Reducing Hospital Transfers from Aged Care Facilities: A Large-Scale Stepped Wedge Evaluation

Carolyn J. Hullick, BMed,[*†‡§] *Alix E. Hall, PhD,*[‡§] *Jane F. Conway, RN, DEd,*[‡¶] *Jacqueline M. Hewitt, RN, MNurs(AdvPrac),*[‖] *Leigh F. Darcy, RN, MAppMgnt(Nursing),*[**] *Roslyn T. Barker, RN, MAM,*[†] *Christopher Oldmeadow, PhD,*[§] *and John R. Attia, MD, PhD*[*†‡§]

BACKGROUND/OBJECTIVES: Older people living in residential aged care facilities (RACFs) experience acute deterioration requiring assessment and decision making. We evaluated the impact of a large-scale regional Aged Care Emergency (ACE) program in reducing hospital admissions and emergency department (ED) transfers.

DESIGN: A stepped wedge nonrandomized cluster trial with 11 steps, implemented from May 2013 to August 2016.

SETTING: A large regional and rural area of northern and western New South Wales, Australia.

PARTICIPANTS: Nine hospital EDs and 81 RACFs participated in the evaluation.

INTERVENTION: The ACE program is an integrated nurse-led intervention underpinned by a community of practice designed to improve the capability of RACFs managing acutely unwell residents. It includes telephone support, evidence-based algorithms, defining goals of care for ED transfer, case management in the ED, and an education program.

MEASUREMENTS: ED transfers and subsequent hospital admissions were collected from administrative data including 13 months baseline and 9 months follow-up.

RESULTS: A total of 18,837 eligible ED visits were analyzed. After accounting for clustering by RACFs and adjusting for time of the year as well as RACF characteristics, a statistically significant reduction in hospital admissions (adjusted incident rate ratio = .79; 95% confidence interval [CI] = .68–.92); $P = .0025$) was seen (i.e., residents were 21% less likely to be admitted to the hospital). This was also observed in ED visit rates (adjusted incidence rate ratio = .80; 95% CI = .69–.92; $P = .0023$) (i.e., residents were 20% less likely to be transferred to the ED). Seven-day ED re-presentation fell from 5.7% to 4.9%, and 30-day hospital readmissions fell from 12% to 10%.

CONCLUSION: The stepped wedge design allowed rigorous evaluation of a real-world large-scale intervention. These results confirm that the ACE program can be scaled up to a large geographic area and can reduce ED visits and hospitalization of older people with complex healthcare needs living in RACFs. **J Am Geriatr Soc 00:1-9, 2020.**

Keywords: geriatric emergency medicine; long-term care; model of care; stepped wedge design; avoidable hospitalization

From the *Belmont District Hospital, Belmont, New South Wales, Australia; †Hunter New England Local Health District, New Lambton Heights, New South Wales, Australia; ‡School of Medicine and Public Health, University of Newcastle, University Drive, Callaghan, New South Wales, Australia; §Hunter Medical Research Institute, Kookaburra Circuit, New Lambton Heights, New South Wales, Australia; ¶Faculty of Medicine and Health, University of New England, Armidale, New South Wales, Australia; ‖Hunter New England Central Coast Primary Health Network, Newcastle, New South Wales, Australia; and the **Hunter Primary Care, Warabrook, New South Wales, Australia.

Address correspondence to Carolyn Hullick, Emergency Medicine, Belmont District Hospital, 16 Croudace Bay Road, Belmont NSW 2280, Australia. E-mail: carolyn.hullick@health.nsw.gov.au; Twitter: @DrcarolynH

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In Australia, aged care homes are known as residential aged care facilities (RACFs). The federal government subsidizes RACFs based on the resident's care needs and their ability to pay. The funding is paid directly to the RACF, with regulation and accreditation through the

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Australian Aged Care Quality and Safety Commission.[1] Entry to an RACF is standardized, with requirements that the older person needs assistance with everyday tasks or health care that can no longer be delivered at home.[1,2] In 2018, more than 220,000 people lived in RACFs, of whom 77% were aged 80 and older.[1] These individuals typically have multiple chronic diseases including cognitive impairment, frailty, and polypharmacy, and they are in the last years of life.[1,3] More than 85% have mental health or behavioral conditions including 51% diagnosed with dementia.[1,4] On average, people live in RACFs for 2.5 years from the time of admission.[1,5]

Aged Care Quality Standards[6] in Australia require that RACFs have sufficient skilled and qualified staff to provide safe and respectful quality care and services. It does not specify the numbers or mix of staff. Most are aged care assistants supervised by registered nurses (RNs).

Australia has a universal healthcare system funded by taxes and Medicare, a federal government levy.[7] Medicare funds outpatient services including primary care. The federal government indirectly funds public hospitals that are managed and administered by the state government. Acutely unwell older people in RACFs with complex healthcare needs require services across the aged and healthcare systems where funding, state and federal boundaries, and professional silos impact the access to care.

RACFs do not have doctors on site. General practitioners (GPs) provide most of the primary care in RACFs with an average of 17 visits a year.[8] Transfers to the emergency department (ED) and hospitalizations are common for older people living in RACFs with acute deteriorations and exacerbations of chronic diseases.[3] They are more likely to present to the ED, be admitted to the hospital, and die in the hospital than older adults living in the community.[9] In many circumstances, the ED is the most appropriate place for urgent care to be delivered[10] for unexpected illness or injury.[11] However, between 13% and 40% of transfers of residents from RACFs to the ED are considered avoidable through delivery of quality clinical care in the RACF.[12-14] Falls, medication errors, inadequate escalation plans for expected deterioration of chronic disease, and palliative and end-of-life care are key contributors to avoidable presentations.[15,16]

The hospital environment poses risks to residents transferred from RACFs such as hospital-acquired infections, deconditioning, delirium, pressure injuries, and further falls.[17-20] When a resident's healthcare needs can be met within the RACF, these risks are mitigated. The Aged Care Emergency (ACE) program was developed to better support acutely unwell residents in RACFs. ACE is a multicomponent service-level intervention designed to support RACF staff in identifying and appropriately addressing the medical needs of residents, with the aim of reducing avoidable ED transfers and subsequent hospital admissions. The pilot for this program involved one hospital and four RACFs, and it demonstrated that residents were 40% less likely to be admitted to the hospital.[21] Based on this success, the program was scaled up[22] to a broader geographic region using a stepped wedge nonrandomized design for evaluation.

Stepped wedge designs have been used to evaluate interventions that lack evidence of effectiveness but are hypothesized to result in a positive outcome with minimal harm. As a pragmatic design, a stepped wedge study is well suited to evaluate complex health service interventions in a real-world setting that may have logistical, financial, and practical constraints.[23,24] In a stepped wedge design, all clusters begin in the control condition and move to the intervention condition at a predetermined time; ideally this is allocated randomly, but due to constraints of implementing and adopting interventions, randomization is not always possible.[25-27] Reasons for not randomizing include logistics such as availability of senior clinical support or geographic distance and travel, impacting assignment of intervention timing.[25]

We report here the evaluation of the large-scale rollout of the ACE program across a large health district with 9 EDs and 81 RACFs. We hypothesized that the introduction of an intervention designed to improve the capability of RACFs to manage acutely unwell residents would result in a reduction in ED visits and subsequent hospital admissions.

METHODS

Study Setting and Participants

The ACE program was implemented across the Hunter New England Health Local Health District (HNELHD), in northern and western New South Wales, Australia, including the metropolitan region of Greater Newcastle along with regional and rural communities. Covering a region approximately the size of New York State (>50,000 square miles), the district has a population of 912,000, with 74,000 people aged 75 and older.[28]

Nine EDs across HNELHD and 81 RACFs that primarily transfer residents to those 9 EDs were engaged in the ACE program. EDs ranged from a small rural ED that saw 11,106 patients in total to a large tertiary referral trauma hospital ED that saw 79,952 patients in 2018.[29] Most hospital admissions for residents of RACFs are routed through the ED. Only these admissions are included in this study.

Study Design

A nonrandomized stepped wedge design was used to evaluate the ACE program. After a 13-month baseline period, the intervention was sequentially rolled out to 11 clusters of RACFs between May 2013 and August 2016 (Supplementary Figure S1). Data were excluded during the first 3 months of the intervention, a wash-in period. Because the intervention required systems changes, training, and more integration between RACFs and hospitals, and based on the pilot study,[21] this 3-month period was required to ensure ACE activities could adequately become part of the delivery of care. The follow-up period included 9-months where all steps received the intervention except for step 11. For pragmatic reasons, early steps focused on metropolitan RACFs; later steps included regional RACFs. As in a hybrid design,[30] the last step (step 11) did not receive the intervention during this evaluation. Because each region received the intervention, the local hospital EDs were partnered with local RACFs and recruited into the program. The stepped

wedge design is well suited to evaluation of real-world programs.[31]

Steps

Each step contained between 4 and16 RACFs, with an average of 7 RACFs. RACFs averaged 84.7 beds with a minimum of 31 beds and a maximum of 188 beds. The duration between steps ranged from 1 to 21 months (Supplementary Figure S1 and Table S1).

Power

Assuming there are 80 beds per RACF per month and 11 RACFs per step, this gives 95% power to detect a difference between seven admissions per 100 beds per month in the pre-period (estimated from the pilot data) to six in the post-period, at the 5% significance threshold.

Intervention

The ACE program[32] is a systemwide intervention designed to improve capability among RACFs to address the needs of acutely unwell residents. The intervention was based on findings from a focus group study[33] with RACF staff and GPs. Table 1 provides further details on the ACE components.

Table 1. Essential Elements of the Aged Care Emergency Program[a]

1. A 24-hour nurse-led telephone consultation service for staff in RACFs provided by RNs in the ED during the day and after hours by RNs from the local general practice organization.
2. Evidence-based algorithms for common acute symptoms and problems experienced by residents from RACFs, developed in consultation with multidisciplinary hospital- and community-based providers along with RACF clinical leaders and the ambulance service.
3. If transfer is required, the telephone call also clarifies the reason for transfer to hospital through establishing the resident's goals of ED care.
4. Once in the ED, the resident receives proactive case management under the guidance of specialist aged care nurses.
5. Empowerment of RACF staff occurs through education in communication techniques including effective clinical handover, recognition of the deteriorating patient, and the evidence-based ACE algorithms.
6. The community of practice supports relationships and collaboration across RACFs, GPs, ambulance, local hospitals, and EDs with a shared understanding of the capability of each service. Quarterly meetings are held to identify barriers and facilitators of care. Regular governance and operational meetings are also held with providers and managers. Every RACF is assigned a home ED.
7. Ongoing change management and coordination for the ACE program key stakeholders.

Abbreviations: ACE, Aged Care Emergency; ED, emergency department; GP, general practitioner; RACF, residential aged care facility; RN, registered nurse.

[a]More information at https://ace.healthpathways.org.au (username: aged; password: care).

The EDs have a specialist older person RN[34] who undertakes comprehensive geriatric assessment, organizes referrals, advocates for older people, and has a role in educating other ED staff. This RN provides the ACE telephone consultation service to the RACFs. After hours, the primary care organization's call center RNs take the calls. If the resident requires ED transfer, clinical handover includes the purpose of the ED transfer. When the resident arrives, they are case managed, discharging the resident home wherever reasonable.

Two ACE advanced practice registered nurses (APRNs), one from HNELHD and one from the primary care organization, provided leadership and change management, coordinating the regional implementation of the ACE program with administrative support and a nurse educator. There were no other new positions. More than 30 algorithms to standardize common ED presentations were developed in consultation with hospital specialists, RACF leaders, the primary care organization, and GPs.

The education used a train-the-trainer model. A 2-day workshop was held at each step. It included local ED and RACF trainers, allowing them to build relationships. The course covered clinical education related to the algorithms; recognizing and escalating expected and unexpected clinical deterioration; and communication strategies including the use of Identiy, Situation, Background, Assessment, and Recommendation (ISBAR). Patient cases were discussed to illuminate application of the ACE approach to care of acutely unwell older people in RACFs. It included ED, ambulance, and RACF transfer requirements and documentation.

The APRNs coordinated the community of practice with quarterly meetings linking each of the EDs with their

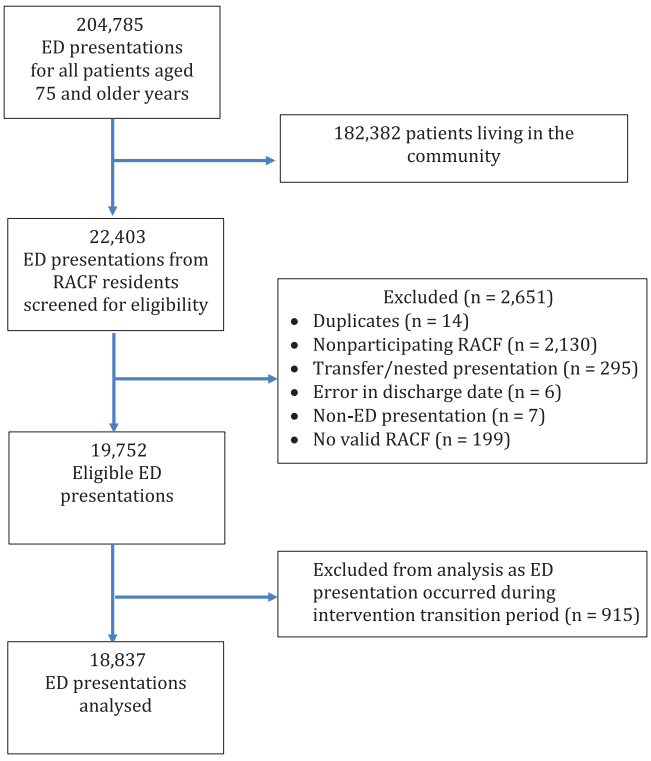

Figure 1. Identification of eligible emergency department (ED) visits. [Color figure can be viewed at wileyonlinelibrary.com]

RACFs. They provided ongoing responsive education support to RACFs when identified. A governance committee met monthly representing the health service, primary care organization, RACFs, and ambulance; it also oversaw the implementation.

Usual Care

Preintervention care was determined by the RACF. When a resident deteriorates, the primary care doctor may or may not be contacted. In the ED, the next available doctor, who may be junior or senior, sees them. Only four nurse practitioners work in RACFs across the district.

Data Collection

The initial data set included all 204,785 ED visits for patients aged 75 and older at the time of the ED visit, from April 2012 to August 2017. This included patient clinical and demographic characteristics, ED visits for all the hospitals across HNELHD, admission status, admission diagnosis, and date of death (whether death occurred at home or

Table 2. Characteristics of All Eligible Emergency Department Presentations by Study Period

Variable		Study period: Control condition (n = 8,657)	Study period: Intervention condition (n = 10,180)	Total (N = 18,837)
Sex, n (%)	Female	5,726 (66)	6,494 (64)	12,220 (65)
Age, y	Median (Q1, Q3)	87 (82, 90)	87 (83, 91)	87 (83, 91)
Arrived by ambulance, n (%)	Yes	7,741 (89)	9,374 (92)	17,115 (91)
Triage category, n (%)	Resuscitation (ATS 1)	110 (1.3)	154 (1.5)	264 (1.4)
	Emergency (ATS 2)	1,004 (12)	1,487 (15)	2,491 (13)
	Urgent (ATS 3)	2,996 (35)	3,438 (34)	6,434 (34)
	Semi-urgent (ATS 4)	4,080 (47)	4,633 (46)	8,713 (46)
	Non-urgent (ATS 5)	467 (5.4)	468 (4.6)	935 (5.0)
Disposition, n (%)	Critical care	363 (4.2)	297 (2.9)	660 (3.5)
	Admitted general ward or palliative	3,999 (46)	4,721 (45)	8,720 (46)
	Transferred to other hospital	357 (4.1)	290 (2.8)	647 (3.4)
	Did not wait or left at own risk	26 (.3)	10 (.1)	36 (.1)
	Died in ED or dead on arrival	58 (.7)	77 (.8)	135 (.7)
	Discharged	3,854 (45)	4,785 (47)	8,639 (46)
Triage diagnosis, defined by frequencies (based on ICD-10 codes), n (%)	Caregiver concern	316 (3.8)	301 (3.1)	617 (3.4)
	Chest pain	379 (4.6)	394 (4.0)	773 (4.3)
	Collapse/Syncope	246 (3.0)	245 (2.5)	491 (2.7)
	Confusion/Disorientation	269 (3.3)	406 (4.1)	675 (3.7)
	Fall	1887 (23)	2,461 (25)	4,348 (24)
	Fever	297 (3.6)	379 (3.9)	676 (3.7)
	Injury	527 (6.4)	572 (5.8)	1,099 (6.1)
	Other	2,960 (36)	3,397 (35)	6,357 (35)
	Pain: abdominal	295 (3.6)	352 (3.6)	647 (3.6)
	Respiratory: cough or shortness of breath	836 (9.6)	1,069 (10.5)	1,905 (10.1)
	Urinary problems/symptoms	226 (2.7)	245 (2.5)	471 (2.6)
	Missing, n	419	359	778
ED LOS <4 h, n (%)	Yes	2,813 (32)	3,482 (34)	6,295 (33)
ED re-presentation within 7 d of previous presentation, n (%)	Yes	494 (5.7)	495 (4.9)	989 (5.3)
Re-presentation within 30 d of previous departure (ED or hospital admission), n (%)	Yes	1,461 (17)	1,539 (15)	3,000 (16)
Died during hospital admission, n (%)	Yes	571 (6.6)	708 (7.0)	1,279 (6.8)
Died within 3 mo of ED presentation, n (%)	Yes	2,092 (24)	2,882 (28)	4,974 (26)
Died within 12 mo of ED presentation, n (%)	Yes	3,221 (37)	4,417 (43)	7,638 (41)

Abbreviations: ATS, Australasian Triage Scale; ED, emergency department; ICD-10, International Classification of Diseases, Tenth Revision; LOS, length of stay; Q, quartile.

in the hospital). ED visits and admissions across the 5 years of the study were linked to RACF addresses using a heuristic logic-matching algorithm with natural language processing that was systematically applied across the 5 years of data. Addresses were validated by manually checking the initial data set with the medical record. The derived hospital data then included all 22,403 ED visits for residents aged 75 and older in RACFs across the region (Figure 1 provides more details).

Outcomes

The primary outcome was hospital admissions, and the secondary outcome was ED visits.

To monitor harm, 7-day ED re-presentation and 30-day hospital readmission were reviewed as well as the Australasian Triage Scale (ATS) and admission to critical care. ATS category indicates the clinical urgency of the ED visit.[35] Rates of death were also monitored.

Statistical Analysis

Summaries of the data are presented overall and by period. Continuous variables are described using means and standard deviations, or medians and quartiles. For categorical variables, frequencies and percentages are used.

A negative binomial mixed effects regression model with an offset for the log number of beds was used for all outcomes. The models included a random intercept for RACF; fixed effects for time (categorical with a level for each month); period (control vs intervention); and RACF characteristics (remoteness, dementia care, respite, self-care units, and 24/7 RN staffing).

The incidence rate ratios, 95% confidence intervals, and *P* values are presented. A significance threshold of .05 was used. Statistical analyses were programmed using SAS v.9.4 (SAS Institute, Cary, NC, USA). The HNELHD Research Ethics Committee approved the study. Individual consent was not required.

RESULTS

Most RACFs in the ACE program have RNs on site 24 hours per day, varying from 50% to 100% per step. Dementia-specific beds varied between 25% and 100%. Respite beds ranged from 27% to 100% of RACFs per step. Almost half of RACFs (44%) were in a rural setting (Supplementary Table S1). A total of 18,837 ED visits for residents from participating RACFs were identified from the derived data set (Figure 1). Characteristics of residents who presented to the ED are shown in Table 2. The average ED length of stay was slightly higher in the control condition compared with the intervention condition (410 minutes vs 384 minutes).

In the crude analysis, earlier clusters had higher overall rates of transfer and admissions (Figure 2 and Supplementary Table S2), with an average of 1.55 ED visits per month per 1,000 RACF bed-days in the control condition compared with an average of 1.48 in the postintervention condition. The average number of hospital admissions per month per 1,000 RACF bed-days was similar in the control and intervention conditions (1.03 vs 1.01). After adjusting for clustering and confounding variables (Table 3), the ED

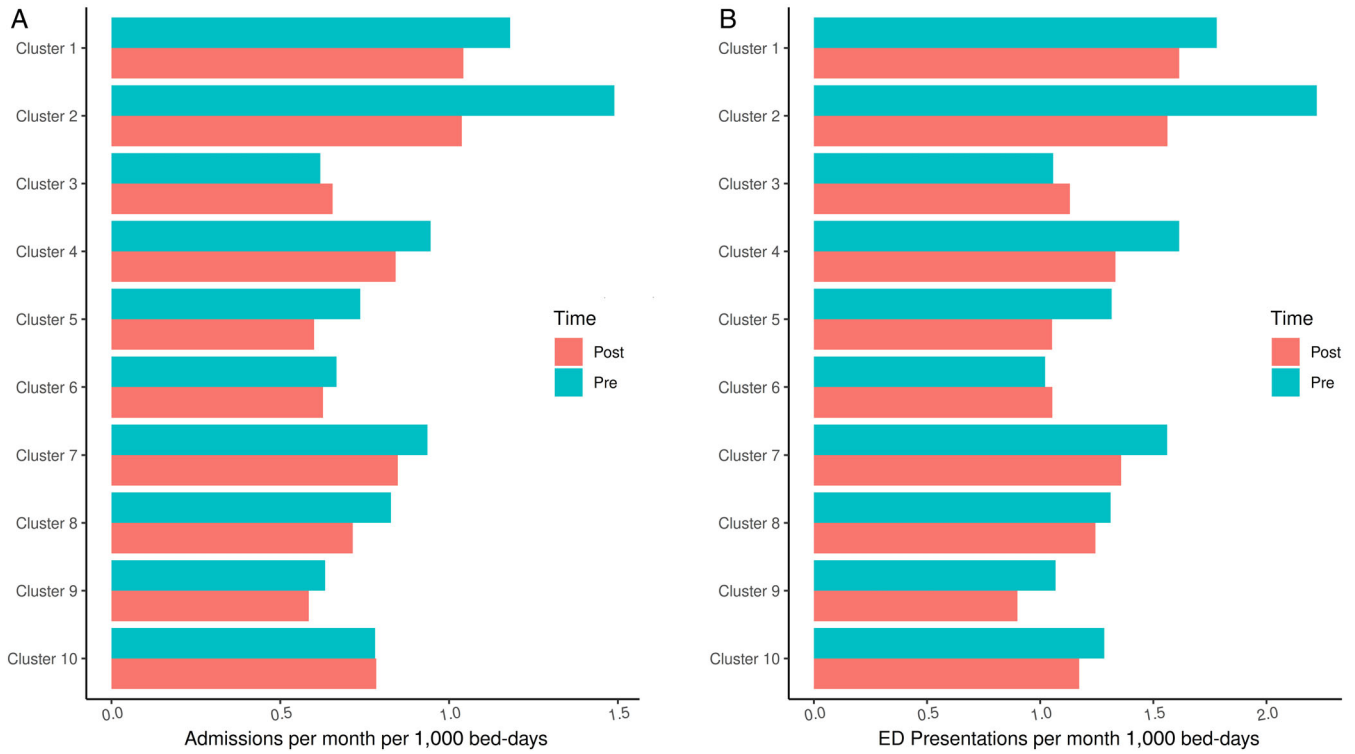

Figure 2. Crude rates of (A) hospital admissions and (B) emergency department (ED) presentations per 1,000 residential aged care facility (RACF) bed-days by cluster before and after the Aged Care Emergency intervention.

Table 3. Results from the Negative Binomial Mixed Regression Models

Outcome	Unadjusted[a] or crude incident rate ratio (95% CI)	Incident rate ratio (95% CI) adjusted for time and clustering	Adjusted[b] incident rate ratio (95% CI)	Adjusted *P* value
No. of ED presentations per RACF per month	.95 (.91–1.00)	.80 (.70–.93)	.80 (.69–.92)	.0023
No. of admissions per RACF per month	.98 (.93–1.03)	.80 (.69–.93)	.79 (.68–.92)	.0025

Abbreviations: CI, confidence interval; ED, emergency department; RACF, residential aged care facility.
[a]Model does not account for clustering by site, time, or any other RACF characteristics.
[b]Model adjusted for clustering, time, and these RACF characteristics: remoteness classification, dementia care, respite care, and 24-hour registered nursing.

presentation rate in the intervention period was .80 times that of the control period (i.e., a 20% reduction in the rate of ED visit); similarly, the rate for hospital admissions was .79 times the control period (i.e., a 21% reduction in the rate of hospital admission).

Harm

The 7-day ED representations fell from 5.7% to 4.9%, and 30-day readmissions fell from 12% for the control period to 10% for the intervention period; 6.6% died in the hospital in the control period with 35% dying within the first 24 hours of admission, and 7% died in the hospital in the intervention period with 40% dying within the first 24 hours.

The proportion of patients classified as ATS 2[35] triage category (i.e., residents need to be seen within 10 minutes of ED arrival) was higher in the postintervention period (15%) compared with the preintervention period (12%). Admissions to critical care wards were lower in the postintervention period compared with preintervention (2.9% vs 4.2%).

DISCUSSION

The ACE program significantly impacted hospital admissions and transfers to the ED, with the rate of hospital admissions and ED visits approximately 20% lower in the intervention period compared with the control period (both *P*s < .003). The model was adjusted for study time and RACF characteristics that impact on the ability of the RACFs to manage acutely unwell residents including size of the facility, dementia-specific beds, access to 24-hour RNs, respite beds and self-care units on the same site, and geographic remoteness. Previous evaluation of this program demonstrated that costs are avoided, particularly those related to ambulance transfers.[36] Given that 92% of residents arrived via ambulance, the opportunity cost is that the ambulance service is unavailable to attend to other emergencies and may even be out of a rural town.

Descriptive data show a shorter ED length of stay and reductions in ED representations within 7 days and 30-day hospital readmissions in the intervention group. Improved communication between the ED and the RACFs enables care that is consistent with the patient's care needs and goals of care, reflected in a reduction in admission to critical care wards. Despite this reduction, the number of higher acuity patients, ATS 2, increased in the intervention period. This may reflect patients with lower acuity problems being managed in the RACF and avoiding hospital transfer, with only sicker residents transferred to the ED.

The numbers of patients who died during their hospital admission (6.8%), who died within 3 months of an ED presentation (26%), and who died within 12 months of an ED presentation (41%)is high, reflecting the high mortality of people living in RACFs. Risk of dying needs to be considered with advanced care planning and goals of care. The descriptive data showed more deaths in the intervention period, but data were only deaths for residents who had an ED visit. With a 20% reduction in the rate of ED transfer demonstrated across the intervention, the data have selection bias for the most unwell older people, not the RACF population overall.

The ACE program findings align with other initiatives aimed to reduce hospitalization from RACFs. In the United States, INTERACT[37] is a well-established quality improvement program to train and support nursing home staff in early recognition and management of acute common conditions, improved transitional care communication, and improving advanced care planning. The original pilot study showed a 17% reduction in transfers.[38] OPTIMISTIC[39] and the Missouri Quality Initiative[40] also showed 19% and 30% reduction in all-cause transfer rates, respectively. Both these programs used the INTERACT program and embedded an APRN in the RACF to provide and support clinical care as well as lead the quality improvement initiative. These programs are a Centers for Medicare & Medicaid Services initiative to reduce avoidable hospitalizations among residents of nursing facilities. Evaluation of phase 2 expands these programs, demonstrating a statistically significant reduction in the probability of transfers.[41] Hospital avoidance programs led from the ED in Australia include the following:

- Care Coordination Through Emergency Department, Residential Aged Care and Primary Health Collaboration (CEDRiC),[42] an outreach service as well as support to all older people in the ED, and
- Comprehensive Aged Residents Emergency and Partners in Assessment, Care and Treatment (CAREPACT),[43] an ED substitution service within RACF led by APRNs with specialist emergency physician and geriatrician support.

An important part of the ACE program is clarifying a resident's goals of care, and reasons for transfer to the ED are clarified beforehand. This enables ED providers to

deliver the care that the resident and their family want. RACF residents have complex and dynamic healthcare needs including high levels of cognitive impairment. Communication of the resident's goals of care and understanding their preferences across the care continuum is required. Residents are transferred to the hospital on their own. Residents without family are more likely to receive healthcare interventions they may not want. A meaningful understanding of what the older person values and wants is an important part of emergency medicine. In the management of unwell residents in the ED, this is particularly important when care itself can have significant impact on quality of life and patient outcomes.[44,45] Identifying goals of care allows providers to align care with what is most important to the patient.[46]

Providers view complex patients and problems through their own lens of expertise. RACF nurses and care staff know the resident and their behaviors well,[47] but they have limited expertise in management of acute injuries and illness.[33] ED providers are experts in diagnosis, resuscitation, and management of acutely unwell patients but have limited understanding of RACF residents' usual health needs and, importantly, their goals of care. The health system and its evidence-based practice paradigm tend to be single-disease focused, at odds with the multimorbidity of RACF residents. Balancing this complexity requires an integrated team approach to managing the most vulnerable people living in our community.

No individual provider can manage these residents in isolation. A community of practice, a multidisciplinary group of interested providers in a local area who create and share knowledge, relationships, and an identity as a group are needed to sustain the ACE program.[48,49] Together, this group has developed shared expertise, collaborating to manage acutely unwell residents of RACFs across a large regional geographic area, integrating and crossing department and jurisdictional boundaries. Given the medical complexity of the residents and the expectation that they will deteriorate, the ACE program supports the collaboration required at a clinical level to deliver the best possible care to residents when they need it.

Strengths and Limitations:

The strengths of this evaluation include the stepped wedge design. This allowed rigorous comparisons before and after the introduction of the ACE program in a practical way.[50] Five years of data were reviewed. The methodology allows seasonal, temporal, and geographic variation to be controlled for in the analysis and all sites to receive the intervention. Staggered starting times created less burden on staff implementing the program.[31] We also demonstrated the ability to scale up[51] a complex intervention across a large, diverse geographic area including 81 metropolitan and rural RACFs and 9 EDs of varying size, mobilizing many stakeholders in a successful community of practice.

Despite its strengths, our study has important limitations. First, clusters were not randomly allocated to the steps of intervention delivery but rather were allocated based on their geographic region. Within the metropolitan region, RACFs with higher transfer rates were initially targeted, and as a consequence, RACFs with high ED transfer rates began early in the sequencing schedule (Figure 2). Given the real-world constraints of scaling up a complex intervention,[51] randomization was not feasible.

A second limitation is the challenges in identifying RACF residents in administrative data sets. We systematically identified them applying a heuristic tool. However, it is possible that some eligible observations were missed because data from RACFs are difficult to identify within hospital data sets, since addresses of RACFs are not standardized.[52,53] The tool was designed specifically to the research data set. It would need to be adapted and revalidated if applied to a new study population. This problem was also reported by Housley et al. in NHS England[52] who developed a similar tool. A more sustainable solution is required to identify RACF residents in hospital administrative data sets, allowing better planning, service evaluation, and evidence-based policy for this vulnerable population.[54]

CONCLUSION

In conclusion, the stepped wedge design allowed rigorous evaluation of a real-world intervention. The study involved many hospitals and RACFs in regional Australia, with good external validity. Knowing the high risk of hospitalization of RACF residents, a collaborative approach that supports a shared understanding of needs and goals of care for both RACF and hospital providers can reduce hospital admissions and transfers in line with the older person's goals of care. Given the significant effect size, these findings demonstrate that it is possible to work together as a community of practice across a large geographic footprint that includes both rural and urban centers.

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Conflict of Interest: Carolyn J. Hullick, Roslyn T. Barker, and John R. Attia are employees of Hunter New England Local Health District, Jacqueline M. Hewitt is an employee of Hunter New England Central Coast Primary Health Network, and Leigh F. Darcy is an employee of Hunter Primary Care. The remaining authors have declared no conflicts of interest for this article.

Author Contributions: Carolyn J. Hullick wrote the first draft of the manuscript, and all authors provided feedback of the drafts and read and approved the final manuscript. Carolyn J. Hullick, Jane F. Conway, Jacqueline M. Hewitt, Christopher J. Oldmeadow, and John R. Attia were all involved in the conception and design of the ACE evaluation. John R. Attia, Christopher J. Oldmeadow, and Alix E. Hall designed the statistical analysis. Alix E. Hall undertook the analysis with support from Christopher

J. Oldmeadow. All authors were involved in the interpretation of the results. Jacqueline M. Hewitt, Roslyn T. Barker, and Leigh F. Darcy led the nursing intervention including development of algorithms, education of ED and RACF staff, arranging meetings, and supporting the community of practice with Carolyn J. Hullick as medical lead.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Table S1: Characteristics of Residential Aged Care Facilities by Cluster

Supplementary Table S2: Rate of ED and Hospital Admissions Per Month Per RACF Days

Supplementary Figure S1: Stepped wedge design with sequential implementation of ACE program with 81 RACFs and across 11 steps from April 2012 to August 2017 including 13 months baseline, implementation from May 2013 to August 2016 and 9 months follow-up.