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Physical environmental designs in residential care to improve quality of life of older people

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Abstract

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows: The main objective is to assess the effects of changes to the physical environment or alternative models of residential care on the quality of life of people living in care facilities. The secondary objective is to assess whether the effects of changes to the physical environment or alternative models of residential care have a different impact on quality of life according to whether the population are living with dementia.

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Physical environmental designs in residential care to improve quality of life of older people (Protocol)

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Physical environmental designs in residential care to improve quality of life of older people

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ABSTRACT

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows:

The main objective is to assess the effects of changes to the physical environment or alternative models of residential care on the quality of life of people living in care facilities. The secondary objective is to assess whether the effects of changes to the physical environment or alternative models of residential care have a different impact on quality of life according to whether the population are living with dementia.

BACKGROUND

Description of the condition

The population is ageing worldwide. Life expectancy has increased and people are living longer in older age, particularly in high-income countries (WHO 2015). There were 901 million people aged 60 years and older worldwide in 2015, and by 2050 this figure is projected to more than double to nearly 2.1 billion (UN 2015). Although information regarding population ageing is well established, the patterns of health and quality of life for older people remain unclear (WHO 2015).

Many older adults experience loss of physical or mental capacities, or both, which may result in the need for care and support from others. A significant decline in function may result in the need for permanent long-term care provision. With an increasing number of people living to an older age, there will be an increase in the proportion of the population who will require accommodation in long-term care facilities (WHO 2015). A large proportion of those who reside in residential care facilities (also called care homes, nursing homes, residential homes, skilled-nursing facilities or assisted-living facilities) are living with dementia, and the number of people living with dementia globally is expected to increase. There are currently 46.8 million people living with dementia and this figure is expected to double every 20 years, to 131.5 million people by 2050 (ADI 2015). An ageing population

and an increasing number of people living with dementia will increase demand for care facilities. Therefore, it will be increasingly important to ensure that these facilities provide an environment which ensures that quality of life is optimised in advancing age.

An optimal quality of life for residents in care facilities has been referred to as the degree to which the well-being of an individual is maintained, including social activity, physical activity and health, and whether or not this meets their or their carer's (or carers') expectations (DHA 2007). Maintaining quality of life in advancing age is important, both for those living in the community and those living in care facilities. However, people who live in care facilities are more likely to experience a reduced quality of life compared to those living in the community (Kane 2003). Interviews with people who live in care facilities demonstrate that quality of life is considered highly important (Lee 2009). Interventions to improve quality of life which target these individuals should be prioritised. Moving from living in the community to living in a care facility is often associated with a decline in quality of life that may be due to loss of independence and purpose (Alzheimer's Australia 2015). Furthermore, quality of life in care facilities has been shown to be a predictor of many health-related outcomes, ranging from retaining independence in activities of daily living to mortality (Lee 2009). Implementing interventions which may improve quality of life for people living in care facilities also has the potential to positively impact the residents, staff and families of the resident.

Description of the intervention

A need has been identified to improve the quality of care in care facilities and improve models of provision of care facilities to encourage engagement in meaningful activities and support, which allows individuals to maintain independence (Tolson 2011). Changing the physical environment refers to changing features of the residential facility which are constantly available to the resident rather than temporary therapies. The physical environment of care facilities can be specifically altered in an attempt to improve the quality of life of the residents. Deciding how the physical environment of residential care may be best enhanced to benefit the residents is an emerging area of research (Fleming 2010).

Traditionally, care facilities were generally based on a medicalised view of the provision of services, meaning that facilities were designed and operated more similarly to medical institutions, rather than homes for the residents (WHO 2015). More recently, care facilities are being encouraged to offer different models of care, which are designed to improve quality of life for the residents by adapting the facilities to create a more stimulating environment, which encourages individuals to maintain independence for longer (Ausserhofer 2016).

This 'person-centred' approach may involve redesigning or building new facilities to create a more home-like environment where residents live in small groups and which have been specifically designed to look and feel more like a domestic home (Chenoweth 2014). These home-like models of care have been developed in different countries such as Australia, Germany, Japan, the Netherlands and the USA. These models may offer different components to how they are designed and operated, but the underlying concept of providing a home-like environment to improve quality of life is consistent.

In the USA, the Green House model is offered in 174 care facilities (as at May 2015). These facilities promote person-centred care for older people by offering small houses where a home-like environment is maintained, meaningful activities are accessible and teams of certified nursing assistants are available (Zimmerman 2016). The Eden Alternative was also originally established in the USA and has since been employed by over 200 care facilities and implemented in Europe, Asia and Australia (Brownie 2011). The Eden Alternative is similar to the Green House model of care as it also aims to create a home-like environment to enrich the lives of the residents, but rather than purpose-built small houses, the Eden Alternative aims to improve the existing environment, using methods such as the introduction of animals and plants (Coleman 2002).

Other small-scale home-like environments specifically designed for people with dementia have also been adopted in various countries in Europe, North America and Australia, but are often implemented in different ways (Verbeek 2009).

Changes to the physical environment do not always involve large-scale changes. Instead, the environmental changes may be small, such as tailored lighting designed to improve sleep quality and behaviour (Figueiro 2014), or improved access to outdoor spaces and gardens to improve well-being (Whear 2014). Previous studies have suggested that techniques to enhance the physical environment of care facilities may improve a broad range of outcomes such as function, quality of life, agitation levels and emotional well-being of the residents, as well as lowering hospital admissions (Ausserhofer 2016; Chenoweth 2014; Zimmerman 2016). However, the evidence for the impact of small-scale or large-scale whole facility changes to the model of care on the quality of life of residents remains unclear.

How the intervention might work

Studies have shown that staff of care facilities are responsive to the idea of enhancing the physical environment of their facilities. Many facilities have reported implementing small environmental changes (Tesh 2002), but fewer residential facilities have adopted large-scale environmental interventions such as changing from more traditional models of residential care to smaller home-like environments (Doty 2007).

As there are a wide range of interventions that can be implemented to improve the physical environment, there will be different ways in which the interventions might work. For example, increased access to outdoor spaces may improve mood and levels of physical activity. Increased lighting during the day may help to im-

prove circadian rhythm, improve sleep patterns for residents and reduce levels of agitation (Joseph 2015). Improvements in these behavioural outcomes have been associated with improved quality of life amongst older adults (Livingston 2014). Interventions such as 'dementia-enabling environments' have been designed to encourage residents with dementia to maintain independence for longer, with the aim of improving quality of life for the residents by helping them to feel valued and purposeful (DEEP 2015).

Older adults prefer greater choice of living accommodation and higher quality of services (Brownie 2013). Interventions to meet this demand may ease the transition to permanent residential care and improve the well-being and behaviour of the individuals by providing a calming environment for the residents, which is more similar to the domestic home they have moved from. Moving to a residential facility can be daunting, as it is a major change from the family home, and can result in declines in psychological health (Ellis 2010). Improving the physical environment could help the residents to maintain normality and establish routine.

As a large proportion of people moving to residential care have a diagnosis of dementia, it is important to recognise that the unmet needs of these individuals can lead to changed behaviours, or behavioural and psychological symptoms of dementia (BPSD) (Lyketsos 2000). Although most previous research has focused on therapies for the individual experiencing BPSD or the staff caring for them, environmental interventions may also have positive effects on BPSD.

Why it is important to do this review

Previous reviews have been conducted in relation to the physical environment of care facilities and various outcomes. Current available reviews suggest that certain environmental changes can improve outcomes for residents and staff of facilities (Ausserhofer 2016; Joseph 2015; Marquardt 2014; Soril 2014).

The majority of the research summarised in previous reviews suggests that studies which have examined environmental changes to residential facilities have focused on specific component interventions, such as outdoor gardens, reduced facility size and changes to lighting (Joseph 2015). Other reviews, including only studies of people with dementia, have found a broad range of interventions to improve the built environment, but provide inconsistent evidence to suggest which interventions are more favourable for certain outcomes, such as managing BPSD in care facilities (Soril 2014).

Similarly, a recent scoping review of home-like environments in care facilities concluded that although some studies showed positive improvements in certain outcomes, further evidence is needed in order to determine the effectiveness of home-like models of residential care compared to traditional models on quality of life (Ausserhofer 2016). However, a different review examining the built environment for people with dementia concluded that design interventions are largely beneficial for many outcomes for people with dementia including behaviour, activities of daily living function, well-being, social abilities, orientation and care outcomes, but the evidence for cognitive function was inconsistent (Marquardt 2014).

It is important to consider risk management of the environmental interventions, as there may also be adverse effects from some environmental modifications, in particular relating to falls. Falls in residential aged care are common and can have serious consequences, including fractures, reduced independence and death (Cameron 2012). Changes to the physical environment, particularly with regard to floor surfaces, furnishings or accessibility to spaces, may have adverse consequences in terms of falls. Therefore systematic analysis of the evidence for both the benefits and harms of physical environmental changes are important in order to establish recommendations for risk management.

The impact on quality of life outcomes of interventions which change the physical environment to improve the well-being of residents is currently unclear. We are unaware of any high-quality review that has examined the effectiveness of both small-scale and large-scale environmental changes to care facilities to improve quality of life of all residents (i.e. not limited to a subgroup). There are a wide-range of interventions that could come under the umbrella term of the 'physical environment', but largely they refer to features of a residential facility which have been specifically altered to improve quality of life for the residents. Investigating ways to improve the quality of life of residents not only benefits the residents themselves, but also benefits staff in the facilities in which they reside and family members of the resident.

This review will be informative for those planning and designing new facilities as well as those managing existing residential facilities. The results will inform which structural features will be of most benefit to improve the quality of life and well-being of residents using an evidence-based approach. Furthermore, researchers in this field will be able to identify which environmental interventions have high-quality research available and which require further research in order to determine their effectiveness.

OBJECTIVES

The main objective is to assess the effects of changes to the physical environment or alternative models of residential care on the quality of life of people living in care facilities. The secondary objective is to assess whether the effects of changes to the physical environment or alternative models of residential care have a different impact on quality of life according to whether the population are living with dementia.

METHODS

Criteria for considering studies for this review

Types of studies

We will include randomised trials and cluster-randomised trials, as these are considered the 'gold standard' study design to assess the effectiveness of an intervention. However, due to the limited feasibility of implementing the environmental design interventions in care facilities in randomised trials, we will also include other study designs. We will include non-randomised trials, controlled before-after studies, interrupted time series studies and repeated-measures studies that provide a comparison to traditional care facilities or alternative physical designs. We will include full-text studies, conference abstracts and unpublished data obtained via correspondence with trialists. We will include studies irrespective of their publication status and language of publication.

Types of participants

Participants in this review will be older adults residing in care facilities, requiring some level of nursing care beyond room and board. We will include studies where the majority ($\geq$ 80%) of the participants are aged 65 years and over (mean age $\geq$ 65 years).

Types of interventions

We will include studies examining interventions which have modified the physical design of a care facility or built a care facility with an alternative model of residential care in order to enhance the environment to promote independence and well-being. The included interventions will be design features that have been specifically implemented to improve the quality of life of the residents. The list of included interventions below indicates many, but not all, possible interventions. We have generated this list from examination of previous reviews and review of a website which has been designed to show enabling environments in aged care facilities (DEEP 2015).

Cochrane EPOC recommendations to group interventions are based on four main groups (delivery arrangements, financial arrangements, governance arrangements, and implementation strategies) (EPOC 2016). Within these groups are categories and subcategories; due to the nature of the review, all of the interventions fit within the 'delivery arrangements' group as described below. We have further categorised the potential interventions according to a previous review (Joseph 2015). They include structural and non-structural interventions as follows.

Delivery arrangements

Category: where care is provided and changes to the healthcare environment.

Subcategory: environment (changes to the physical or sensory healthcare environment, by adding or altering equipment or layout, providing music, art).

- Whole-facility model
  - Home-like models of residential care, such as the Green House model (Zimmerman 2016).
- Outdoor modifications
  - Access to and design of outdoor spaces (e.g. outdoor dining spaces, easy access to a safe enclosed environment, sensory gardens, Men's Shed).
- Building layout
  - Design of dining spaces.
  - Increase in helpful stimuli (way-finding cues, natural light, visibility of key amenities such as the toilet, use of contrast to highlight helpful features and fixtures).
- Furniture, fixtures and equipment
  - Home-like environments (e.g. variety of furniture to produce a non-institutionalised feel).
  - Inclusion of unobtrusive safety measures.
  - Paint colours.
  - Colour contrast of furniture.
  - Changes to lighting (e.g. flexible lighting, buildings designed to optimise natural light).
  - Improvements in visual access (legibility) of the internal spaces to enable residents to see their destination.
  - Reduction in unhelpful stimuli (e.g. noise, clutter, glare).
  - Introduction of familiar furniture, fittings, memorabilia.
- Indoor privacy/social interaction modifications
  - Non-shared rooms (single-resident rooms).
  - Designated quiet rooms.
  - Smaller intimate seating areas to promote socialisation.
  - Kitchen designs which promote opportunities for engagement.
  - Reminiscence rooms.
  - Improving facilities that encourage links with the community (better facilities for visitors, volunteers or children).
  - Increasing number of social rooms.

Subcategory: size of organisations (increasing or decreasing the size of health service provider units)

- Changes in scale of the building.
- Reduction in number of residents living together.

We will not include temporary interventions applied as a management/treatment tool at an individual resident level, such as light therapy and sensory therapy (e.g. Snoezelen).

The comparison for this review will be:

- usual care (any alternative residential care facility design which meets the national accreditation standards for residential care, but without specific enhancements, as described above); or
- alternative physical environmental designs.

Types of outcome measures

Primary outcomes

- Health-related quality of life (as measured on internationally recognised scales such as the EuroQol (EQ5D); 36-Item Short Form Health Survey (SF-36); Health Utilities Index (HUI); and ASCOT instruments).
- Behaviour or mood, or both (as measured on recognised quantitative scales (e.g. global measures with the Challenging Behaviour Scale, agitation measured with Cohen-Mansfield Agitation Inventory)).
- Function
    - Basic function (as measured by activities of daily living (ADL)-recognised scales such as the Barthel Index, or individual quantitative measures of basic self-care activities (i.e. ability to dress independently)).
    - Instrumental function (as measured by ADL-recognised scales such as the Lawton's instrumental ADL scale, or individual measures of instrumental function (e.g. independence in shopping, using the telephone)).

Secondary outcomes

- Global cognitive functioning
    - Measured with any validated measure, e.g. Alzheimer's Disease Assessment Scale cognitive subscale (ADAS-cog); Mini Mental State Examination (MMSE); Repeatable Battery for the Assessment of Neuropsychological Status (RBANS); Cambridge Cognition Examination (CAMCOG).
- Dementia-specific measures
    - e.g. global behaviour measures with the Neuropsychiatric Inventory, depression as measured with Cornell Scale for Depression in Dementia.
- Quality of care
    - Number of bedfast residents, catheter use, pressure ulcers and hospital readmissions.
- Serious adverse effects
    - Including falls and the use of physical restraints.
- Outcomes for carers including mood/depression, quality of life and burden
    - Measured with any established tool, e.g. carer mood or depression measured with Geriatric Depression Scale; Hospital Anxiety and Depression Scale; Centre Epidemiological Studies-Depression Scale; Montgomery-Åsberg Depression Rating Scale; General Well-Being Scale; care quality of life measured with SF36; EQ5D; World Health Organization Quality of Life Questionnaire (WHOQOL-BREF); and carer burden measured with Zarit Burden Inventory; Perceived Stress Scale; Family Caregiving Burden Inventory.
- Outcomes for staff including staff knowledge, attitude, self-efficacy, quality of life, stress (or burnout), and work satisfaction
    - Measured with any established tool, e.g. Satisfaction in Nursing Care and Work Scale, Caregiver Stress Scale (CSS), Strains in Nursing Care Scale, Maslach Burnout Inventory (MBI), Staff Attitude Questionnaire (SAQ), and the Quality of Work Life Questionnaire.

Search methods for identification of studies

The authors of this review will develop a search strategy in collaboration with the Cochrane Effective Practice and Organisation of Care (EPOC) Information Specialist.

Electronic searches

We will search the Cochrane Database of Systematic Reviews (CDSR) and the Database of Abstracts of Reviews of Effects (DARE) for related systematic reviews.
We will search the following databases for primary studies, from inception to the date of search.

- Cochrane Central Register of Controlled Trials (CENTRAL, latest issue), in the Cochrane Library.
- MEDLINE Ovid (1946 to date of search).
- Embase Ovid (1974 to date of search).
- PsycINFO Ovid (1967 to date of search).
- CINAHL (Cumulative Index to Nursing and Allied Health Literature), EbscoHost (1982 to date of search).
- Dissertations and Theses, ProQuest (to date of search).
- Index to Theses (to date of search).
- Science Citation Index Expanded, ISI Web of Knowledge (1945 to date of search).
- Conference Proceedings Citation Index - Science, ISI Web of Knowledge (1990 to date of search).
- Health Management Information Consortium (HMIC) Ovid (1983 to date of search).
- Social Care Online (www.scie-socialcareonline.org.uk; to date of search).

Search strategies are comprised of keywords and controlled vocabulary terms. We will not apply any limits on language and we will search all databases from inception to the date of search.
We will use two methodology search filters to limit retrieval to appropriate study designs: a modified version of the Cochrane Highly Sensitive Search Strategy to identify randomised trials (sensitivity- and precision-maximizing version - 2008 revision; Lefebvre 2011); and an EPOC methodology filter to identify non-randomised trial designs. See Appendix 1 for the MEDLINE search strategy, which we will adapt for other databases using appropriate syntax and vocabulary for those databases. The strategy includes Medical Subject Headings (MeSH) and synonyms for different

potential environmental design interventions (which we will potentially include in the review) and different terms for care facilities.

Searching other resources

Trial registries

- WHO ICTRP (World Health Organization International Clinical Trials Registry Platform; www.who.int/ictrp; to date of search).
- US National Institutes of Health Ongoing Trials Register (www.ClinicalTrials.gov; to date of search).
- ANZCTR (www.anzctr.org.au).

Grey literature

We will conduct a grey literature search to identify studies not indexed in the databases listed above.

- OpenGrey (www.opengrey.eu; to date of search).
- Grey Literature Report (New York Academy of Medicine; www.greylit.org; to date of search).
- Agency for Healthcare Research and Quality (AHRQ; www.ahrq.gov; to date of search).
- Joanna Briggs Institute (www.joannabriggs.edu.au; to date of search).
- National Institute for Health and Clinical Excellence (NICE; www.nice.org.uk; to date of search).
- NHS Evidence (www.evidence.nhs.uk).

We will also review reference lists of all included studies and relevant systematic reviews of alternative models of residential care to identify additional potentially eligible primary studies. We will contact authors of included studies/reviews to clarify reported published information and to seek unpublished results/data. We will conduct cited reference searches for included studies which examined whole-facility models in ISI Web of Knowledge. We will list all strategies used in the appendices, including a list of sources screened and relevant reviews/primary studies reviewed.

Data collection and analysis

Selection of studies

We will download all titles and abstracts retrieved by electronic searching to a reference management database (Endnote) and remove duplicates. Two review authors from the following (SLH, SMD or RKM) will independently screen titles and abstracts for inclusion. We will retrieve the full-text study reports/publication and two review authors (SLH and SMD) will independently screen the full-text and identify studies for inclusion and identify and record reasons for exclusion of the ineligible studies. We will resolve any disagreement through discussion or, if required, we will consult a third review author (KEL, MC or RF).

We will list studies that initially appeared to meet the inclusion criteria but that we later excluded in the 'Characteristics of excluded studies' table. We will collate multiple reports of the same study so that each study, rather than each report, is the unit of interest in the review. We will also provide any information we can obtain about ongoing studies. We will record the selection process in sufficient detail to complete a PRISMA flow diagram (Liberati 2009).

Data extraction and management

We will use the EPOC standard data collection form and adapt it for study characteristics and outcome data (EPOC 2017a); we will pilot the form on at least one study in the review. Two review authors (KEL and RKM) will independently extract the following study characteristics from the included studies and enter the data into Review Manager 5 (Review Manager 2014).

- Methods: study design, number of study centres and location, study setting, withdrawals, date of study, follow-up.
- Participants: number, mean age, age range, gender, severity of condition, diagnostic criteria, ethnicity, country, inclusion criteria, exclusion criteria, other relevant characteristics.
- Interventions: intervention components, comparison, fidelity assessment.
- Outcomes: main and other outcomes specified and collected, time points reported.
- Notes: funding for trial, notable conflicts of interest of trial authors, ethical approval.

Two review authors (KEL and RKM) will independently extract outcome data from included studies. We will note in the 'Characteristics of included studies' table if outcome data were reported in an unusable way. We will resolve disagreements by consensus or by involving a third review author (SLH).

Assessment of risk of bias in included studies

Two review authors (SLH and SMD) will independently assess risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011), and the guidance from the EPOC group (EPOC 2017b). Any disagreement will be resolved by discussion or by involving a third review author (KEL). We will assess the risk of bias according to the following domains.

- Random sequence generation.
- Allocation concealment.
- Blinding of participants and personnel.
- Blinding of outcome assessment.
- Incomplete outcome data.
- Selective outcome reporting.

- Baseline outcomes measurement.
- Baseline characteristics.
- Other bias.

For interrupted time series studies we will assess the risk of bias according to the following domains.

- Intervention independent of other events.
- Shape of the intervention effect prespecified.
- Affect/influence of intervention on data collection.
- Allocation concealment.
- Incomplete outcome data.
- Selective outcome reporting.
- Other bias.

We will judge each potential source of bias as 'high', 'low', or 'unclear' and provide a quote from the study report together with a justification for our judgement in the 'Risk of bias' table. We will assign an overall low risk of bias if we judge all domains to have a low risk of bias, an overall high risk of bias if we judge one or more domains to have a high risk of bias, and an overall unclear risk of bias if we judge one or more domains to have an unclear risk of bias (i.e. not clearly reported). We will summarise the 'Risk of bias' judgements across different studies for each of the domains listed. We will consider blinding separately for different key outcomes where necessary (e.g. for unblinded outcome assessment, risk of bias for all-cause mortality may be very different than for a patient-reported pain scale). Where information on risk of bias relates to unpublished data or correspondence with a trialist, we will note this in the 'Risk of bias' table. We will not exclude studies on the grounds of their risk of bias, but will clearly report the risk of bias when presenting the results of the studies.

When considering treatment effects, we will take into account the risk of bias for the studies that contribute to that outcome.

We will conduct the review according to this published protocol and report any deviations from it in the 'Differences between protocol and review' section of the review.

Measures of treatment effect

We will estimate the effect of the intervention using risk ratio/risk difference or rate ratio (as appropriate) for dichotomous data, and mean difference or standardised mean difference for continuous data, together with the 95% confidence interval. We will ensure that an increase in scores for continuous outcomes can be interpreted in the same way for each outcome, explain the direction to the reader, and report where the directions were reversed, if this was necessary.

For randomised trials we will use study endpoints in preference to change from baseline data, if possible, as recommended in Chapter 7 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). For interrupted time series studies, we will abstract the difference in slope and the difference in level pre- to post-intervention. We will report the post- versus pre-intervention difference (adjusted for trends) at specific time points. If the differences are not available in the primary reports, we will attempt re-analysis using data from graphs or tables based on the EPOC-specific guidance for analysis of interrupted time series studies.

Unit of analysis issues

If cluster-randomised trials are included, where possible we will extract data which takes the effect of clustering into account. When clustering has not been taken into account we will attempt to account for the effect of clustering by dividing the original sample size by the design effect, as described in Chapter 16.3 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).

Dealing with missing data

We will contact investigators in order to verify key study characteristics and obtain missing outcome data where possible (e.g. when a study is identified as abstract only). When authors do not respond to requests for information, we will take missing data into account in our risk of bias estimates and analyse the available information.

Assessment of heterogeneity

If we find a sufficient number of studies, we will conduct a meta-analysis. We will use the I^2 statistic to measure heterogeneity among the trials in each analysis. If we identify substantial heterogeneity ($I^2 > 50\%$) we will explore it by prespecified subgroup analysis.

Assessment of reporting biases

We will attempt to contact study authors, asking them to provide missing outcome data. Where this is not possible, and the missing data are thought to introduce serious bias, we will explore the impact of including such studies in the overall assessment of results**.** If we are able to pool more than 10 trials, we will create and examine a funnel plot to explore possible publication biases, interpreting the results with caution (Sterne 2011).

Data synthesis

We will undertake meta-analyses only where this is meaningful, i.e. if the treatments, participants, and the underlying clinical question are similar enough for pooling to make sense. A common way that trialists indicate when they have skewed data is by reporting medians and interquartile ranges. When we encounter this we will note that the data are skewed and consider the implication of this. Where multiple trial arms are reported in a single trial, we will include only the relevant arms. If two comparisons (e.g. intervention A versus usual care and intervention B versus usual care) must be entered into the same meta-analysis, we will halve the control

group to avoid double-counting. Alternatively, if intervention A and B are considered sufficiently similar, we may combine the outcomes for the two intervention arms.

If meta-analyses are not meaningful, we will complete a narrative synthesis of the results grouped by the intervention examined (e.g. whole-facility model studies would be grouped together) and further grouped by study design and outcome category (e.g. health-related quality of life).

We will consider interpretation of the clinical importance of outcomes, the external validity of studies, context and considerations of equity within the Discussion.

'Summary of findings' table and GRADE

We will create a 'Summary of findings' table for the main intervention comparison (whole-facility model compared to usual care or alternative designs) and include main outcomes - health-related quality of life; measures of behaviour or mood; measures of basic function; measures of instrumental function; and serious adverse effects - in order to draw conclusions about the certainty of the evidence within the text of the review. If we become aware during the review process of an important outcome that we failed to list in our planned 'Summary of findings' table, we will include the relevant outcome and explain the reasons for this in the section 'Differences between protocol and review'.

Two review authors (SLH, SMD) will independently assess the certainty of the evidence (high, moderate, low, and very low) using the five GRADE considerations (risk of bias, consistency of effect, imprecision, indirectness, and publication bias) (Guyatt 2008). We will use methods and recommendations described in Section 8.5 and Chapter 12 of the *Cochrane Handbook for Systematic Reviews of interventions* (Higgins 2011), and the EPOC worksheets (EPOC 2017c), and using GRADEpro GDT software (GRADEpro GDT 2015). We will resolve disagreements on certainty ratings by discussion and provide justification for decisions to down- or upgrade the ratings using footnotes in the table and make comments to aid readers' understanding of the review, where necessary. We will use plain language statements to report these findings in the review (EPOC 2017c).

We will consider whether there is any additional outcome information that could not be incorporated into meta-analyses; note this in the comments; and state if it supports or contradicts the information from the meta-analyses. If it is not possible to meta-analyse the data, we will summarise the results in the text.

Subgroup analysis and investigation of heterogeneity

We plan to carry out the following subgroup analyses.

- Level of nursing care provided by the facility (high versus intermediate/low/mixed).
- Cognitive status (i.e. dementia versus no dementia/mixed population).

We will examine quality of life in the subgroup analyses.

Sensitivity analysis

We will perform sensitivity analyses defined a priori to assess the robustness of our conclusions and explore their impact on effect sizes. This will involve:

- restricting the analysis to published studies; and
- restricting the analysis to studies with a low risk of bias.

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* *Indicates the major publication for the study*

APPENDICES

Appendix 1. MEDLINE search strategy

1.	aged/
2.	"aged, 80 and over"/
3.	frail elderly/
4.	(geriatric? or senior? or elderly or aged).ti,ab.
5.	(older adult? or older person? or older people or older patient?).ti,ab
6.	geriatrics/
7.	*geriatric dentistry/
8.	*geriatric nursing/
9.	geriatric assessment/
10.	*geriatric psychiatry/
11.	"health services for the aged"/
12.	or/1-11
13.	long-term care/
14.	long-term care.ti,ab.
15.	(long stay adj2 (care or healthcare or service? or treatment? or patient? or resident?)).ti,ab
16.	(function* adj2 (dependen* or independen* or limit* or decline* or status or impair*)).ti,ab
17.	(candidate? adj3 (institution* or deinstitution* or home or place*)).ti,ab
18.	(residential adj3 (care or healthcare or facilit*)).ti,ab.
19.	residential facilities/
20.	assisted living facilities/
21.	group homes/
22.	(group? adj (home? or living)).ti,ab.

(*Continued*)

23.	halfway houses/
24.	halfway hous*.ti,ab.
25.	homes for the aged/
26.	intermediate care facilities/
27.	skilled nursing facilities/
28.	hospice?.ti,ab.
29.	hospices/
30.	or/13-29
31.	nursing homes/
32.	nursing home?.ti,ab.
33.	12 and 30
34.	or/31-33
35.	exp health facility environment/
36.	exp "facility design and construction"/
37.	(environment* adj2 (person-centered or person-centred or attribute* or model? or change? or built or scale or modif* or special* or design* or physical or safe or stimul* or home* or house* or access* or improv* or facilit* or residential* or infrastructur* or adjust* or adapt* or living)).ti,ab
38.	((men* or communit*) adj2 shed?).ti,ab.
39.	(architectur* or cottage model? or green house or home-like or homelike or person-centered or person-centred or outdoor* or garden* or private room* or quiet room* or lighting or paint* or colour? or color? or floor* or dining or kitchen* or reminiscen* or small-scale or large-scale or furnishing*).ti,ab
40.	or/35-39
41.	34 and 40
42.	randomized controlled trial.pt.
43.	controlled clinical trial.pt.
44.	multicenter study.pt.

(*Continued*)

45.	pragmatic clinical trial.pt.
46.	(randomis* or randomiz* or randomly).ti,ab.
47.	groups.ab.
48.	(trial or multicenter or multi center or multicentre or multi centre).ti
49.	(intervention? or effect? or impact? or controlled or control group? or (before adj5 after) or (pre adj5 post) or ((pretest or pre test) and (posttest or post test)) or quasiexperiment* or quasi experiment* or pseudo experiment* or pseudoexperiment* or evaluat* or time series or time point? or repeated measur*).ti,ab
50.	non-randomized controlled trials as topic/
51.	interrupted time series analysis/
52.	controlled before-after studies/
53.	or/42-52
54.	exp animals/
55.	humans/
56.	54 not (54 and 55)
57.	review.pt.
58.	meta analysis.pt.
59.	news.pt.
60.	comment.pt.
61.	editorial.pt.
62.	cochrane database of systematic reviews.jn.
63.	comment on.cm.
64.	(systematic review or literature review).ti.
65.	or/56-64
66.	53 not 65
67.	41 and 66

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Conceiving the protocol: MC, SMD, SLH

Designing the protocol: SLH, SMD, KEL, RKM, RF, MC

Co-ordinating the protocol: SLH, SMD, KEL, RKM, RF, MC

Designing search strategies: SLH, SMD

Writing the protocol: SLH, SMD, KEL, RKM, RF, MC

Providing general advice on the protocol: SLH, SMD, KEL, RKM, RF, MC

Securing funding for the protocol: MC

Performing previous work that was the foundation of the current study: SLH, SMD, RKM, MC

DECLARATIONS OF INTEREST

- SLH: none known.
- SMD has been paid as a contractor for her contribution to a separate Cochrane Review on interventions for falls prevention by the John Walsh Centre for Rehabilitation Research, Kolling Institute, Rehabilitation Studies Unit, The University of Sydney.
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