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The Geriatric Emergency Department Intervention model of care: a pragmatic trial

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Abstract

Background: To evaluate a Geriatric Emergency Department Intervention (GEDI) model of service delivery for adults aged 70 years and older.

Methods: A pragmatic trial of the GEDI model using a pre-post design. GEDI is a nurse-led, physician-championed, Emergency Department (ED) intervention; developed to improve the care of frail older adults in the ED. The nurses had gerontology experience and education and provided targeted geriatric assessment and streamlining of care. The final format included 2.4 full time equivalent nurses working 7 days from 0700 h to 1730 h (1530 h at weekends). There were three implementations periods: pre-implementation (2012); a developmental phase from January 2013 to August 2015; and full implementation from September 2015 to August 2016. The outcomes measured were disposition (discharged home, admitted or died); ED length of stay; hospital length of stay; all cause in-hospital mortality within 28 days; time to ED re-presentation up to 28 days post-discharge; in-hospital costs. The setting was a tertiary hospital ED, with 385 beds, in Queensland, Australia. Approximately 53,000 patients presented to the ED annually with 20% aged 70 years and older. All patients over the age 70 who presented to the ED between January 2012 and August 2016 ($n = 44{,}983$) were included in the trial.

Results: Older persons who presented to the ED when the GEDI team were working had increased likelihoods of discharge (Hazard ratio (HR) = 1.19; 95% CI: 1.13–1.24) and reduced ED length of stay (HR = 1.42; 95% CI: 1.33–1.52) compared with those who presented when GEDI were not working. There was no increase in the risk of mortality (HR = 1.01; 95% CI = 0.23–4.43) or risk of same cause re-presentation to 28 days (HR = 1.21; 95% CI: 0.99–1.49). The GEDI service resulted in average cost savings per ED presentation of $35 [95% CI, $21, $49] and savings of $1469 [95% CI, $1105, $1834] per hospital admission.

Conclusions: Implementation of a nurse-led physician-championed model of ED care, focused on frail older adults, reduced ED length of stay, hospital admission and if admitted, hospital length of stay and cost, without increasing mortality or same cause re-presentation. These increases were sustained over time and after the initial implementation team had changed roles.

Trial registration: Australian Clinical Trials Registration Number ACTRN12615001157561 - retrospectively registered on 29/10/2015. Data were retrieved via retrospective access to clinical information systems. First data access was on 1/7/2015.

Keywords: Geriatric, Emergency medical services, Nurses' practice patterns, Hospital, Homes for the aged, Delivery of health care, Protocol, Outcomes, Evaluation, Pragmatic paradigm

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Background

As a consequence of the ageing of the population, older people comprise an increasing proportion of emergency department (ED) presentations [1]. Many frail older persons live in residential aged care facilities (RACFs) but 30 to 50% live in the community [2, 3]. When presenting to the ED, frail older adults receive a greater number of tests, spend longer in ED awaiting disposition planning and are at greater risk for medical complications, functional decline and poorer health following discharge [4, 5]. If RACF residents are hospitalised they suffer higher rates of adverse events and are susceptible to de-conditioning and worsening cognitive state [6–8]. Hospital admission for frail older adults is associated with increased morbidity and mortality [9, 10].

Previous studies have indicated ways in which the care of frail older adults experiencing acute illness can be improved [11, 12]. There are numerous suggestions for improvements in RACFs focusing on enhancing primary care [1, 13–15]. In the ED there are several studies looking at older persons over the age of 65, however, these actively exclude RACF residents [16, 17]. The limited previous research on this topic indicates that to improve the care of frail older adults in the ED there should be a single point of contact and structured communication tools [12, 17]; advanced aged care assessment at point of ED entry [11, 12, 17–19]; expert gerontological care by both medical and nursing staff [11, 20, 21]; and streamlining of patient management in ED [17, 22, 23]. The increased costs of these additional services means that research in this area must also collect data on costs as well as effectiveness.

Clinicians at a regional hospital in Queensland, Australia in collaboration with staff from a local RACF identified that both RACF residents and frail older adults living in the community were experiencing high rates of ED presentation and having worse outcomes than other cohorts. In consultation with university colleagues and the local primary health network (PHN) they designed the Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) project. This was a two-pronged model of service delivery with interventions in both the RACF and ED. In the ED the Geriatric Emergency Department Intervention (GEDI) was implemented while a Nurse Practitioner Candidate was introduced to the aged care facility.

Methods

The aim of this study was to evaluate the effectiveness and cost of the GEDI model of service delivery for adults aged 70 years and over, presenting to an ED in regional Queensland, Australia. The protocol for the structure, process and outcome evaluation [24] of the GEDI model has been published [25].

A randomised trial of individual patients was not feasible when considering a change to the model of care for a whole ED, and a cluster-randomised trial would be costly. Hence we undertook a pragmatic trial using a pre-post design that tracked eligible patients before and after the intervention was implemented [26].

Participants and data collection

De-identified data for all patients aged 70 years and older, who presented to the study ED from January 2012 through to 31st August 2016, were retrieved from Emergency Department Information Service (EDIS; Healthcare Group, CSC)® and Hospital Based Corporate Information System (HBCIS; iSoft) databases. Data extraction was undertaken by health service data managers with deterministic linking of the EDIS, HBCIS and financial data. There were three time periods:

1. 1st January to 31st December 2012: prior to development of any aspect of GEDI (hereon referred to as – "pre-intervention or pre-GEDI");
2. 1st January 2013 to 31st August 2015 – the development phase of the intervention during which funding and staffing models changed (hereon referred to as – "interim intervention or interim GEDI"); and
3. 1st September 2015 to 31st August 2016 – (hereon referred to as "full intervention").

To overcome the 'improvement-evaporation effect', whereby the benefits reaped from new practices diminish over time [27] we used data from the immediate period post intervention (interim intervention), when the model was being developed and staffed by the most experienced and dedicated clinicians, but also included the full implementation period which represents a more standard implementation environment.

Independent variables that were used to describe the sample and to build multivariable models to compare outcomes were:

- Demographics - Age, Sex
- Date and time of presentation
- Clinical diagnosis – reason for presentation as ICD-10 code – this variable was then mapped to 25 major diagnostic categories
- Arrival by ambulance
- Presented from RACF
- Australasian Triage Score (ATS) [28, 29] – three groups 1&2, 3, 4&5
- Adult Deterioration Detection System (ADDS) Score [28]

- Time (per 100 days increase across the project)
- Presented to ED during GEDI working hours - Yes/No
- Intervention group (explained below)

Intervention

The intervention has been described previously [25, 30] and is detailed within an Implementation Toolkit [31]. The aims of the model of care are to avoid hospital admission, if appropriate, and where this is not possible, to fast-track admission and medical management. Briefly, the GEDI intervention is delivered in the ED by a multidisciplinary team consisting of an ED physician champion and advanced practice ED nurses who have at least 5 years of experience working with older adults and preferably post-graduate qualifications in gerontology. The GEDI nurses operate as a supplementary sub-speciality team assisting the primary ED nurses and physicians. They target all patients over the age of 70 years especially those transferred from RACFs. They will either receive referrals from the primary care team or will identify patients via the electronic medical records system or via routine rounding. The use of frailty screening was trialled but was not found to be of use for these experienced clinicians.

In consultation, with the ED physician champion they will undertake targeted geriatric assessment (using the aspects of a comprehensive geriatric assessment that are appropriate for the individual patient) and problem formulation. They will then work with the primary ED team to fast-track diagnostic processes and engage the multi-disciplinary team and, where possible, the family in client-centred decision-making. Where necessary GEDI will undertake early referral to specialist care and/or activate standardised fast track pathways e.g. for orthopaedic surgery or stroke management.

When necessary, GEDI will coordinate admission to a specialty in-patient ward avoiding, where possible, a stay on a medical assessment unit. When admission is not required, the GEDI team may assist the primary care team with hands on care (e.g. wound care, catheter change etc.) and/or liaise with appropriate community or RACF services, to mobilise resources within the patient's home to ensure safe discharge. Finally, the team communicates all ED care and future requirements of care to either the ward or the community care team, including the GP.

The GEDI team also provides an ongoing staff development program for other ED staff. Through a program of in-service education sessions new and junior staff are provided with information about the model of care and are also educated about geriatric syndromes, cognitive assessment and the care pathways used in the department.

Objectives

The study objectives were to test differences in disposition, ED and hospital length of stay, time to ED re-presentation, all-cause mortality and costs between the groups of patients who presented, to the study ED, in the three time periods.

Outcomes

Primary

- Disposition - discharged home, admitted, died

Secondary

- ED length of stay– in minutes
- Hospital length of stay – in days
- All cause in-hospital mortality within 30 days of ED presentation
- Time to ED re-presentations up to 28 days
- Cost of hospital admission

Patient and public involvement

This project and the development of the intervention were a co-design activity that included two members of the public who were over 70 years of age. They are volunteers who spent a lot of their time visiting older adults in aged care facilities and had both personal and proxy experience of the health service and the ED. They not only joined the External Advisory Group set up to guide the development of the intervention and the conduct of the study but also visited the ED and a local aged care facility with members of the research team to discuss issues specific to older adults.

Statistical methods

An independent statistician, not otherwise involved in the study, provided statistical summaries and analysis. Descriptive statistics were used to describe the participants in the three time periods including frequencies, percentages, appropriate measures of central tendency and distribution.

For the primary outcome, survival analysis was used to jointly model length of stay and disposition, with the three destinations as competing risks [32]. We used survival analysis for ED re-presentations with out-of-hospital mortality as a competing risk. All models adjusted for the patient level factors of gender, age, ATS, season, day of the week and time of presentation. Survival analysis is ideal here because our primary outcomes are times that are subject to censoring from competing risks. Previous analysis have simply categorised time and used logistic regression, for example discharge within 24 h. However, this wastes valuable information and reduces statistical power. We used cumulative incidence curves to look for changes due to the intervention over all times.

Pre-post designs are vulnerable to confounding by other changes over time that may be attributed to the

intervention [33]. To control for this, we included a linear trend (based on date) in all models to account for gradual changes that are not captured in the individual variables, e.g., experience of healthcare workforce. We also adjusted for season using a sinusoid with an annual cycle to control for the winter peak in morbidity [34]. The survival analyses used Cox proportional hazard survival models. The models' residuals were checked for outliers and correlation over time. We calculated Cook's influential statistic and examined relatively large outliers. We calculated the variance inflation factor and removed variables with a score above five on the basis that they were co-linear. The key outcome was the mean effect of the intervention together with 95% confidence intervals.

We compared patients who may have received the GEDI intervention to patients for whom it was not available. This "usual care" group could be those who were admitted before the intervention was introduced, or those who were admitted after the intervention but outside the GEDI team's hours. We also expected the intervention to change during the interim and full period, hence we created five categories:

- Pre intervention (control)
- Interim intervention during GEDI working hours (intervention)
- Interim intervention outside GEDI working hours (control)
- Full intervention during GEDI working hours (intervention)
- Full intervention outside GEDI working hours (control)

Hence we had three control groups and two intervention groups. We used the additional control groups because we suspected that there would be carry-over effects from the intervention that may create some additional benefit compared with the pre-intervention controls.

Economic analysis

We compared the hospital lengths of stay and costs for the three time periods. We specified a two-stage recursive model which exploits the unidirectional causal pathway among the endogenous outcome variables (i.e. length of stay and cost) such that, for a given set of exogenous variables, the endogenous variables can be identified sequentially [35]. The exogenous variables that potentially influenced the length of stay and cost include: patient individual characteristics (age, gender and place of residence), the properties of the presentation (mode of arrival, major diagnostic category and mode of discharge) and whether or not the patient arrived during working hours. Since the recursive model does not allow variables that are linked in a causal chain to have correlated with the error terms, it can control for unobserved heterogeneity and endogeneity within the data [35, 36].

Results

A total of 44,983 records were retrieved (pre-GEDI n = 9066; interim GEDI n = 25,675; full-GEDI n = 10,242). The patients' mean age was 81 years (sd = 7) and 51% were female. Most presentations were on weekdays (with peaks on Mondays and Fridays) and between 0800 and 1900 h. There were no important differences between the three time periods for these variables (See Table 1).

There was a small difference in the major diagnostic categories attributed to the three groups with the full intervention sample having a smaller proportion of cardiac presentations ($p < 0.001$), the Interim group having fewer presentations for respiratory conditions ($p < 0.001$) and the pre-intervention group having fewer presentations for trauma ($p < 0.001$). More patients arrived by ambulance in the pre-intervention and interim periods than during the full intervention ($p < 0.001$). Also there were between group differences in ATS category with the full intervention group having a larger proportion in ATS category 2 (urgent, see within 10 min) compared to the other time periods ($p < 0.001$). The differences between the three groups noted above were relatively small, and we attempted to minimise the impact of these differences by adjusting for the above variables in our survival models.

Outcomes

Primary outcome

The total follow-up time was over 246,000 days. Patients who presented during the GEDI intervention periods, during the GEDI working hours, were more likely to be discharged (See Fig. 1). After 24 h, the discharge probability for the two intervention groups was close to 0.50, whereas the three control groups were closer to 0.35 (See Fig. 1). The adjusted hazard ratios, for discharge of patients presenting in the GEDI intervention periods, ranged from 1.19 (full intervention during GEDI working hours, 95% CI 1.13, 1.24) to 1.31 (interim intervention outside GEDI working hours, 95% CI 1.23, 1.39). As expected, many of the patient characteristics influenced discharge, with older patients and those arriving by ambulance less likely to be discharged. There was also a slight trend over time for increased discharge (See Table 2).

There was a reduction in length of hospital stay, for admitted patients, of approximately 1 day between the pre-GEDI time period and the two GEDI intervention periods (Table 3).

Table 1 Demographic and clinical characteristics of the sample

Characteristic	Pre-implementation Group n = 9066	Interim-implementation Group *n* = 25,675	Full-implementation Group n = 10,242
Age - mean (sd)	81 (7)	81 (7)	81 (7)
Male gender – n (%)	4349 (48)	12,543 (49)	5073 (50)
Presenting conditions – n (%)			
Cardiac	2441 (27)	6586 (26)	2439 (24)
Trauma	1557 (17)	4674 (18)	1860 (18)
Gastrointestinal	828 (9)	2259 (9)	914 (9)
Respiratory	805 (9)	2102 (8)	883 (9)
Neurological	735 (8)	2221 (9)	865 (8)
Other (20 codes)	2696 (30)	7830 (30)	3273 (32)
Missing	4 (< 0.1)	3 (< 0.1)	8 (< 0.1)
Arrived by ambulance- n (%)	7196 (79)	19,830 (77)	7746 (76)
Australian Triage Score Category – n (%)			
Resuscitation	139 (2)	406 (2)	146 (1)
Emergent	2521 (28)	6968 (27)	2554 (25)
Urgent	4219 (47)	12,040 (47)	4754 (46)
Less urgent	2043 (23)	5776 (23)	2581 (25)
Non-urgent	144 (2)	485 (2)	207 (2)

N.B. Some column percentages do not add to 100% because of rounding

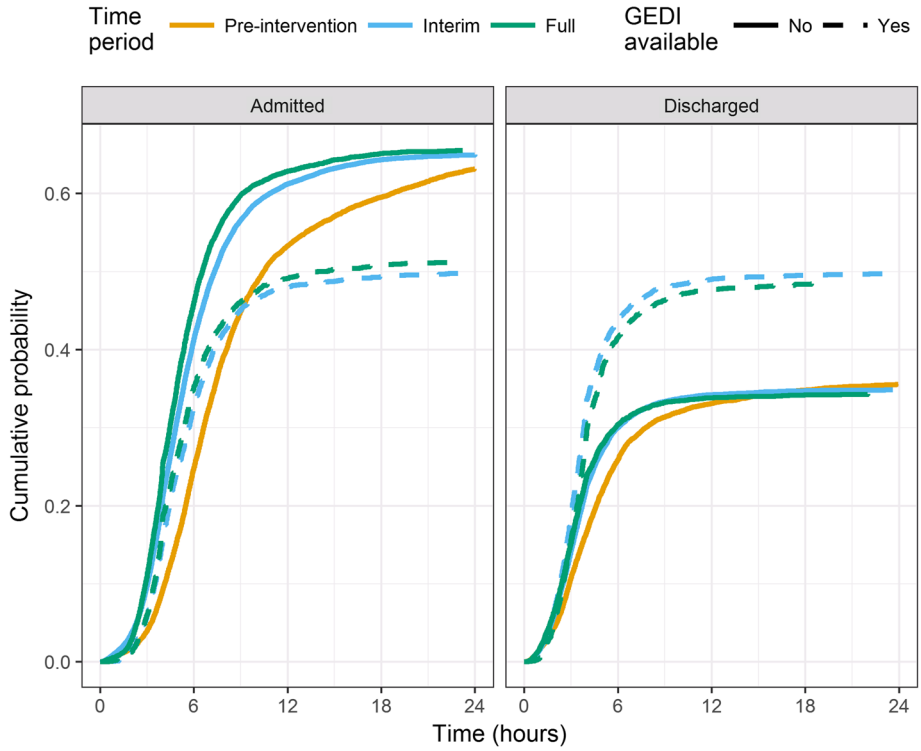

Fig. 1 Cumulative incidence of admission or discharge in the first 24 h after presentation to ED for the five intervention groups. Results are not adjusted for potential confounders

Table 2 Hazard ratios and 95% confidence intervals for discharge using a Cox survival model with 5 GEDI groups

Predictor	Hazard Ratio	95% CI
Time (per 100 days increase)	1.02	1.02, 1.03
Age (per 10 year increase)	0.95	0.94, 0.97
Male sex	1.01	0.99, 1.04
Arrival by ambulance	0.72	0.70, 0.75
Australian Triage Score 1 and 2	0.94	0.90, 0.97
Australian Triage Score 3	0.82	0.80, 0.85
Presented from RACF	0.92	0.89, 0.95
MDC Diagnosis = Cardiac	0.95	0.92, 0.97
MDC Diagnosis = Trauma	1.22	1.18, 1.25
GEDI group (primary outcome):		
Interim outside GEDI hours	1.31	1.23, 1.39
Interim during GEDI hours	1.20	1.11, 1.29
Full outside GEDI hours	1.47	1.41, 1.53
Full during GEDI hours	1.19	1.13, 1.24

NB Reference for GEDI is pre-intervention. Reference for ATS is 4&5. Reference for diagnosis is all other matched diagnostic codes
Legend: *MDC* Major diagnostic category

Secondary outcomes

The length of stay in the ED was shorter for all the GEDI intervention groups compared with pre-intervention (see Table 4). By comparison there was only the likelihood of a shorter hospital length of stay in the interim intervention period during GEDI hours, when compared to pre-GEDI.

There was no clear difference in the risk of death for any of the GEDI periods when compared with pre-GEDI (see Table 4). We note the statistical power for this comparison is relatively low because deaths were rare. The likelihood of a shorter ED or hospital length of stay increased 2% for every 100 days of the trial.

Re-presentation for the same or any cause based on MDC was not altered by the intervention. The likelihood of re-presentation for other causes was increased if presenting in the interim GEDI period during working hours (see Table 4).

For the economic evaluation, we estimated a number of recursive model specifications to check for robustness and to test the sensitivity of the coefficient estimates. This analysis revealed that when compared to the pre-GEDI period, costs per hospital admission in both the full-GEDI and interim-GEDI period were lower (full-GEDI period = –$1469 [95% CI, $1105, $1834] and interim-GEDI period = –$1018 [95% CI, $709, $1326].

Table 3 Comparison of Hospital length of stay (days) by GEDI intervention period using mean differences, 95% confidence interval for the mean difference and *p*-value from an unpaired t-test

Comparison	Mean difference	95% CIs	P-value
Pre vs Interim	−0.96	−1.02, − 0.90	< 0.001
Pre vs Full	−1.05	− 1.12, − 0.98	< 0.001
Interim vs Full	− 0.09	− 0.13, − 0.04	< 0.001

Discussion

Principal findings

In this pragmatic trial we aimed to control for a range of factors that previous studies have shown influence outcomes for older adults who present to the ED. The results indicate that the GEDI model increases the likelihood of discharge, decreases ED and, to some extent, hospital length of stay and costs, with no effect on same cause re-presentation or mortality. Older patients who presented in the months when the GEDI model was in place, and were subsequently admitted to hospital, spent 1 day less in hospital per admission, compared with patients presenting when no GEDI model was implemented and this resulted in cost saving. Other factors also influenced these outcomes with general changes in service provision over time increasing the likelihood of discharge directly from ED.

Strengths and limitations of the study

This study capitalised on an opportunity to test the effect of a new model of service delivery over the course of its development and once the final version had been determined. Often new models of service delivery are not sustained [27]. Similarly, the final model tested in this intervention did not perform as well as the interim model (possibly representing the enthusiastic efforts of the innovative clinicians that began the change process) but it still outperformed the model employed prior to the commencement of the intervention.

While this pragmatic study used a pre-post design rather than a randomised controlled design to test the effect of the GEDI intervention, design features were incorporated to provide greater generalisability of the results. Our analysis included a variable to adjust for other changes that may have been occurring, in the study ED, over time (for example, maturation of the whole team or other interventions that were introduced to decrease ED length of stay). We also used the survival analysis taking into account major factors identified in the literature that affect patient outcomes for this cohort.

Functional decline and quality of life are important outcomes for this population. However, these variables are not routinely collected in our hospital and hence could not be examined here because of our retrospective study design.

Comparison with other studies

There are a range of other models of care which aim to improve outcomes for older adults presenting to the ED.

Table 4 Secondary outcomes for GEDI Intervention

OUTCOME	Interim during GEDI hours Ratio (95% CI)	Interim outside GEDI hours Ratio (95% CI)	Full during GEDI hours Ratio (95% CI)	Full outside GEDI hours Ratio (95% CI)
[a]Shorter ED LoS	1.40	1.48	1.28	1.42
	(1.32, 1.48)	(1.42, 1.54)	(1.19, 1.38)	(1.33, 1.52)
[a]Shorter In-Hospital LoS	1.15	1.04	1.00	0.98
	(1.07, 1.23)	(0.99, 1.09)	(0.91, 1.11)	(0.90, 1.06)
[b]Risk of Death	0.32	0.52	1.01	0.77
	(0.08, 1.08)	(0.23, 1.14)	(0.23, 4.43)	(0.18, 3.22)
[a]Less same cause ED re-presentation within 28 days	1.13	1.04	1.21	1.19
	(0.89, 1.42)	(0.89, 1.22)	(0.88, 1.66)	(0.89, 1.58)
[a]Less any cause ED re-present within 28 days	1.18	1.06	1.21	1.10
	(1.02, 1.37)	(0.96, 1.18)	(0.99, 1.49)	(0.91, 1.32)

[a] hazard ratio, [b] prevalence ratio, *NB* Reference for GEDI is pre-intervention

Some are outreach models or Hospital in the Nursing Home models in which ED or hospital clinicians travel to RACFs aiming to prevent transfer [15, 37–40]. These outreach models, unlike the GEDI model, may de-skill RACF staff and result in general medical practitioner disengagement. They may also be very expensive, although it is difficult to understand cost as few robust cost analyses have been undertaken [1]. Additionally, these models only work for the small proportion of older adults living in RACFs.

Other models focus on enhancing the care within the ED. The senior work up assessment and treatment (SWAT) model [41], the Triage and Rapid Elderly Assessment Team (TREAT) model [12], the Aged Care Services Emergency Team (ASET) Program [42], the GEDI WISE transitional care nurses [43] and a range of other models that combine some level of increased geriatric assessment and liaison with community services [44] have been described. Of these models only the first three report rigorous evaluative research outcomes. Unlike our GEDI model the SWAT [41] model, of increased senior medical officer involvement, did not improve overall ED length of stay but did improve length of stay on high volume days and for discharged patients. The TREAT [12] model which involved a highly skilled specialist team of consultant geriatricians and physicians, nurse practitioners and allied health staff, did reduce hospital admission but as there was no economic evaluation it is not possible to compare the costs of this service with the GEDI model. The GEDI WISE [43] transitional care model is the model most similar to GEDI and also resulted in decreased admissions. However, there is no specific physician champion in the GEDI WISE model and the increase in re-presentation seen in their model, but not seen in our GEDI evaluation, may be because of the important role played by the senior medical officer. The physician champion role, in this nurse-led model, is unique to GEDI and ensures there is multi-disciplinary involvement and that the care of older adults is seen as being as important as the care of other cohorts within the ED. In addition, the provision of post ED support to prevent re-presentations in the community dwelling cohort is dependent upon a supportive community-based health network. The ED physician champion plays a role in ensuring collaboration between the ED setting and community health services to provide continuity of client care.

Meaning of the study

Focusing on improving the care of older adults in the ED and on strategies to prevent inappropriate ED presentation by older adults is of increasing importance in light of population ageing. Sinha and colleagues [17] identified the eight components of ED-based models of care for non-institutionalised older adults. The GEDI model was developed to include all of these components. A key finding of Sinha et al. [17] was that, "collaborative working practices are critical in model implementation and rely on the interpersonal skill sets of the clinicians delivering those initiatives and their ability to earn the trust and respect of their colleagues within and beyond the ED" (p. 680). Our findings suggest that it is possible to have advanced practice nurses, rather than nurse practitioners, in the GEDI model provided there is a strong physician-champion who supports, advises and works collaboratively with the senior nurse. This provides a relatively inexpensive yet effective model of care that reduces length of stay and increases discharge of older adults from the ED, when appropriate.

Conclusions

There is a need for senior managers and policy makers to reconsider the models of care employed in ED service delivery for vulnerable groups. It is well accepted that

emergency care for paediatric patients requires specialized resources including equipment, drugs, trained personnel, and facilities [45]. Yet for other vulnerable groups the provision of specialist care within the ED or increased training in a specialty for ED clinicians is not recognised. The results of this study suggest that having teams of emergency clinicians (doctors and nurses) with previous training and experience in geriatrics and community care, who are focused on streamlining the care of frail older adults in the ED, improves outcomes and cuts costs. Furthermore, these benefits can be sustained over time and while they may slightly decrease when the innovative team that effects change have moved to more senior roles, overall improvement remains. Finding solutions that maximise the outcomes for older people living in RACFs, who develop an acute illness, will involve greater inter-sectoral collaboration and require further research.

Abbreviations

CEDRiC project: Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration project; ED: Emergency Department; GEDI: Geriatric Emergency Department Intervention; HREC: Human Research Ethics Committee; PHN: Primary health network; RACF: Residential aged care facility

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Availability of data and materials

To guarantee the confidentiality of anonymised patient data and health information only the authors have had access to the de-identified data during the study. The linked data were provided by the hospital and health service under a research agreement that does not permit sharing.

Authors' contributions

The development of the intervention was led by EM and AT with input from MW, JC, AG and members of the external advisory committee. The research study was planned by MW and EM with input from all other authors and input from members of the advisory committee. The analysis of data was planned and executed by AB in consultation with MW, AC and EM. The health economics component was undertaken by K-HN in consultation with MW, AC and EM. The project was managed by AC assisted by MB and CJ with input from all authors and the external advisory committee. MW led the interpretation of the data and the drafting of the manuscript with help from all other authors. All authors contributed to revisions of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study received ethics approval and approval for a waiver of consent (as the data used were de-identified retrospectively accessed clinical and financial records) from The Prince Charles' Hospital Human Research Ethics Committee (HREC), University of Sunshine Coast HREC with associated Public Health Act and site specific approvals for the relevant Hospital and Health Service as per the following list. HREC/14/QPCH/220, HREC/15/QPCH/290, A/15/718, SSA/15/QNB/40 and SSA/16/QNB/17. Agreements were in place between all partner organisations.

Consent for publication

N/A. No individual data are presented.

Competing interests

All authors have completed the ICMJE uniform disclosure form at www.icmje.org/coi_disclosure.pdf and declare: that this study was supported by competitive grants from the Australian Government (Department of Social Services and Department of Health) and the Wishlist Foundation; that this study was supported financially by the Sunshine Coast Medicare Local and received in kind support from the Sunshine Coast Hospital and Health Service and the University of the Sunshine Coast; no financial relationships with any organisations that might have an interest in the submitted work in the previous 3 years; no other relationships or activities that could appear to have influenced the submitted work.

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Innovation and Translation

Nurse-led multidisciplinary initiatives to improve outcomes and reduce hospital admissions for older adults: The Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration project

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Objectives: *This article describes the Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) project.*

Methods: *CEDRiC is designed to improve the health outcomes for older people with an acute illness. It attempts this via enhanced primary care in residential aged care facilities, focused and streamlined care in the emergency department and enhanced intersectoral communication and referral.*

Results: *Implementing this approach has the potential to decrease inappropriate hospital admissions while improving care for older people in residential aged care and community settings.*

Conclusion: *This article discusses an innovative way of caring for older adults in an ageing population utilising the existing evidence. A formal evaluation is currently underway.*

Policy Impact: The nurse-led Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) model of care can improve the health outcomes and reduce the health service costs associated with the care of older adults with acute illness. CEDRiC enhances the coordinated care of older people and reduces potentially avoidable hospital admissions. The current siloed funding models between the Commonwealth and the States and Territories require innovative cross-sectorial approaches.

Practice Impact: Increasing the availability of skilled practitioners with knowledge in geriatric syndromes in primary care can potentially reduce hospital admissions.

Key words: *advanced practice nurse, aged care, coordinated care, emergency department, geriatrics, hospital avoidance.*

Introduction

As people age, there is an increased risk of developing chronic illness, cognitive deficit and frailty [1]. In Australia, emergency department (ED) presentations of persons aged 65 years and above from community and residential aged care are reported at more than 20% of total presentations [2]. Despite this high presentation rate, ED staff do not have specific geriatric assessment skills [3] and the incorrect medical diagnosis of older people is reported to be around 12% [3]. This correlates with an increased hospital length of stay [4] with subsequent increases in health system costs and decrease in quality-of-life outcomes for patients.

Innovations designed to improve care for older people in their place of residence, in either the community or residential aged care facilities (RACFs), can assist in decreasing the iatrogenic complications of inappropriate hospital transfer when transfer can be avoided [3,5]. The need for transfer to the ED by the older person is influenced by multiple interrelated factors. These include the perceived urgency of their condition, ability to access primary healthcare services such as general practitioners (GPs) and the affordability of primary care [6].

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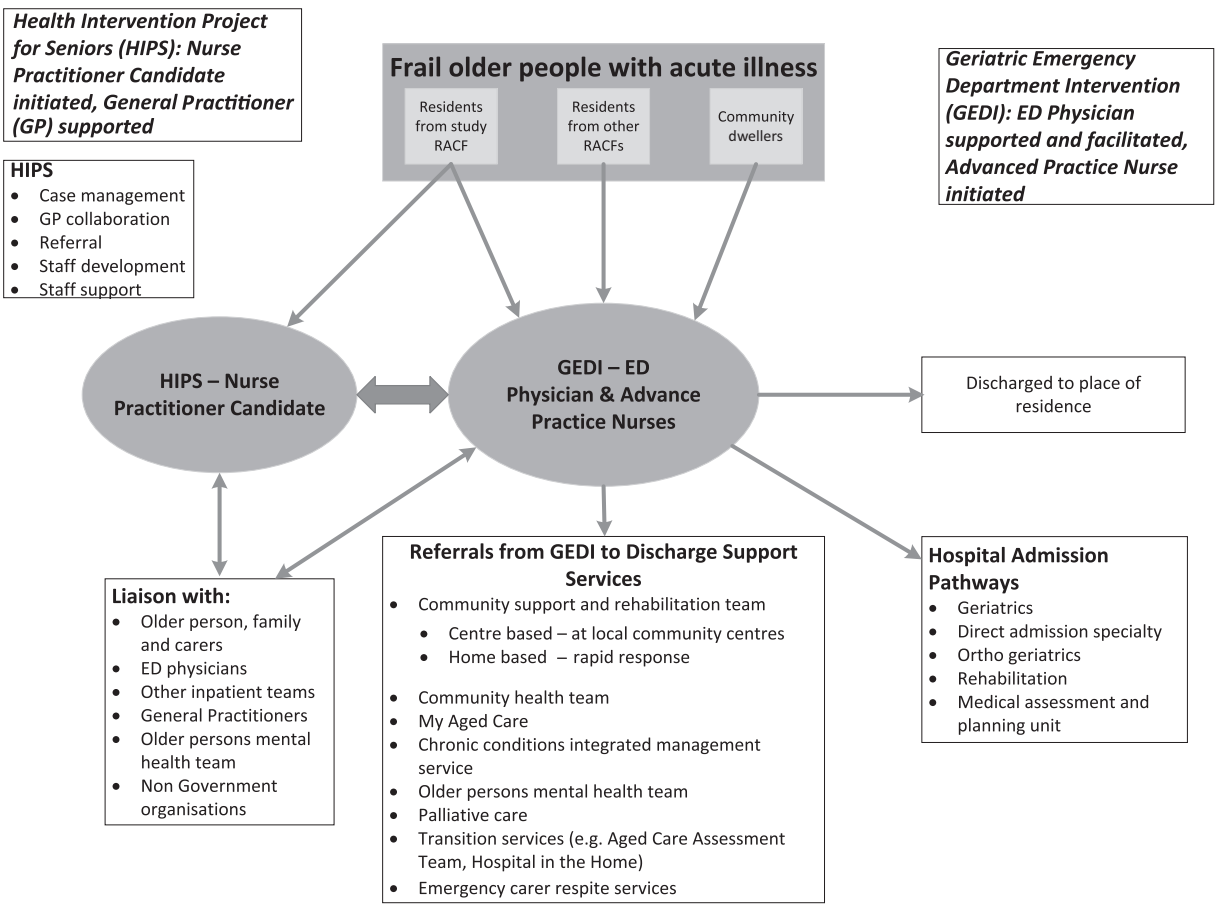
In Australia, funding for RACFs and primary care in the community lies with the Commonwealth Government, while the public hospitals are funded by the State Governments. This division of funding sources creates an added incentive to develop projects that can bridge this divide and be sustainable across both sectors. This article describes the Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) project, developed to address these funding issues while providing quality health care for older people living in both RACFs and the community.

CEDRiC project

The CEDRiC project began in 2013 in response to high hospital admission rates of acutely unwell older adults presenting to a regional ED in South East Queensland. The project built on the designs of the previous interventions such as the Triage and Rapid Elderly Assessment Team, Aged Care Emergency (ACE) service, models undertaking comprehensive geriatric assessment (CGA) in the ED, the Geriatric Nurse Liaison Model and assessment of older patient flow in the ED leading to the establishment of a frailty unit [7–12] that reported improved outcomes. Several issues were identified from these earlier studies that needed to be addressed in developing an improved model of care. These included the following: supporting the provision of additional clinical resources within RACFs; promotion of Advance Care Directives (ACDs) and End of Life Pathways for palliative care [7]; rapid older person assessment and CGA in the ED [8]; and enhanced education in gerontology care [9–12]. These issues were considered, modified and incorporated into the CEDRiC project. Utilising a system-wide approach to care for older people, the project was delivered via two geographically separate services. These were the Geriatric Emergency Department Intervention (GEDI) based in the ED at the local regional hospital and the Health Intervention Program for Seniors (HIPS) within several RACFs operated by one provider across different locations within the same region. The nurses providing these services communicated with GPs and health professionals from the existing services offered under the umbrella of community health: community gerontology; rapid response community discharge liaison; and the Aged Care Assessment Team (Figure 1). Importantly, HIPS and GEDI communicate and collaborate with each other but operate independently. This was necessary to address the issue of cost shifting between services that are funded by different levels of Government in Australia.

Figure 1: System wide Care coordination through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC) project.



Methods

Geriatric Emergency Department Intervention

Geriatric Emergency Department Intervention is a nurse-led and physician championed the intervention delivered in the ED. The role of the GEDI ED physician is to: (i) facilitate implementation; (ii) identify areas the GEDI nurses can support the medical team to enable timely assessment; and (iii) promote a culture of change towards care of the older person in the ED. This role is crucial in embedding GEDI not only into the ED but also to the wider hospital community and is a unique feature of GEDI.

Interventions built into GEDI were derived from the literature and included the following: (i) Combined senior medical review; (ii) comprehensive geriatric assessment and supported discharge [8]; (iii) ED staff education in geriatric emergency medicine and nursing care; and (iv) implementation of care pathways in common geriatric syndromes [12]. Interventions such as these were included as they have demonstrated improvements in reducing length of stay, hospital admission and complication rates in older adults [8,10–14].

The GEDI nursing team is led by a clinical nurse consultant providing clinical expertise, management of the team, implementation of policy and procedure around GEDI and facilitation of the model into the ED. The responsibilities of the GEDI team include clinical expertise, collaboration, rapid assessment and management of older persons, provision of simple point of contact in the ED, provision of education for ED staff, facilitation of discharge and direct referral to inpatient and community services [15]. Two GEDI clinical nurses are rostered to the ED on overlapping shifts from 07:00 to 17:30 Monday to Friday and one nurse 07:00 to 15:30 on weekends. These clinical nurses provide a clear communication pathway both internally and externally: internally between different service providers in the ED and hospital and externally to the community and RACF-based services. The GEDI nurses aim to see every patient presenting from a RACF and screen all non-RACF residents aged 70 years and above to identify those who are frail and can be prioritised for discharge or admission. The role of the GEDI nurse is to gather relevant clinical information to contribute to disposition planning with the medical team. This includes information from the patient, family and carer in the ED to ensure they are actively engaged in decisions that affect their health. Such information contributes to medical disposition planning via shared decision-making where the patient, family and carer are provided with at least two medically reasonable options and the decision centres on patient and carer values and preferences [16]. The shared decision-making aims to prevent the potential complications for frail older people that often result from being transferred to hospital [7,17].

If the GEDI team identify the older person is at high risk of requiring the ongoing interventions, a targeted geriatric assessment is undertaken. This distinguishes the degree of functional, social and/or cognitive impairment including recognition of delirium. For persons who are assessed as being at risk of poor short-term outcomes, such as functional decline and unanticipated ED re-presentations, the GEDI nurse engages additional emergency physician, geriatrician, allied health or nursing intervention. Examples of unanticipated ED re-presentations include the following: uncontrolled pain, functional decline, or recurring symptoms related to acute or chronic disease. For those who require admission, the GEDI team provides guidance and facilitates the selection of the most appropriate admission pathway, for example direct admission to orthopaedics or gerontology [15].

Health Intervention Program for Seniors

The HIPS component of CEDRiC utilised a nurse practitioner candidate (NPC) to provide comprehensive assessment, communication of acute care needs to the GP and to facilitate care within the RACF with existing staff. This aimed to foster the development of a collegial relationship between the NPC, GPs and RACF staff. This approach provided GPs with the opportunity to review the clinical skills and work ethic of the NPC throughout the developmental phase of the CEDRiC project. The aims of this approach were to:

- prevent the GPs potentially viewing the role as competition to their existing service as the NPC is unable to bill the national insurance scheme, Medicare;
- enable the NPC to demonstrate the skill set of the role and develop a professional relationship, centred on trust, with GPs;
- facilitate close supportive relationships between the NPC, geriatricians and ED physicians who provide mentorship, additional practicum placement for the NPC, weekly case review and professional development opportunities;
- provide comprehensive assessment, communication of acute care needs to the GP and to facilitate care within the facility with the existing staff; and
- facilitate organisational change management processes.

In Australia, the Masters-level qualification that prepares the candidate for endorsement as a nurse practitioner (NP) can be studied full or part time and will require at least 1.5 years of full-time study. During this time, the NPC will begin to develop professional relationships with the GPs who visit the RACF. This will underpin the development of the collaborative agreements between the GPs and the NP that are necessary for practice. These agreements are required so that the NP can access Medicare billing rights. The HIPS NPC role consists of both clinical and administrative responsibilities are listed in Table 1. Once endorsement and employment as an NP is achieved, the scope of practice increases to include prescribing of medications and ordering appropriate diagnostic tests and interventions. Within CEDRiC, the role of the NPC is to work with GPs

Table 1: Health Intervention Program for Seniors (HIPS) nurse practitioner candidate responsibilities

HIPS nurse practitioner candidate
Clinical responsibilities • Communication with GPs, other community health-care professionals and the GEDI team; • Identification of deteriorating older people, assessment and diagnosis of conditions of older people; • Collaboration with GPs for more timely interventions enabled through more comprehensive clinical assessment of RACF residents; • Provision of early intervention for older people whose clinical condition is deteriorating in consultation with the GP; • Promotion of Advance Care Planning.
Administrative responsibilities • Facilitation and establishment of policies and procedures relative to the role; • Creation of clinical pathways for the deterioration of chronic disease and other common conditions that often lead to avoidable hospitalisation; • Provision of formal education of care staff and clinical team members; • One-on-one impromptu education of care staff and clinical team members; • Upskilling of clinical team members through discussions and conveying tacit knowledge in the context of care; • Professional education/clinical exposure in ED to enhance skill base and knowledge of the ED setting for translation into practice within the aged care service setting.

ED, emergency department; GEDI, Geriatric Emergency Department Intervention; GPs, general practitioners; RACFs, residential aged care facilities.

to provide primary care for acutely unwell residents. The NPC works Monday to Friday from 7 am until 4 pm reviewing residents across several sites.

The existing interventions in RACFs designed to reduce hospital transfer include the implementation of clinical pathways within RACFs [7], the implementation of advanced clinical roles (such as NPs) within RACFs [18] and, more recently, the ACE service providing a combination of strategies [19]. Overwhelmingly, the successful elements from these studies were focussed on ACD in aged care facilities, implementation of NPs and better collaboration and communication between RACFs, GPs and EDs. These elements were built into the NPC primary care role.

Results

Service coordination

A critical feature of the CEDRiC project is the coordination of care between the HIPS NPC and the GEDI team which relies on enhanced communication strategies. In instances where an aged care resident is acutely unwell and unable to be cared for in the aged care facility, the NPC communicates with the GP, other primary health-care providers and the GEDI team to determine the best course of action and treatment. Should hospital transfer be required, the NPC coordinates the goals of transfer with the GEDI team. This enables streamlining of the interfacility transfer and subsequent assessment and admission processes through the ED.

The GEDI team facilitates professional education and clinical experience in the ED for the NPC during the candidacy phase to enhance the acquisition of skill base and knowledge of the ED setting. The acquisition of this knowledge and skill base is then translated into practice within the RACF promoting opportunity for the upskilling of the existing RACF staff. Mentoring and supported decision-making by the GEDI team enables the NPC to identify deterioration in the resident at an early stage so that more timely interventions can be implemented in the RACF to reduce unnecessary hospital admissions. Such interaction is pivotal in CEDRiC to build capacity and support for NP candidacy and improve communication and links between the RACF and local hospital and health services.

Discussion

Lessons learned and policy implications

As CEDRiC has developed, challenges have been faced and addressed. The biggest challenge for the CEDRiC project has been establishing commitment with the key staff in clinical areas, health service management and executive. Implementing practice change into clinical areas and organisations is a process requiring time, repeated exposure to the innovation, education and feedback on the successes and challenges [20]. To facilitate this, increased dissemination of information about the CEDRiC project including HIPS and GEDI, within the clinical areas, has occurred to facilitate awareness of the innovations. Communication strategies included the following: (i) Development of brochures; (ii) staff education sessions; (iii) utilisation of high-visibility bright pink shirts; and (iv) a GEDI communication board. The communication board displayed CEDRiC statistics, regular intervention updates, research-based literature on emergency geriatric care and an open forum area for staff feedback on service improvement. In the RACF, important elements for establishing commitment included the following: (i) Staff familiarisation meetings with the NPC; (ii) staff education; and (iii) ensuring the NPC did not assume responsibility for the care of acutely unwell residents but rather supplemented and supported primary carers. In this way, RACF staff upskill and become more confident with the care they provide.

Clinical staffing has been challenging. The right mix of staff to cope with both the complexities of care of the older person and the fast-paced environment of the ED is an issue for the GEDI team. The choice of a NPC for HIPS rather than commencing with an endorsed NP supports an increasing acceptance by GPs and improving acceptance of the role with the existing care staff of the facility. However, there were disadvantages associated with the NPC not being able to prescribe medication or bill for service delivery via Medicare. For example, some delays in the prescription of medication or lack of access to GPs resulted in hospital transfer that might have been avoided had the HIPs service been able

to prescribe medications or commence treatments at the same level as a NP. Once the NPC is endorsed, it is hoped the transition to NP will further enhance service delivery.

Establishing and maintaining funding for the interventions has required extensive efforts from the collaborating team. Ongoing research evaluation aims to provide further evidence of improved patient/resident outcomes and cost saving to create an environment for sustainability of the services. However, cost saving at the health service, funded by the State Government, does not equate to income gained for the aged care facility, which is funded by the Commonwealth. This siloed health funding model in Australia adds complexity to the developing cross-sectorial interventions. Increasing discharges from the ED potentially increases the use of community support services with cost consequences. Robust evidence is required to increase the awareness of where health-care costs can be redistributed effectively. Policy change and government support for successful, cost-effective models is required.

Further research to determine the evidence-based interventions that can improve the care of the acutely unwell older person in the primary care setting to avoid transfer where appropriate and in the ED is essential. Once such interventions are positively evaluated, implementation into other health services can occur ensuring quality services are available to all older adults.

Conclusion

The CEDRiC project aims to improve the care of frail older adults. The teams involved in HIPS and GEDI work collaboratively with the older person's usual GP who remains the cornerstone of their health care. Additional community health and primary care services are implemented, as needed, to improve acute care of the older person. It is hoped that the professional and collaborative affiliations made during the development of CEDRiC and the evaluative research project underway will provide the evidence and support the structures required to successfully translate this project and share the vision of improved health-care services for older people. The increased collaboration, knowledge and skills of the clinical and multidisciplinary teams will also benefit from this vision.

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A pragmatic trial of a Nurse Practitioner candidate role in a residential aged care facility: a descriptive correlational study

Submitted to Collegian (Journal of the Australian College of Nursing)

Title: Enhanced primary care provided by a Nurse Practitioner Candidate to aged care facility residents: A quasi-experimental study

Running Head: NPC in Aged Care Facility (30 char including spaces)

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Abstract

Background: Residents of aged care facilities are at risk of potentially preventable hospitalisation. This risk is increased for those who are older, have more co-morbidities, are malnourished, taking multiple medications and have a history of previous falls.

Objective: To evaluate the impact of a Nurse Practitioner Candidate delivering care to acutely ill older adults living in aged care facilities.

Methods: Nested in a larger program of research, this study comprised i) a descriptive analysis of interventions performed by the Nurse Practitioner Candidate and ii) a quasi-experimental study comparing patient and health service outcomes of residents transferred to the local hospital emergency department in the 12-month pre-intervention period (control group) and residents transferred in the 12-month post-intervention (intervention group).

Intervention: A Nurse Practitioner Candidate providing early intervention to residents with acute illness. This included: advanced assessment, enhanced primary care with the General Practitioner, advanced care planning, and opportunistic education to facility staff.

Setting: One aged care provider of approximately 300 beds in Queensland, Australia.

Results: The Nurse Practitioner Candidate completed 1,790 consultations with 266 residents over the 12-month Intervention period. The intervention group had shorter mean length of stay in the emergency department (Pre:342mins; Intervention:283mins; p=0.004), and hospital (Pre:2.4days; Intervention:1.7days; p=0.037) compared to control group with no change to re-presentation rates. Cost of ED presentations for residents from the intervention facility was less than from other aged care facilities. There was a 300% increase in the number of residents with Advanced Care Planning post-intervention.

Conclusion: Introduction of a Nurse Practitioner Candidate working with General Practitioners improved outcomes for aged care facility residents transferred to hospital and increased documentation of advance care planning.

Keywords: older people, complex interventions, nurse practitioner candidate, emergency department, residential aged care

Manuscript

Introduction

The growing dependency needs of ageing populations requires increased availability of long-term care internationally (1). In Australia, residents living in aged care facilities (ACFs) increased 13.3% over the period 2005-2013. Currently, there are more residents aged over 85 years, and more with high care needs than prior to 2005 (2). Residents of ACFs are at risk of hospitalisation and this risk is increased for those who are older, have more co-morbidities, are malnourished, taking multiple medications and have a history of falls (3, 4).

Literature review

Internationally in ACFs, clinical skill mix, confidence of clinical staff, ratios of clinical staff to residents and difficulty accessing primary care have resulted in increased transfer of residents to emergency departments (EDs) (2, 5-8). Increasingly, research is focused on trialling innovative interventions aimed at reducing the unnecessary transfer of residents from ACFs to the ED (9-14). Results of these studies demonstrate that interventions such as increasing numbers of residents with Advance Care Planning (14), primary care outreach services (10), hospital in the nursing home (11, 12) or telephone triage (15), may increase the capacity to treat the resident in the ACF, avoiding transfers or admissions to hospital for procedures (10).

There is beginning evidence that Nurse Practitioner (NP) care for ACF residents results in reduced health service utilisation, decreased rates of transfer and admission to hospital; and decreased length of hospital stay post-transfer (16-18). Issues that have slowed the adoption of this model of service delivery are the poor quality of research-based evidence and low levels of acceptance of NP-led care by other health professionals. Although General Medical Practitioner (GP) acceptance of NPs is increasing, resistance to the role by management and other nursing staff persists (19).

This paper presents outcomes of a quasi-experimental study evaluating the impact of a Nurse Practitioner Candidate (NPC) delivering care to acutely ill older adults living in several ACFs operated by the same provider in Queensland, Australia. There were three aims of this

study: (i) to describe the occasions of service provided by the NPC; (ii) compare the outcomes for two groups of residents transferred to the ED; those in the two 12 month periods before (control) and after (intervention) the implementation of the NPC and; (iii) compare the costs for residents transferred during the intervention with those of residents who transferred from other ACFs.

Research Design

This study combines a descriptive study of ACF residents consulted by an NPC (part 1) with a quasi-experimental study of the effect of the provision of a NPC on the outcomes of residents transferred to one local ED (part 2) and cost comparison of transfers from the intervention ACF with transfers from other ACFs (part3).

Participants and setting

The records maintained by the NPC and records from the clinical information system of the local public hospital were accessed retrospectively for this study. The pre-intervention period was 1 April 2013 to 31 March 2014 and the intervention period was 1 July 2015 to 30 June 2016. In part 1, the medical records sampled in the NPC group included records of all residents seen by the NPC during the intervention period. In part 2, records of all residents transferred to the local hospital ED during the pre-intervention period with no access to the NPC formed the control group. For the intervention group, records of all residents transferred to the local hospital ED during the intervention period with access to NPC were retrieved. Additional records of transfers from other ACFs were identified from the ED data for cost comparison in part 3. The interval between pre-intervention and intervention periods involved the NPC negotiating and beginning transition into the role. Completion of candidature and process of endorsement as an NP began post intervention in July 2016.

The study setting include three sites operated by one aged care provider. The sites contained approximately 306 beds in total and were geographically close in location. All three sites had what were previously termed low-care beds for residents with minimal care requirements. With national policy change to recognise ageing in place in 1997, all beds were transitioned to provide for residents at any level of care (20). During the study, the NPC was based at the main-site travelling to off-site locations by car when requested or to

provide regular review of residents two days each week. If a resident required hospital care, they were transferred were to one local, government-funded, public hospital ED. At the time of this study, this local ED recorded approximately 50,000 patient presentations per year of which approximately 20% were aged 70 years and over. Approximately 3000 of those transferred were from ACFs.

Intervention

The intervention (nurse-led service) was grounded in the Nursing Role Effectiveness model utilising Shared Decision Making and Recognition Primed Decision Making theory (21, 22). The evaluation occurred while the onsite NP was a candidate (student) rather than post endorsement as a NP. This approach was designed to build trust in the role and facilitate close collaboration with facility staff and with the GPs providing primary care to residents. Supervision for the NPC was provided by a variety of clinicians including the local ED physician and other NPs. During NP candidature, the model of supervision involves some observation of clinical practice and regular meetings with the supervisor to discuss case management. Additionally, this meant each resident's GP remained responsible for their care and the NPC could not independently initiate diagnostic testing or treatment independent of the GP.

The NPC provided primary care for acutely unwell or deteriorating residents to reduce potentially preventable transfer to hospital. In Australia, endorsement as an NP requires that a Registered Nurse has worked in an advanced practice capacity for at least four years and has completed a Masters level qualification involving 1.5 -2 years full-time study or equivalent. The NPC was in the final year of three years of part-time study during the intervention period. Further detail, including the clinical and administrative responsibilities of the NPC is published elsewhere (23). To summarise briefly, the NPC identified or was referred to acutely unwell residents, providing early intervention via advanced assessment. Identification was achieved by regularly visiting all resident areas, discussing resident conditions with all levels of clinical staff of the facility and visiting residents with a history of known comorbid conditions. The NPC also collaborated with the GP in the care of residents, promoted advanced care planning, and provided opportunistic education to ACF staff.

This study occurred in parallel with implementation of a geriatric emergency department intervention (GEDI) in the local ED (24). Communication and care coordination between the NPC and the GEDI nurses for residents who required transfer to hospital aimed to streamline care for each resident (23).

Methods

Data Collection

Data collected during part 1 of the study included: age, gender, number, type and reasons for consultation, NPC assessment, care processes, interventions, NPC care in collaboration with GP care, GP liaison details, GP interventions, and care provided prior to transfer to the ED. Data were recorded by the NPC at time of referral and consultation.

For part 2, outcomes measured for residents transferred to the ED in the pre-intervention and intervention periods included: disposition (hospital admission, transfer to another facility or discharge to ACF), length of stay in the ED or hospital (if admitted), costs, re-presentation within 28 days, mortality and presence of advanced care planning. Data were identified via a retrospective audit of ACF databases and hospital Emergency Department Information System (EDIS), Hospital Based Clinical Information System (HBCIS) and costing data records for all residents of ACFs who had presented to the local hospital ED during the specified periods.

Hospital data were manually cleaned and potential discrepancies identified and corrected where possible. A two-stage process of address checking was used to identify residents from the study ACF as EDIS does not have a specific identifier for ACF residents. The EDIS and HBCIS data were linked by the hospital. This database was then linked manually to the ACF data. Once manual linkage of was completed, identifiers were removed.

Statistical analyses

For part 1, descriptive analysis using frequencies, percentages and measures of central tendency (mean and median) and distribution (standard deviation and interquartile range)

were used to describe the population. For part 2, comparisons of variables in pre-intervention and intervention periods, and between locations (main-site and off-site) were made with appropriate tests of difference (ANOVA/t-test for normally distributed data) and association (Kruskal Wallis/Mann Whitney/Chi-squared tests for non-normally distributed data). A p-value less than 0.05 was considered statistically significant. Pairwise deletion was used for the small instances of missing data. All calculations that include instances of missing data are identified. Data analysed using IBM SPSS statistics 24 software.

For the costs analysis (part 3), propensity score matching was used to estimate the effect of the NPC at the study ACF compared to other ACFs without onsite NPC's or NPs. The model matches the costs for residents transferred to the ED during the intervention period from the intervention ACF with transfer data from other ACFs using resident characteristics such as age, gender and triage category. We then compare the length of stay and costs associated with ED presentation and inpatient occasions of services of these two 'matched' samples. If the two samples can be matched well, the comparison is deemed reliable and statistical inference (in differences in length of stay and costs) can be drawn.

Ethics

This study conforms to the "Statement on Human Experimentation" by the National Health and Medical Research Council of Australia. All data were obtained retrospectively and anonymised post data linkage. Public Health Act Approval for this study was granted waiving the requirement for participant consent for access to data. Human Research Ethics Committee approvals from the associated hospital and health service and university were in place through the study.

Results

Description of groups

This study included approximately 306 ACF beds across the facilities. Due to the nature of providing care to the frail aged, beds can be occupied by more than one individual in a 12 month period. It was not possible to get completely accurate bed day occupancy data from the ACF database.

Part 1: Description of NPC group activity during the intervention period

During the 12-month intervention period, the NPC completed 1,790 consultations with 266 residents, the median number of consultations per resident was four (IQR=7). Residents referred to the NPC were on average 86 years of age and 67% were female. The NPC identified the need for 795 (44.4%) of the total consultations with other referrals made by registered nurses (n=394, 22.0%) and enrolled nurses (n=297, 16.6%). The majority of reasons for referral to the NPC clustered around assessment or management of acute illness (n=794, 44.9%) and assessment or ongoing management of chronic conditions (n=828, 46.4%).

Comparison of NPC and GP interventions

In 164 of the 1,790 episodes of NPC care, where a resident was seen by both the GP and NPC, the primary care interventions suggested by the NPC were the same as those suggested by the GP in 143 (87.2%) cases. In most cases where prescriptions or investigations such as pathology were required (n=214), the prescription or investigation suggested to the GP by the NPC matched the GP request (n=151, 70.6%).

Part 2: Outcomes of residents transferred to ED – pre-intervention and intervention comparison

Description of pre-intervention and intervention groups

The mean age and proportion of females in the ACF who were transferred to the ED were similar for each study group. For residents from all three ACF locations who were transferred to the ED, there were no statistically significant differences between the pre-intervention and the intervention groups for the variables of month or day of the week of presentation; mode of arrival to the ED; triage priority (Assessment: 1=immediate, 2=within 10 minutes, 3= within 30 minutes, 4=within 60 minutes, 5=within 120 minutes); and ED diagnosis (based on Major Diagnostic Code (MDC)).The frequency of transfer per resident was similar for each period (Figure 1).

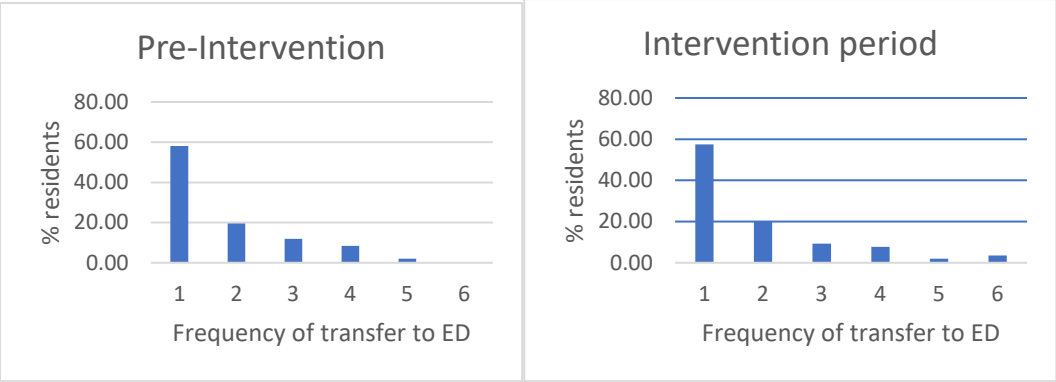

Figure 1: Frequency of transfer to the ED per resident pre-intervention and during intervention periods.

The most common reasons for presentation by Major Diagnostic Category (MDC) were similar between groups; the main four being trauma (Pre 30%; Intervention 27.4%), cardiac (Pre 14.8%; Intervention 17.1%), respiratory (Pre 11.7%; Intervention 10.6%), and infection (Pre 7.8%; Intervention 9.4%). The differences in proportions of residents with different MDC's between study groups did not reach statistical significance (p=0.13). Most transfers to the ED (61.8%) occurred when the NPC was not on duty and only 21.5% of residents transferred had been seen by the NPC in the 48 hours prior to transfer. Similar results are observed for residents seen by a GP with only 27.5% (pre-intervention) and 38.5% (intervention period) being seen in the 48 hours prior to transfer. 50.9% of residents transferred from the ACF during the intervention period were seen by a GEDI nurse in the ED.

Outcomes for residents transferred to the ED compared by study group showed no statistically significant between-group differences for disposition outcomes, nor for ED re-presentations. The lengths of stay in the ED and the hospital, if the resident was admitted, however, were significantly shorter for residents transferred during the intervention period when compared to pre-intervention. In addition, more of the residents seen by the NPC prior to transfer met the National Emergency Access Target (<4 hours in the ED) than pre-intervention group (see Table 1).

Table 1: Comparison of pre-intervention and intervention group transfer outcomes

Outcome	**Pre-intervention (n=283 transfers of 173 residents)**	**Intervention period (n=340 transfers of 181 residents)**	**Inferential statistic**	**p value**
*ED length of stay (Mins) Median (IQR)	342.5 (227)	283 (166)	MWU=40578.0	p=0.004
*Met NEAT (ED <4 hours) f (%)	109 (38.5%)	165 (48.5%)	χ^2(df) =6.3 (1)	p=0.01
Admitted to hospital f (%)	125 (44.2%)	142 (41.8%)	χ^2(df) =1.1 (2)	p=0.57
*Hospital length of stay (Days) Median (IQR)	2.4 (5.0)	1.7 (3.5)	MWU=8700.5	p=0.037
All cause re-presentation to 72 hours f (%)	6 (2.1%)	12 (3.5%)	χ^2(df) =1.08 (1);	p=0.30
All cause re-presentation to 28 days f (%)	41 (14.5%)	65 (19.1%)	χ^2(df) =2.35 (1);	p=0.13
Same cause re-presentation to 72 hours f (%)	3 (1.1%)	7 (2.1%)	χ^2(df) =0.98 (1);	p=0.32
Same cause re-presentation to 28 days f (%)	15 (5.3%)	18 (5.3%)	χ^2(df) =0.00 (1);	p=1.0

NB: MWU=Mann-Whitney U test *: Statistically significant p<0.05

Cost

Residents from the intervention ACF and those transferred from other ACFs transferred to the ED during the intervention period had similar characteristics (demographic and clinical). Using the Propensity Score Matching (PSM) method, we found that, during the intervention period, residents transferred to the ED from the intervention ACF cost less than residents from other ACFs: the average cost differences per ED presentation was $62 [95 CI: $12, $111] (Figure 2, Table 2). There was no statistically significant difference in cost per hospital admission of residents from the intervention ACF versus those from other ACFs (Figure 3, Table 3).

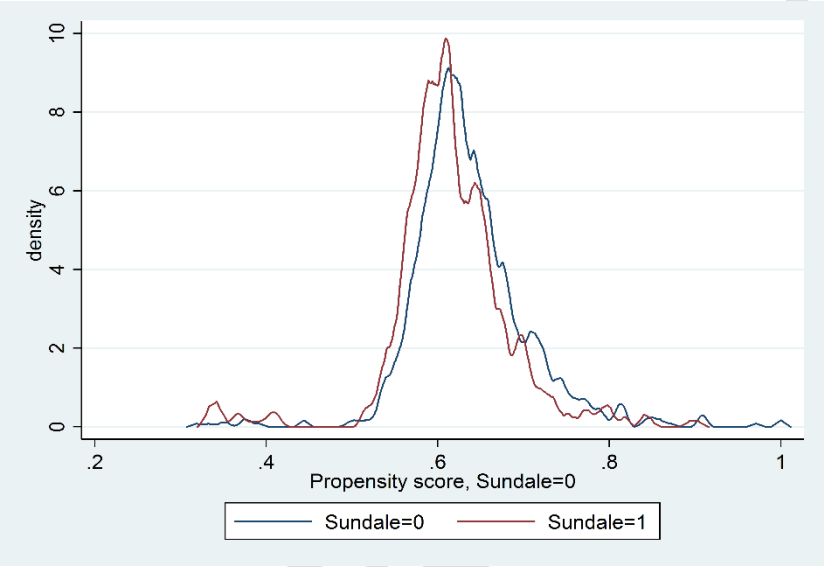

Figure 2: Propensity score matching (PSM) for ED presentation of residents from intervention ACF (Sundale) compared with all other ACFs

Table 2: PSM result - average difference in ED cost between residents from the intervention ACF and other ACFs

Outcome	Coefficient	AI Robust Standard Error	z	P>|z|	95% Confidence Interval
Intervention ACF (1) compared to Other ACF(0)	-62.13684	25.10772	-2.47	0.013	-111.3471 - 12.92662

Figure 3: Propensity scores for hospital admission matched for residents from intervention ACF compared to all other ACFs

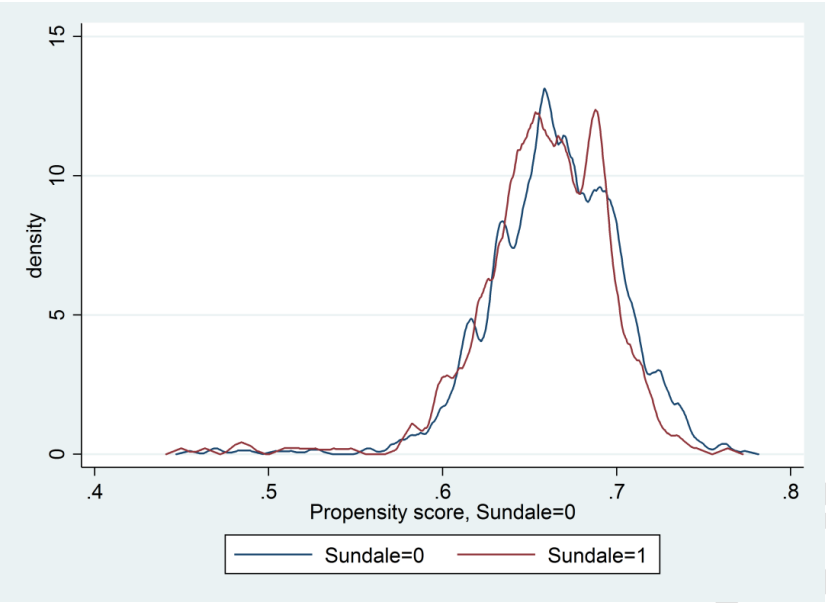

Table 3: PSM result - average difference in hospital admission cost (Sundale vs other ACFs)

Outcome	Coefficient	AI Robust Standard Error	z	P>|z|	95% Confidence Interval
Intervention ACF (1) compared to Other ACF(0)	111.257	548.374	0.20	0.839	-963.5362 1186.05

NB: Treatment-effects estimation: Estimator = PSM; Outcome model = matching; Treatment model = probit; Number of observations = 1564; matches requested = 1 (min 1, max 2)

Advance Care Planning

The number of residents with Advance Care Planning in place increased from 25.3% pre-intervention to 74.7% during the intervention period (P<0.001).

Discussion

Summary of results

This study is the first to evaluate the effect of enhanced primary care provided by a Nurse Practitioner Candidate working with GPs, for residents of ACFs. Most residents, requiring

care were identified by the NPC, not referred by facility nursing or care staff and needed care for both acute and chronic conditions. The primary care interventions proposed by the NPC were similar to those prescribed by the GP. Residents transferred to hospital during the study intervention period required shorter lengths of stay in the ED, cost less than residents transferred from other ACFS and more met the National Emergency Access Target of less than 4 hours. Residents also had a shorter length of stay if admitted to hospital without any change to re-presentation rates. There was also a three-fold increase in the number of residents with Advanced Care Planning in the intervention group. The results of this study align with international evidence recommending NPs for the provision of primary care of residents in ACFs (18, 25, 26). Improved access to primary care by the NPC and improved communication between the study ACF and local ED through the GEDI team are thought to have positively contributed to these outcomes.

The finding from this study that residents transferred to the ED and/or admitted to hospital had reduced lengths of stay is consistent with literature of endorsed NP models of care in ACFs (16-18). Therefore, implementation of this NPC model, which facilitates the building of trust with facility staff and GPs, should be considered in long-term care. Grow your own NP initiatives already operate in Canada aiming to build workforce capacity (27) however no research was identified evaluating health outcomes. It could be argued that the presence of the GEDI team in the local ED may have contributed to the reduced length of stay outcome for residents requiring transfer. The lower cost for residents transferring from the intervention ACF when compared to residents from other ACFs may result from a lower length of stay. We argue that the communication and care coordination between the NPC and the GEDI team also contributed to this reduced length of stay. Research on models of care providing telephone triage for ACF staff considering transfer residents report lower lengths of hospital admission (28, 29).

The large increase in the number of residents with Advance Care Planning found in this study may have an ongoing positive impact on reducing transfers to the ED after the study period. There is high quality evidence that increasing Advance Care Planning in ACFs reduces

unnecessary hospitalisation (30). For residents of ACFs, the prevalence of Advance Care Planning varies, ranging from 5% to 27% in Australia (31), compared to 65% in U.S. (32).

Comparison of plans of care and investigations ordered by the NPC and those suggested by the GP in this study showed high similarity. Other research comparing recommended interventions and medications between Aged Care NPC and GP were found to correlate highly (33). The presence of differences suggested there were areas the NPC was able to learn from the GP. This also provided the opportunity for the GP to build trust in the actions of the NPC and develop collaborative relationships with the visiting GPs. While collaboration was not evaluated as part of this study, more collaborative services with GPs are recommended in the literature (2).

Finally, our finding that referrals to the NPC by ACF clinical staff were low, aligns with recommendations for improvement to the identification of deterioration of residents by ACF staff (5-7). It could be argued that both a lack of skill in identification of deterioration and the overall reduction in care staff contribute to this problem. The dilution of qualified clinical staff in ACFs with nursing assistants increases clinical staff reliance on an unskilled workforce to report signs of deterioration in residents. This study adds to the literature on candidate models but measurement of clinical outcomes for NPCs remains scant and further investigation is warranted.

Limitations

The study linked data from several sources to overcome known limitations due to a lack of quality digital data available from ACFs (34). However, regardless of linkage, we were unable to get precise ACF occupancy data for the pre-intervention period resulting in the inability to compare rate of transfers accurately. Study outcomes were limited by data from only one aged care provider, and the provision of care by one NPC, which may have resulted in unintended bias. We also did not collect data on residents who were not seen by the NPC and did not go to hospital resulting in the inability to assess the intervention as an independent factor in hospital avoidance. It is recommended that future study design include data on all residents regardless of source of primary care provision.

Conclusions

Identification of models of care that improve care for ACF residents and that integrate with existing primary care is critical for policy makers. The ongoing fiscal constraints in health and aged care and an increasing aged population mandate service development. This study demonstrated that while progressing towards endorsement, a Nurse Practitioner Candidate can contribute to the delivery of primary care required for this cohort. Incentives for provision of candidate positions in ACFs could extend their potential for collaborative primary care.

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