306 (25)	799 (24)	415 (29)
Arrival by ambulance, *n* (%)	1173 (97)	3184 (96)	1409 (96)
Season, *n* (%)			
Summer	317 (26)	807 (24)	363 (25)
Autumn	283 (23)	931 (28)	355 (24)
Winter	320 (27)	1021 (31)	396 (27)
Spring	287 (24)	571 (17)	347 (24)
Day of the week, *n* (%)			
Monday	175 (14.5)	476 (14.3)	216 (14.8)
Tuesday	142 (11.8)	440 (13.2)	195 (13.3)
Wednesday	162 (13.4)	472 (14.2)	198 (13.6)
Thursday	135 (11.2)	455 (13.7)	226 (15.5)
Friday	179 (14.8)	538 (16.2)	187 (12.8)
Saturday	218 (18.1)	473 (14.2)	230 (15.7)
Sunday	196 (16.2)	467 (14.1)	209 (14.3)
Mapped ICD – 10 code, *n* (%)			
Cardiovascular	191 (16)	495 (15)	208 (14)
Neurological	102 (9)	335 (10)	148 (10)
Respiratory	142 (12)	383 (12)	148 (10)
Trauma	338 (28)	950 (29)	416 (29)
Other	436 (36)	1161 (35)	538 (37)

ATS, Australasian Triage Scale; GEDI, Geriatric Emergency Department Intervention; SD, standard deviation.

Secondary outcomes

Multivariable models examining the predictors for in-hospital LoS, risk of death, ED re-presentation for same cause up to 28 days, and ED re-presentation for any cause up to 28 days revealed no significant effects for the interim GEDI and post-GEDI intervention periods (Table 2). Regardless of GEDI, there was a statistically significant increase in likelihood of any cause re-presentation within 28 days for male patients. There was decreased likelihood of re-presentation from all causes if the patient was assigned an ATS of 1, 2 or 3, or as patient age increased in 10-year increments. There was an increase in in-hospital LoS if the patient was older, had an ATS 1 or 2, or presented with a cardiac condition. The only significant increase in the risk of death was if the patient presented with a cardiac condition, and the only significant reduction in death risk was if the patients presented with trauma (Table 2).

Discussion

The present study highlights the beneficial impact of the GEDI model in the ED. Overall, the results indicate a significant increase in likelihood of discharge from ED with a shorter ED LoS if RACF residents present when the GEDI model is in place. Admission to hospital potentially contributes to a RACF resident's functional decline[19] and places them at increased risk of iatrogenic complications such as falls, pressure injuries, medication errors and death.[20] Conversely, the management of acutely unwell older adults within the RACF has shown similar or better outcomes than those managed in hospital.[21,22] When assessing the older person in ED, the benefit of hospitalisation must outweigh the risks. Novel or alternative models must be designed to address this problem. The present study demonstrates that GEDI is one such a model and is associated with a significant decrease in the risk of hospital admission for RACF residents without increasing the risk of death or re-presentation from same or all causes.

The mean age of this sample is in the category of the oldest old. In the present study each 10-year increase in age increased the risk of longer ED stay and decreased the risk of re-presentation. It is likely that older patients had more complex presentations and safe discharge, or admission required a longer stay in ED. It is also possible that a hospital presentation would prompt advance care planning on return to the RACF resulting in fewer subsequent presentations.[23] However, being male resulted in increased risk of any cause re-presentation. This is in keeping with a number of studies related to emergency care for the oldest old.[24]

When the GEDI model was available, RACF residents were more likely to be discharged from the ED. This outcome supports the findings from previous studies that found an ED intervention for older adults

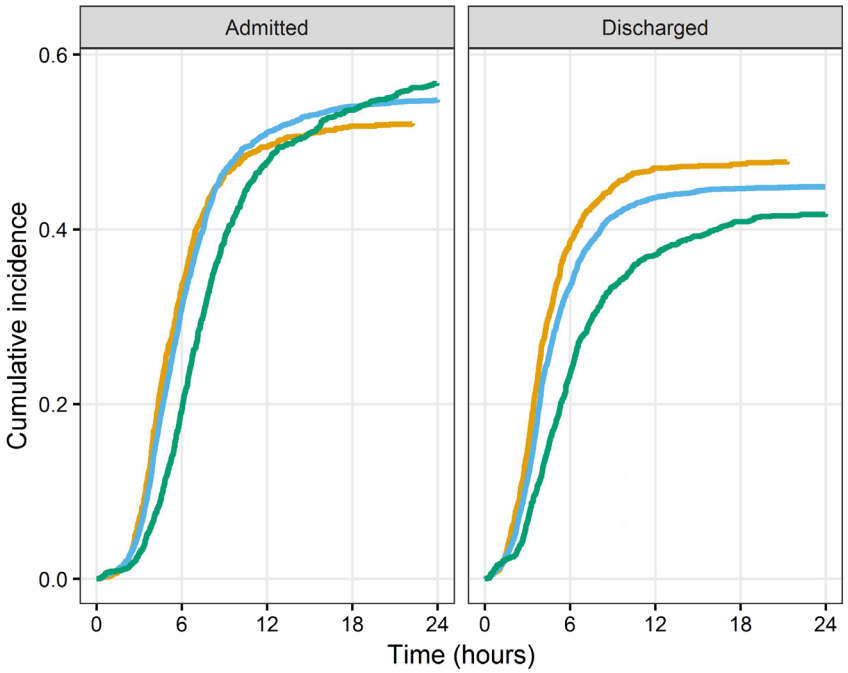

Figure 1. *Cumulative incidence of admission or discharge using three Geriatric Emergency Department Intervention (GEDI) groups in the first 24 h after presentation to ED. (——) Full intervention; (——) interim intervention; (——) pre-intervention.*

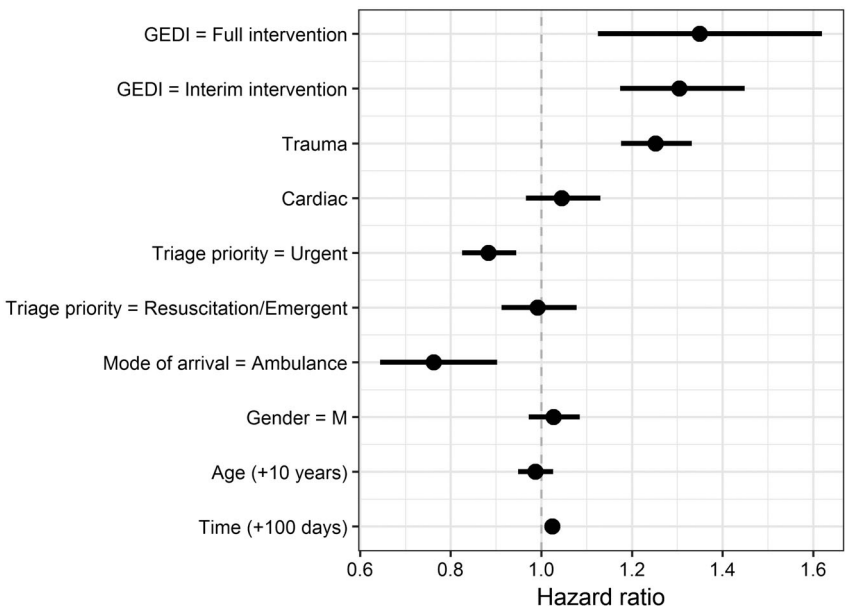

Figure 2. *Hazard ratios and 95% confidence intervals of discharge using a Cox survival model with three Geriatric Emergency Department Intervention (GEDI) groups. Reference for GEDI is pre-intervention. Reference for triage priority is 'less urgent/nonurgent'.*

improved patient and health service outcomes and decreased hospital admissions.[25–27] While operating as a similar model to hospital in the nursing home[26] and the American Geriatric ED innovations project,[25] the GEDI team also targeted non-RACF patients, provided education and support to RACF and ED staff, were clinically 'hands-on' in the care of the older patient in the ED while remaining an in-reach ED based model. The importance of the provision of geriatric-specific ED staff education and multidisciplinary care of these often complex and time consuming patients was also acknowledged in a recent Australian study looking at the attitudes of health professionals towards older patients.[28]

Across the three time periods (pre-GEDI, interim GEDI and post-GEDI), trauma was the primary reason for ED presentation. This is consistent with other studies with older adults from RACFs.[29,30] There was a higher likelihood of discharge and a decreased risk of death if presentation was trauma related; this may be explained by the frequency of this presentation category for relatively minor trauma. The high number of presentations in the trauma MDC may be a consequence of changes to RACF policy related to ED transfer for residents experiencing unwitnessed falls or falls in residents who are anticoagulated. This change in practice is thought to have been a response to a recent Australian coronial inquiry that advocated for ED transfer in such circumstances.[31]

Increasing discharges of RACF residents from EDs may not automatically equate to improved outcomes. The Australasian College for Emergency Medicine quality standards recommend that 'patients are screened by the relevant ED team member or delegate to ensure the discharge decision is appropriate and to assess the patient's suitability and safety for discharge'.[32] Reassuringly, despite the increased likelihood of discharge of RACF residents managed by the GEDI nurses, there was no increase in re-presentation for same or all causes and no change in mortality between the three time periods. This suggests that despite the higher rates of discharge of RACF residents their safety was not compromised.

Older adults utilise far greater ED resources than their younger counterparts.[24,33] Accompanied with the higher rates of ED presentation, hospital admission and prolonged ED

TABLE 2. *Hazard or prevalence ratios and 95% confidence intervals for secondary outcomes measures using a Cox survival model for the survival outcomes and a logistic model for the binary outcome of death (all cells show mean ratio and 95% confidence interval; reference for GEDI is pre-intervention; reference for triage priority is Australasian Triage Score [ATS] 4/5)*

Outcome	Interim GEDI	Post-GEDI	Time (+100 days)	Age (+10 years)	Male sex ratio	Triage priority = ATS 1/2	Triage priority = ATS 3	Reason for presentation cardiac	Reason for presentation trauma
In-hospital LoS†	1.07 (0.93, 1.23)	1.00 (0.79, 1.28)	1.03§ (1.02, 1.05)	1.14§ (1.08, 1.20)	0.96 (0.89, 1.03)	1.13§ (1.02, 1.27)	1.08 (0.98, 1.20)	1.37§ (1.24, 1.52)	0.78 (0.93, 1.23)
Risk of death‡	0.60 (0.13, 2.46)	0.87 (0.07, 1.46)	1.01 (0.85, 1.20)	1.26 (0.75, 2.16)	1.75 (0.86, 3.59)	NA	NA	2.26§ (1.04, 4.67)	0.22§ (0.04, 0.76)
Same cause ED re-presentation within 28 days†	0.85 (0.53, 1.36)	1.07 (0.48, 2.40)	1.00 (0.95, 1.06)	0.77§ (0.65, 0.91)	1.22 (0.96, 1.53)	0.72 (0.51, 1.02)	1.01 (0.77, 1.31)	NA	NA
Any cause ED re-presentation within 28 days†	0.88 (0.66, 1.16)	0.82 (0.51, 1.32)	1.01 (0.98, 1.05)	0.86§ (0.78, 0.95)	1.27§ (1.10, 1.46)	0.61§ (0.50, 0.75)	0.84§ (0.72, 0.98)	NA	NA

†Hazard ratio. ‡Prevalence ratio. §Statistically significant. GEDI, Geriatric Emergency Department Intervention; LoS, length of stay; MDC, major diagnostic category.

LoS associated with the ageing population increasing ED costs as the Australian population ages are predicted.[24] Given the GEDI model's benefit of a decreased likelihood of prolonged ED LoS and decreased likelihood of hospital admission further studies into the cost effectiveness of the GEDI model would be beneficial.

Limitations

There are limitations to the present study. Random assignment to experimental or control groups was not possible, and therefore the design is vulnerable to confounding by other changes that occurred in the ED over time, such as any changes in the EDs admission processes over that time.[14] The complexity of the ED environment makes it impossible to state definitively whether the intervention alone lead to changes in the outcomes; however, the analysis made a statistical adjustment for the passage of time to mitigate this.

Second, the data on representation is limited to hospital representation and lacks representation data from primary health physicians or other hospitals in the region. This is due to lack of data linkage between hospital and RACFs in SE Queensland; however, the study hospital is geographically isolated and the ambulance services usual practice would be to direct the majority of residents from the study RACFs to the study hospital.

Third, the study was limited with respect to ED and hospital outcome measures with mortality and ED re-presentation as the only patient related health outcomes. Further studies reviewing patient related health outcomes, such as quality of life and primary health utilisation are recommended. Finally, a comprehensive economic evaluation would be beneficial and recommended; however, this was beyond the scope of this paper.

Conclusion

GEDI is an innovative model that provides a single point of contact in the

ED for RACF providers, primary health services and secondary health services. The primary focus is to deliver high quality care for the older adults from an RACF through seamless continuity of care as they transition through the ED. Complex, multifocal interventions, such as the GEDI model, are frequently implemented without rigorous evaluative research. The present study has provided evidence that the GEDI model can increase the likelihood of discharge and decrease the ED LoS without increasing ED re-presentation or mortality for this vulnerable cohort.

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Author contributions

EM, MW, MB and JC were involved in the study design and successfully applied for competitive funding. EM, AT and MW designed and developed the intervention. AC was research project manager and contributed to study design and implementation. EM, AC, JC, AB and MW were involved in outcomes evaluation. AB undertook the statistical analysis. EM drafted the manuscript and all authors reviewed and amended drafts and approved the final manuscript.

Competing interests

Several authors were employees at the institution where the current study was undertaken.

Data sharing and data accessibility

We are unable to share or make publicly available data used for the current study due to ethics and data privacy requirements.

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