Reducing time in acute hospitals: a stepped wedge randomised control trial of a specialist palliative care intervention in residential care homes

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Abstract

Background: Care home residents are frequently transferred to hospital, rather than provided with appropriate and timely specialist care in the care home.
Aim: To determine if a model of care providing specialist palliative care in care homes, called Specialist Palliative Care Needs Rounds, could reduce length of stay in hospital.
Design: Stepped wedge randomised control trial. The primary outcome was length of stay in acute care (over 24 hours duration), with secondary outcomes being the number and cost of hospitalisations. Care homes were randomly assigned to cross-over from control to intervention using a random number generator; masking was not possible due to the nature of the intervention. Analyses were by intention to treat. The trial was registered with ANZCTR: ACTRN12617000080325. Data were collected between 1st February 2017 and 30th June 2018
Setting/participants: 1700 residents in 12 Australian care homes for older people.
Results: Specialist Palliative Care Needs Rounds led to reduced length of stay in hospital (unadjusted difference: 0.5 days; adjusted difference 0.22 days with 95% C.I. -0.44, -0.01 and p=0.038). The intervention also provided a clinically significant reduction in the number of hospitalisations by 23%, from 5.6 to 4.3 per facility-month. A conservative estimate of annual net cost-saving from reduced admissions was AUD$1,759,011 (US$1·3m; UK£0·98m).
Conclusion: The model of care significantly reduces hospitalisations through provision of out-reach by specialist palliative care clinicians. The data offer substantial evidence for Specialist Palliative Care Needs Rounds to reduce hospitalisations in older people approaching end of life, living in care homes.

Key words
palliative care, hospitalization, nursing home, length of stay

What is already known about the topic?

- There is a paucity of robust studies examining models of delivering palliative care in residential care homes for older people.
- Care home residents often have multiple morbidities, and mortality often occurs within a year of admission.
- Access to specialist palliative care provision is often inadequate, and residents risk experiencing unnecessary hospitalisations.

What this paper adds

- Palliative Care Needs Rounds are triage meetings with care home staff and specialist palliative care clinicians, focusing on residents at risk of dying without a plan in place.
- This study demonstrates that Palliative Care Needs Rounds substantially reduce the number and length of hospitalisations of care home residents.
- This is the first fully powered robust study of the model of care.

Implications for practice

- The approach supports people to avoid hospitalisation by proactive management of symptoms and capability development in staff.
- Adopting the model of care can lead to substantial cost savings for acute care.

Background

Older people living in residential care (hereafter 'care homes') often die within months of admission[1,2] due to frailty or complex multiple morbidities.[3] Care home residents (hereafter 'residents') often experience multiple admissions to hospital prior to their death,[4] despite some admissions being preventable.[5] Hospital admissions are costly and may prompt futile or burdensome interventions.[6] In Australia, 9-11% of hospitalisations (around 200,000) for older people were for people living in, or discharged to, care homes.[7]

A core outcome for services providing specialist palliative care in care homes is to decrease hospitalisations,[8] since acute care admissions are not proven to improve symptom management or quality of life, and indeed for people with dementia may exacerbate cognitive decline.[9] However, admissions are not always avoidable for care home residents, and shortening the duration of hospitalisations is an important aspect of limiting the potential negative sequelae of these stays. Reducing avoidable admissions and decreasing duration involves recognising deterioration and dying, anticipatory planning and documenting preferences for hospitalisation, which is predicated on staff having sufficient death literacy (the ability to talk and then act on discussions about death and dying, such as through advance care planning or goals of care discussion) to engage with residents and families about end of life care. Staff education therefore plays an important role in improving end of life care in care homes,[10] and is also a core element of the international PACE study seeking to increase basic palliative care provision into care homes.[11]

Many residents will require specialist palliative care to manage complex symptoms[12] to avoid hospitalisation at end of life. Yet there is limited robust evidence to support specific models of delivery in care homes[13] resulting in an urgent need to develop and test methods of improving the care of residents in their last months of life.

This intervention draws together a number of recognised requirements for looking after older people in care, offering micro and meso-level interventions.[14] First, care home staff wish to reduce preventable hospitalisations, yet often lack clear methods of doing so.[15] Second, increasing anticipatory planning (including Advance Care Plans – and anticipatory prescribing) improves the confidence of residential care staff to discuss goals of care and leads to a reduction in hospitalisations.[16] Further, care home nurses who are supported to administer anticipatory medications reduce hospital admissions and facilitate faster symptom management.[17] Provision of support and education to care home staff improves end of life care for residents,[18] if provided in conjunction with other interventions.[19] The development of the Specialist Palliative Care Needs Rounds (hereafter 'Needs Rounds') model of care arose from an attempt to meet these care requirements to deliver the desired outcomes for both care home staff and residents. Care homes in Australia are staffed primarily by nursing aides, with a small number of registered nurses, for people who need continuous supported care and can no longer live at home. The majority of care homes have long-term residents with high needs and low functional ability, and a small number of respite beds. We conducted a quasi-experimental pilot study of Needs Rounds in four care homes (comparing residents with a matched, decedent control group) and demonstrated decreased length of hospitalizations, increased residents dying in their preferred place[20] and enabled staff to normalize death and dying[21] by adopting an out-reach model of specialist palliative care. The current study sought to establish, through a robust prospective trial, whether the model of care reduces length of stay in acute care as the primary outcome, and number/cost of hospitalisation.

Methods

Study design and participants

We applied a prospective stepped wedge cluster randomised control trial. The study protocol is available from the corresponding author. Stepped wedge was adopted as the most acceptable trial design as it avoided the moral concerns of a two arm trial given the efficacy of the model during pilot testing, and those of a wait-list control design due to the limited expected survival of residents.[22] The design also allowed for management of clinicians' workload through sequential roll-out. Individuals were followed across both control and intervention phases. Masking of sites was not possible because it was not feasible to blind staff administering the intervention.

Facilities were eligible for inclusion if they were a care home for older people in the Australian Capital Territory. Twenty-six such facilities were in operation at commencement of the trial. Four facilities were excluded because they had been used in the pilot study, and were therefore considered contaminated. A further facility was excluded because it was used as a training site. The remaining 21 facilities were invited to participate; 12 opted into the trial, all of which were included. All residents in each facility were included in the sample and included in analyses, with the exception of respite residents, who were often transient.

Randomisation and masking

Care homes were randomised to one of five clusters. Randomisation was performed by a researcher independent of the trial's assessment and delivery. Randomisation at the level of care home was to avoid contamination of staff exposure to the intervention if randomisation had occurred at the individual level. Simple randomisation was used, with sites allocated a unique code at the outset of the project. Sequence generation was managed through an internet-based programme which randomly selected sites for each step. Once randomisation

was conducted, sites were informed of the timing of their facility's migration from control to intervention condition by the study's chief investigator.

Intervention description

The specialist palliative care intervention consisted of direct support (clinical work with residents) and indirect support in the form of 'Needs Rounds' which have been described in detail elsewhere, including a checklist to guide practice (included in the supplementary files).[23] Needs Rounds are monthly 60 minute triage meetings, where up to ten residents who are at greatest risk of dying without a plan in place and who have a high symptom burden are discussed. Risk stratification and case-finding was the theoretical model underpinning the intervention[24,25] to promote equitable and efficient distribution of specialist palliative care services. Hence care home staff are asked to prioritise residents for discussion in Needs Rounds who, for example, have been transferred from hospital while actively dying, or where staff would not be surprised if the resident died within six months. Needs rounds integrate case-based education, with each resident's bio-psycho-social status discussed to promote symptom management and identify opportunities to reinforce and extend staff knowledge. Discussion of residents at Needs Rounds frequently led to initiating case conferences (attended by the resident, GP, and care home staff), completion of advance care planning with resident input, management of current and anticipatory medicines, and identifying legally appointed alternate decision makers. Prior to commencement of the Needs Rounds, staff at each site were provided with a briefing regarding the aims of the model of care and practicalities of how it would function, including recommendation to develop a system for identifying residents to discuss. Site briefing notes are available from the corresponding author. Needs Rounds were run by specialist palliative care staff (two nurse practitioners and a clinical nurse consultant, who had access to advice from palliative medicine specialists for

clinical decision making). All trial clinicians were based in the city's specialist palliative care unit that provides outreach to care homes and provided the intervention face-to-face with care home staff. Care home staff attending Needs Rounds included registered nurses, enrolled nurses, nursing aides, activities coordinators and managers.

The control condition involved usual care, which consisted of the specialist palliative care clinicians providing ad-hoc reactive clinical consultations when referred by facility staff. The research team monitored all sites for fidelity to the intervention, grading them with a 3-tier rating system, namely low, moderate, and high fidelity. Fidelity was assessed by two methods. First, a random sample of 20% of all audio-recorded Needs Rounds were assessed for adherence to the Needs Rounds Checklist.[23] Second, feedback from the specialist palliative care clinicians was assessed regarding site buy-in to the model of care, for example engagement in organising case conferences, and take up of actions following Needs Rounds. Two of the sites had very poor fidelity to the intervention procedures. Fidelity ratings are shown in a supplementary file, alongside the TIDieR checklist for reporting interventions.

Procedure

The intervention commenced with two sites on 11th April 2017. Other sites crossed over from control bi-monthly in clusters of two or three. The last two sites crossed-over on 7th December 2017, with follow-up on all sites occurring monthly until cessation of data collection on 30th June 2018. Different cluster sizes reflected pragmatic constraints of clinicians' workloads throughout the course of the study. The trial ceased as planned six months after the final site received the intervention. New admissions to facilities were included in prospective data collection.

Ethics committee approvals were obtained from Calvary Public Hospital in Canberra (ref: 44-2016), National Capital Private Hospital Canberra (ref: 20/2/2017) and the Australian Catholic University (ref: 020685). Consent to run the trial was gained at site, rather than individual resident, level given the impracticalities of gaining informed consent from a large population (1700 people) many of whom were likely to have substantial cognitive impairment (with few appointed medical power of attorneys at commencement), with low risk to participants, and sufficient protection of participant privacy. This follows national guidelines for Australia from the NHMRC.[26] The trial was registered with ANZCTR: ACTRN12617000080325, on 16-1-2017 prior to enrolment of first residents. No methodological changes were made after study commencement. Facilities were encouraged to report any adverse outcomes/harms to the research team.

Outcomes

The primary outcome was length of stay in hospital for care home residents. Length of stay was preferred over hospitalisation, since some hospitalisations are not preventable (for example a broken hip). Reducing length of stay decreases risks of iatrogenic harm, including: delirium, infection, cognitive and physical decline, futile or burdensome interventions, and the risk of dying in hospital.[6,7]

Length of stay was calculated for those residents who were hospitalised for longer than 24 hours,[27] including those who died during the hospitalisation. Residents who were hospitalised for less than 24 hours were excluded from length of stay analyses (as their length of stay was considered as 0 days). All hospitalisations were recorded and reported for analysis. Data on hospitalisations were gathered by facility administrators and academic researchers from

residents' care home files, and hospital discharge summaries in a bespoke spreadsheet. Demographic and clinical data included age, sex, admission and discharge date, whether they died during hospital admission, primary diagnosis and comorbidities, presence of an advance care plan, health directive and medical power of attorney documentation.

Secondary outcomes included overall number and cost of admissions (reported below). Other outcomes including quality of death, staff confidence and place of death, are reported elsewhere.[28] Two months of baseline data collection occurred in all sites.

Statistical and cost analysis

The sample size was estimated taking into consideration of the study design as a stepped-wedge randomised trial, with the primary outcome as length of hospitalisation when participants are admitted to the hospital. Results obtained from the pilot study suggested that the intervention could achieve a moderate effect size of 0.6 with a means difference in LOS of 1.8 days (pooled S.D.=2.9).

The sample size was derived initially from a two-arm randomised control design with 1:1 allocation ratio, whereby an unadjusted sample of about 41 residents in each arm would provide 80% power at a 2-tail significance level of 5% with an intervention effect size of 0.6. The calculation was then adjusted for the stepped wedge design,[29] with the design effect calculated as 4.55, and a minimum total of 410 hospitalised residents required, recognising that a larger sample would offer greater analytic power.

Generalised Linear and Latent Mixed Model was used to analyse length of stay, to manage the fact that patients could have been hospitalised multiple times in the control and intervention phases. This approach is able to incorporate the clustering effect of repeated measures from individual patients nested in different sites, the duration of exposure, as well as the variabilities among patients across various sites. In the regression model, we included

the residents' demographics, characteristics, the level of fidelity to the intervention procedure (1, 2, and 3, representing low, moderate, and high fidelity, respectively) and duration of exposure"

Analysis was conducted by intention-to-treat, and not by denominator (of those discussed at Needs Rounds) since the intervention's education component was hypothesised to impact potentially all residents not just those discussed.

Logistic regression could not be conducted on the likelihood of hospitalisation. Under the data structure, all non-hospitalised residents would be given a value of 0 under the logistic regression framework across both control and intervention phases irrespective of the time spent in both phases. This means that there is no variation for all non-hospitalised residents in the data. Consequently, analysis of length of stay used Generalised Linear and Latent Mixed Model with 'negative binomial' being the link function for the model.

The cost analysis was calculated by comparing the difference in total overnight stays in hospital between control and intervention phase. Adjustment was made to accommodate the difference of time spent in the control phase (74 facility-months) and intervention phase (124 facility-months).

The hospital bed cost was calculated based on the most recent National Hospital Cost Data Collection Cost Report 2015-2016.[30] The bed day costs were calculated using the sub-acute bed day rate for geriatric evaluation and management of AUD$1,286 (US$915).

Results

Residents were recruited from 12 sites with a total sample size of 1700, of whom 567 were discussed in Needs Rounds. Figure 1 illustrates flow through the trial. A small number of residents (n=11) migrated from one cluster to another during the study period. Only one

resident moved between clusters that were in different phases of the trial (i.e. moved from control cluster to intervention). Consequently, the impact of such migration across cluster on the analyses was negligible. One site withdrew at month 12 citing a mismatch with their preferred reactive, rather than proactive, model of care.

Sites spent a total of 74 months in control condition and 124 months in intervention, as shown in Figure 1 (last page of document).

Table 1 illustrates the characteristics of residents (and the Supplementary materials S1 presents further site description). Table 2 shows hospitalisations by phase of trial. In total, there were 1149 hospital encounters, of which 943 were hospital admissions of >24 hours. Of these hospital admissions, 415 (44%) were in the control phase, with 528 in the intervention phase. There were 88 and 123 hospitalisations of <24 hours in the control and intervention phases respectively. Many residents had multiple admissions, as expected in this population, with 377 residents having only one admission. Of the 211 residents who were admitted more than once, 137 had two admissions, 45 had three admissions, 11 had four admissions, and 18 had more than four admissions.

The primary outcome - length of stay - reduced in the intervention phase by 23%, from 5·6 to 4·3 days per facility month. The total hospital bed days per facility-month was reduced by 31% from 39 to 27. That is, the model of care led to fewer residents using acute care services, as illustrated in Figure 2.

Table 1. Descriptive information on the residents

	Baseline at Step 0 (*n* = 1089)	**Full sample (*n* = 1700)**
Patients' Characteristics	**Mean [S.D.] or n (%)**	**Mean [S.D.] or n (%)**
Age	85 [9.1]	85 [8.8]
≤65	25 (2.3%)	34 (2%)
66-80	252 (23%)	402 (24%)
81-99	782 (71%)	1219 (72%)
≥100	24 (2.2%)	33 (1.9%)
Male	362 (33%)	613 (36%)
Medical power of attorney	724 (67%)	1180 (71%)
Health Direction	22 (2.0%)	59 (3.6%)
Advance Care Plan	460 (44%)	680 (42%)
Primary Diagnosis		
Dementia/Parkinson	396 (36%)	579 (34%)
Cancer	32 (2.9%)	78 (4.6%)
Cardiovascular Disease	150 (14%)	219 (13%)
Frail aged	103 (9.5%)	128 (7.5%)
Organ Failure	36 (3.3%)	57 (3.4%)
Others	372 (34%)	638 (38%)
Age-adjusted Charlson Comorbidity Index	5.4 [1.5]	5.4 [1.5]

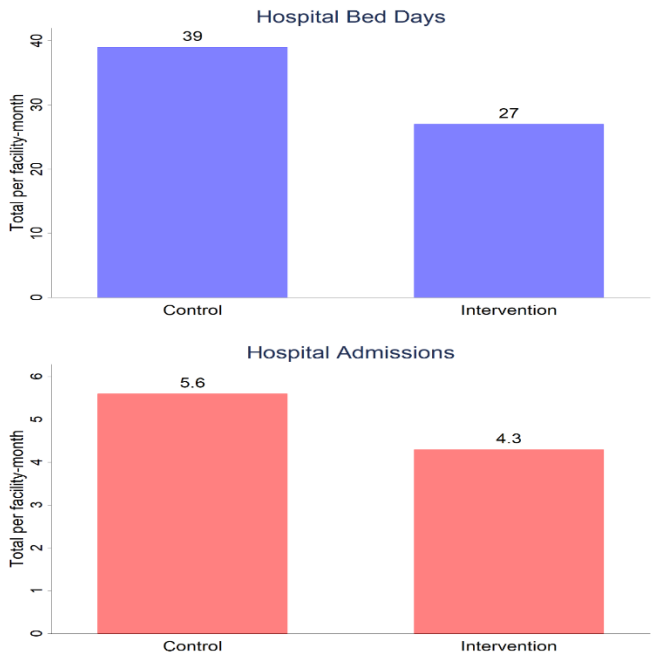

Figure 2: Hospital bed days and admissions by phase of trial

The unadjusted average length of stay for residents in the intervention phase and control phase were 6.4 days (s.d.=8.3) and 6.9 days (s.d.=9.1) respectively. After adjusting for demographics, resident characteristics, fidelity and duration of exposure, the Generalised Linear Latent Mixed Model the intervention reduced length of stay by 0.22 days (95% CI: -0.44, -0.01; p=0.038) (Table 2). The results were driven by sites with high and moderate fidelity to the intervention, where length of stay was reduced by 0.26 days (95% CI: -0.46, -0.05; p=0.015) in these sites (Table 3).

Table 2. Descriptive information on the hospitalisation of residents by phases

	Control	**Intervention**
No. of hospital admissions (>24 hours)	415	528
No. of presentations to hospital (<24 hours)	83	123
Minimal number of hospitalisation	1	1
Maximum number of hospitalisation	18	14
Total bed days	2876	3385
No. of admissions per facility-month	5.6	4.3
No. of presentations per facility-month	1.1	1.0
Total bed days per facility-month	39	27
Total deaths	234	303

Table 3. Length of hospital stays for those admitted and discharged by phases and fidelity

	LOS (days) For those admitted and discharged				**Results**[a]		
	Control		**Intervention**				
	Unadj. Mean	SD	Unadj. Mean	SD	*Treatment Effect*	95% CI	*p* value
Full sample	6.9	9.1	6.4	8.3	-0.22	[-0.44, -0.01]	0.038
Sites by fidelity rating							
High/Moderate	6.7	9.1	6.5	8.7	-0.26	[-0.46, -0.05]	0.015
Low	9.4	9.6	5.4	6.1	-0.08	[-0.57, 0.41]	0.737

[a] Adjusted for age, sex, medical power of attorney, health directive, Advance Care Plan/statement of choices, Primary diagnosis, and age-adjusted Charlson Comorbidity index. For the full sample, we adjusted for fidelity to the model.

Cost calculation

Bed day costs were calculated at $1,286 per day. The total number of bed days during the 74 facility-months of the control phase was 2,876. The corresponding number during the intervention phase was 3,385 over a period of 124 facility-months of exposure to the new model of care.

Given the total time spent in each phase, the reduction of bed days for each facility-month was: 2,876/74 –3,385/124 = 11.56. This yields an average monthly cost saving of $14,866 per facility.

This model of care was delivered by senior nurses, employed as nurse practitioners or clinical nurse consultant. To report a net cost-saving, maximum staffing during the trial is based on two full time nurse practitioners, where annual salaries (plus on-cost) were approximately $381,716. Consequently, the overall annual estimated net cost-saving across 12 sites was $1,759,011 (12 monthly savings of $14,866 × 12 sites, minus annual staffing of $381,716).

No harms, adverse events or unintended consequences were reported.

Discussion

Main findings

Needs Rounds offer a robust proactive approach to reducing length of stay in hospital and number of hospitalisations, by focusing on those with greatest symptom burden, providing specialist clinical care, education and anticipatory planning, including access to medications needed at end of life.

Preventing inappropriate admissions to acute care,[31] or reducing length of stay where possible fits, with quality clinical practice goals for care home residents,[4,15] for example, facilitating people to die in their preferred place of the care home, rather than in hospital.[20]

Our model focuses on people with the most complex care needs, who by virtue of their residence in care are likely to be approaching end of life. Consequently, this intervention is better tailored to care home residents than other interventions which focus on care coordination,[32] or primary palliative care.[33] This intervention is also flexible to the changing needs of care homes and their staff. The degree of focus on different components of Needs Rounds, such as staff education, and the determination of when specialist clinical input is required, is dynamic allowing responsiveness to local context. This is of particular utility due to the known high-turnover of care home staff, the related difficulties in maintaining care practices,[34] and jurisdictional differences in determining the role and availability of specialist palliative care in care homes.[32]

Demographic trends of increasing numbers of older people[35] demand increased focus on services which meet the clinical complexities of older people, including end of life and palliative care. Risk stratification which underpins the implementation of Needs Rounds is essential in effective stewardship of hospital and specialist palliative care resources.[24] The cost savings are substantial and represents a cost-effective mechanism for governments to invest in Needs Rounds to reduce acute care costs.[36]

Since sites with higher fidelity reported greater outcomes, adherence to the model is important in achieving reduced hospitalisations, requiring sites to run monthly Needs Rounds, have care home cultures that support staff engagement with Needs Rounds and specialist palliative care staff who adhere to the checklist.[23]

Since addressing the healthcare needs of ageing populations is of international concern, we purposefully developed the checklist that guides Needs Rounds to be suitable to use across organisations and countries[23] to allow for greatest uptake of the approach. Nursing care homes for older people do not differ substantially between developed nations; most support a frail, older population, operate often as sub-acute units and struggle to retain their staff, many of whom are ethnic minorities with limited tertiary education. Consequently, the model of care can be adopted internationally to reduce hospitalisations of care home residents.

Critically, since hospitalizations often have iatrogenic consequences,[15,37] this model of care can substantially improve the quality of life for residents in their final months of life.

Limitations

This is the first high quality, fully powered, cluster trial demonstrating substantial impacts on the number and duration of hospitalisations, among older people living in residential care, and is thus a substantial contribution to a sparse evidence base.[13]

Our study had some limitations. While demonstrating a statistically significant reduction in hospitalisations, there is no international standard of a clinically significant reduction in admissions. The effect size may be small, yet is based on all residents not just the denominator of those discussed at Needs Rounds (in line with the analytic principle of intention-to-treat and the assumption that the education provided would impact wider clinical practice, not just for those residents discussed). The cost calculations reflect day rates for sub-acute beds, and thus underestimate the total savings as it excludes treatment costs, acute bed use and transfer (ambulance) costs. The dose effect of the intervention and its impact on cost savings has not been calculated. Cost savings may not continue at a linear rate; benefits may plateau or be less powerful in facilities which already had high quality anticipatory planning

for all residents. Masking of sites was not possible. Facilities varied in their engagement and fidelity with the intervention, with consequent impact on outcomes. Yet the implementation challenges reflect real-world working dynamics where facility cultures may ease or hinder the adoption of new models of care. Some residents had received inpatient specialist palliative care admissions but the data collected did not allow for granular reporting of these episodes. Needs Rounds are likely to have reduced the number of inpatient palliative care admissions, since staff were able to care for residents within the facility rather than refer them out.

Conclusion

Despite its limitations, this study is the largest trial to date (12 facilities with 1700 residents) to assess the effectiveness of Needs Rounds in reducing length of stay in hospital and number of admissions. There are direct cost-savings in reduced admissions and further potential savings in reducing ambulance usage in hospital transfers and post hospital care. The trial is strengthened by the stepped-wedge design which managed possible site-level effects. Needs Rounds are easy to implement, and the approach can be used internationally to enable care home residents to live well until they die.

Declarations

Author contributors

LF designed the study's methodology. LF was the Chief Investigator for the study. LF, JK were responsible for study administration and management, and all authors were involved in ongoing implementation, data collection or data cleaning. LL and WL analysed the data. LL, WL, LF and JK interpreted the data. LF and JK wrote the first draft of the manuscript. All authors revised it critically for important intellectual content. All authors read and approved the final manuscript.

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Conflict of interest

We declare no competing interests.

Ethics

Ethics committee approvals were obtained from Calvary Public Hospital in Canberra (ref: 44-2016), National Capital Private Hospital Canberra (ref: 20/2/2017) and the Australian Catholic University (ref: 020685). Consent to run the trial was gained at site, rather than individual resident, level given the impracticalities of gaining informed consent from a large population (1700 people) many of whom were likely to have substantial cognitive impairment (with few appointed medical power of attorneys at commencement), with low

risk to participants, and sufficient protection of participant privacy. This follows national guidelines for Australia from the NHMRC.

Data sharing

Individual-level data collected for this study is subject to ethical and privacy restrictions. The conditions of ethical approval do not allow us to distribute or make available these data directly to other parties. However, the study protocol is available online. Applications for data access should be made by contacting the Chief Investigator. Researchers must have their study protocol approved by an appropriate research ethics review board.

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Supplementary files (available when published)

- Table S1: Description of sites
- Table S2: Rating on the extent of fidelity to the intervention
- Figure S3: Palliative Care Needs Rounds Checklist
- CONSORT Stepped Wedge checklist
- TIDIER checklist

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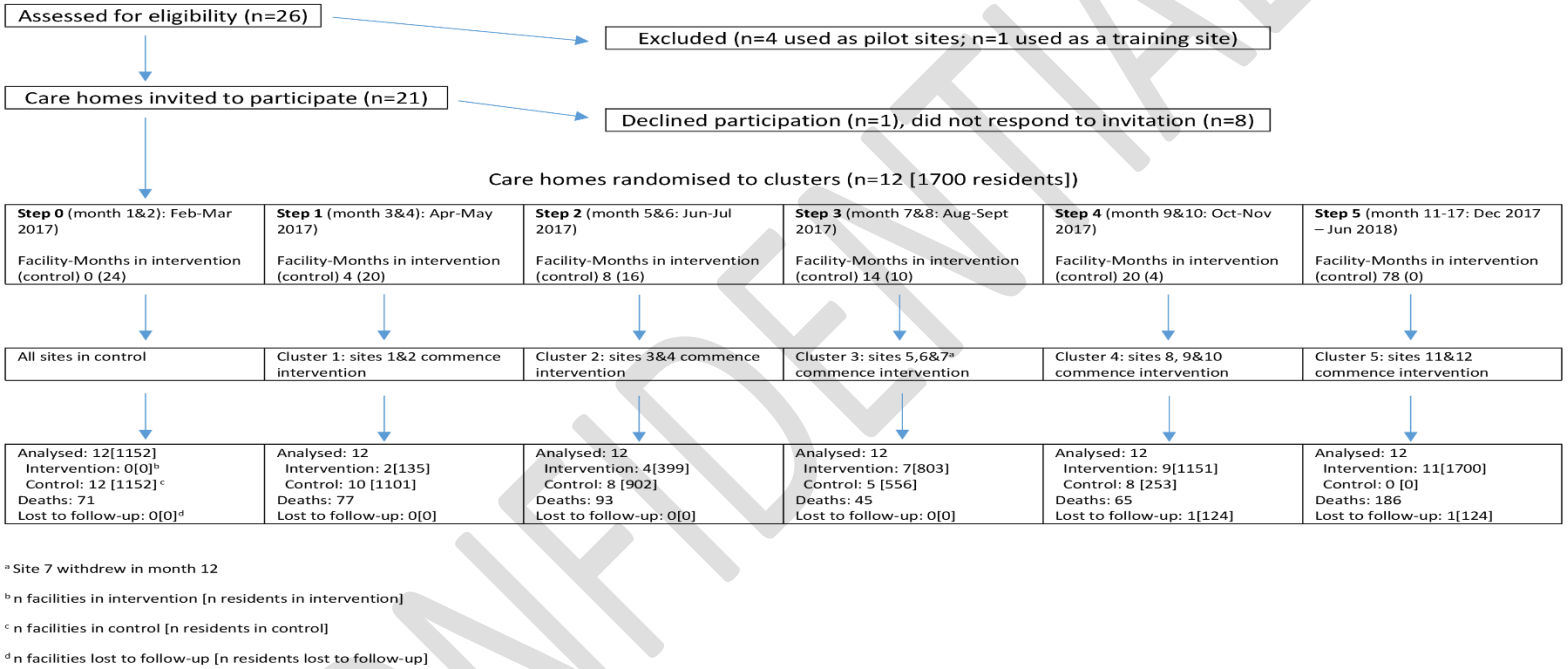
Figure 1: Participant flow



[a] Site 7 withdrew in month 12

[b] n facilities in intervention [n residents in intervention]

[c] n facilities in control [n residents in control]

[d] n facilities lost to follow-up [n residents lost to follow-up]