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Reducing unplanned hospital admissions from care homes: a systematic review

Duncan Chambers, Anna Cantrell, Louise Preston, Carl Marincowitz, Lynne Wright, Simon Conroy and Adam Lee Gordon

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Reducing unplanned hospital admissions from care homes: a systematic review

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Abstract

Reducing unplanned hospital admissions from care homes: a systematic review

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Background: Care homes predominantly care for older people with complex health and care needs, who are at high risk of unplanned hospital admissions. While often necessary, such admissions can be distressing and provide an opportunity cost as well as a financial cost.

Objectives: Our objective was to update a 2014 evidence review of interventions to reduce unplanned admissions of care home residents. We carried out a systematic review of interventions used in the UK and other high-income countries by synthesising evidence of effects of these interventions on hospital admissions; feasibility and acceptability; costs and value for money; and factors affecting applicability of international evidence to UK settings.

Data sources: We searched the following databases in December 2021 for studies published since 2014: Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews; Cumulative Index to Nursing and Allied Health Literature; Health Management Information Consortium; Medline; PsycINFO; Science and Social Sciences Citation Indexes; Social Care Online; and Social Service Abstracts. 'Grey' literature (January 2022) and citations were searched and reference lists were checked.

Methods: We included studies of any design reporting interventions delivered in care homes (with or without nursing) or hospitals to reduce unplanned hospital admissions. A taxonomy of interventions was developed from an initial scoping search. Outcomes of interest included measures of effect on unplanned admissions among care home residents; barriers/facilitators to implementation in a UK setting and acceptability to care home residents, their families and staff. Study selection, data extraction and risk of bias assessment were performed by two independent reviewers. We used published frameworks to extract data on intervention characteristics, implementation barriers/facilitators and applicability of international evidence. We performed a narrative synthesis grouped by intervention type and setting. Overall strength of evidence for admission reduction was assessed using a framework based on study design, study numbers and direction of effect.

Results: We included 124 publications/reports (30 from the UK). Integrated care and quality improvement programmes providing additional support to care homes (e.g. the English Care Homes Vanguard initiatives and hospital-based services in Australia) appeared to reduce unplanned admissions relative to usual care. Simpler training and staff development initiatives showed mixed results, as did interventions aimed at tackling specific problems (e.g. medication review). Advance care planning was

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key to the success of most quality improvement programmes but do-not-hospitalise orders were problematic. Qualitative research identified tensions affecting decision-making involving paramedics, care home staff and residents/family carers. The best way to reduce end-of-life admissions through access to palliative care was unclear in the face of inconsistent and generally low-quality evidence.

Conclusions: Effective implementation of interventions at various stages of residents' care pathways may reduce unplanned admissions. Most interventions are complex and require adaptation to local contexts. Work at the interface between health and social care is key to successful implementation.

Limitations: Much of the evidence identified was of low quality because of factors such as uncontrolled study designs and small sample size. Meta-analysis was not possible.

Future work: We identified a need for improved economic evidence and the evaluation of integrated care models of the type delivered by hospital-based teams. Researchers should carefully consider what is realistic in terms of study design and data collection given the current context of extreme pressure on care homes.

Study registration: This study is registered as PROSPERO database CRD42021289418.

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List of abbreviations

A&E	accident and emergency
ACP	advance care planning
ARCHUS	Aged Residential Care Healthcare Utilisation Study
BHiRCH-NH	Better Health in Residents of Care Homes with Nursing
CI	confidence interval
CMS	Centers for Medicare and Medicaid Services
CRD	Centre for Reviews and Dissemination
DNH	do not hospitalise
ED	emergency department
EDDIE	Early Detection of Deterioration in Elderly Residents
EHCH	Enhanced Health in Care Homes
FITAR	Framework for Intervention Transferability Applicability Reporting
GP	general practitioner
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
HiNH	Hospital in the Nursing Home
INTERACT	Interventions to Reduce Acute Care Transfers
MDT	multidisciplinary team
MOQI	Missouri Quality Initiative
OPTIMISTIC	Optimising Patient Transfers, Impacting Medical Quality and Improving Symptoms: Transforming Institutional Care
PARIHS	Promoting Action on Research Implementation in Health Services
PPI	patient and public involvement
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
QI	quality improvement
RACF	residential aged care facility
RCT	randomised controlled trial
REAP	regular early assessment post-discharge
TIDieR-Lite	Template for Intervention Description and Replication (adapted)

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Plain language summary

Older people living in care homes often have complex health problems such as dementia and frailty, and they may need to be taken to hospital at short notice. This can lead to them being admitted for further tests and treatment. We know that some of these unplanned hospital admissions might be avoided if health and social care services worked together to meet residents' needs.

We looked for published research on methods (interventions) used in health and social care to reduce these admissions. Interventions could be carried out by care home staff, general practitioners, nurses, paramedics or other specialists individually or in teams. We asked which interventions have been evaluated, how strong is the evidence that they work and how acceptable they are to care home residents, family carers and staff. We also looked for information on how easy or difficult they are to implement and whether they represent good value for money.

We included 124 research studies (30 from the UK). We found that integrated care programmes linking care homes with general practitioners and community services can be effective but need time and support (such as extra money and specialist staff) to implement them. Quality improvement programmes and training to improve staff skills may also reduce admissions. For care home residents nearing the end of life, advance care planning and palliative care can ensure that wishes are followed and avoid potentially burdensome admissions to hospital. Hospital-based teams providing 'outreach' services to care homes have been evaluated in Australia and could be suitable for UK research. We found limited evidence on interventions involving paramedics and on 'value for money'.

We found many barriers to implementing new services in the UK, particularly staff shortages and high staff turnover, together with care homes closing down or changing ownership. Successful interventions have often been based on existing services and relationships.

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Scientific summary

Background

Residents of care homes for older people often have complex health and care needs driven by frailty and dementia and are at high risk of experiencing unplanned hospital admissions. While such admissions may be appropriate, they can be distressing for residents, their families, friends, and care home staff. They can also be costly for the NHS. Unplanned care home admissions may be avoidable if they arise from conditions that can be managed outside the hospital or are triggered by how care is organised in the community.

Interventions to reduce unplanned admissions may be implemented at various points in the health and social care system. In 2014, the University of York Centre for Reviews and Dissemination (CRD) published an evidence briefing on the topic for health service commissioners. They categorised interventions under the headings of community geriatrician services, case management, discharge planning, integrated working between primary care and care homes, medicines management, the prevention of delirium and end-of-life care. The review was based predominantly on systematic reviews and the key finding was that 'there is little good quality comparative evidence to inform strategies for reducing unplanned admissions from care homes'. The authors noted, however, that closer working between healthcare and care home staff, training for care home staff and advance care planning at the end of life all showed promise.

This topic was commissioned by the National Institute for Health and Care Research Health and Social Care Delivery Research Programme in 2020 and the need for an update to the CRD review is justified by the substantial volume of new research since 2014. This review updates and extends the CRD review published in 2014.

Objectives/research questions

The review addresses the following five research questions:

1. What interventions are used in the UK health and social care system to minimise unplanned hospital admissions of care home residents?
2. What candidate interventions, used in other applicable settings, could potentially be used in the UK?
3. What can we learn from research studies and 'real-world' evaluations about the effects of such interventions on admissions?
4. What is known about the feasibility of implementing such interventions in routine practice and their acceptability to care home residents, their families and staff?
5. What is known about the costs and value for money associated with these interventions?

Methods

A broad search for evidence was conducted in December 2021 to identify published and peer-reviewed literature on interventions to reduce unplanned admissions from care homes in the UK and other high-income countries. The search strategy was initially developed on MEDLINE and included thesaurus and free-text terms and relevant synonyms for the population (residents in care homes for older people) and intervention (interventions to reduce unplanned admissions). The search was limited to research

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published in English from 2014 to December 2021 to reflect developments since the previous review. The National Institute for Health and Care Excellence filter for Organisation for Economic Co-operation and Development countries was used to aid retrieval of studies from UK and other high-income countries.

Searches were conducted on the following databases:

- Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews
- Cumulative Index to Nursing and Allied Health Literature
- EMBASE
- Health Management Information Consortium
- MEDLINE
- PsycINFO® (American Psychological Association, Washington, DC, USA)
- Science and Social Sciences Citation Indexes
- Social Care Online
- Social Service Abstracts.

Targeted 'grey' literature searches were also conducted to identify reports, guidelines and policy in January 2022. Reference checking of all included studies was undertaken and citation searches of the initial included studies.

Search results were downloaded to a bibliographic management database (EndNote X9; Clarivate Analytics, Philadelphia, PA, USA) for deduplication and then exported to EPPI-Reviewer Web (EPPI Centre, University College London, London, UK) for coding and analysis.

Inclusion criteria for the review were as follows:

- **Population**: Residents of care homes for older people with and without nursing.
- **Intervention**: Interventions delivered in care homes or hospitals to reduce unplanned admissions. A taxonomy of interventions was developed to classify the interventions which includes quality improvement (QI) programmes, integrated care, training/workforce development, palliative/end-of-life care, advance care planning (ACP), management of specific problems, emergency department interventions, paramedic assessment/non-conveyance and other.
- **Outcomes**: Primary outcomes were measures of impact on unplanned admissions among care home residents; barriers/facilitators to implementation in a UK setting and acceptability to care home residents, their families and staff involved in delivering the intervention.
- **Setting**: The setting of interest is the UK social care and health system. Studies from other high-income countries (as defined by the World Bank) were included but synthesised separately and assessed for relevance to the UK context.
- **Comparator**: Studies will ideally compare an intervention with an alternative (such as continuing current practice) using an experimental or quasi-experimental design. Before/after studies with or without a control setting and non-comparative qualitative or mixed methods studies were also included.
- **Study design**: We included any study design that provided data on the outcomes of interest. We also included systematic literature reviews, but in view of the volume of primary literature retrieved, these were used for reference checking only.

Study selection was undertaken in stages:

1. Keyword searching of EPPI-Reviewer for relevant terms in title and abstract was used as a preliminary filter to reduce the large number of records retrieved to a more manageable set.
2. A single reviewer excluded records with relevant terms that were clearly not relevant based on the title.

3. Remaining records, titles and abstracts were screened independently by two reviewers.
4. Full-text items that potentially met the inclusion criteria were obtained and evaluated by two reviewers independently with discrepancies resolved by consensus or referral to a third reviewer.

Data from included studies were extracted into EPPI-Reviewer using a customised set of codes that covered the study characteristics, key findings/conclusions and strengths/limitations. The Template for Intervention Description and Replication checklist was used to extract data on intervention components and delivery. The Promoting Action on Research Implementation in Health Services framework was used to support extraction of relevant data on implementation of interventions from included UK studies and the Framework for Intervention Transferability Applicability Reporting) tools was used to assess applicability of international evidence to the UK context. Risk of bias for studies using recognised research designs was assessment using the following tools:

- Joanna Briggs Institute checklists for randomised controlled trials and quasi-experimental studies.
- National Heart, Lung and Blood Institute checklist for cohort and cross-sectional studies.
- Mixed Methods Appraisal Tool for mixed methods and qualitative studies.

Assessments were performed by two reviewers independently, with discrepancies resolved by consensus or referral to a third reviewer.

The review evidence was synthesised narratively. Studies were grouped by type of intervention, using the taxonomy, and setting (UK or international) and the study characteristics, findings and study quality for each group were summarised with any general issues about implementation or applicability to the UK setting. The overall strength of evidence for intervention effectiveness was classified as 'stronger', 'weaker', 'very limited' or 'inconsistent'. To help decision-makers to form an overall assessment of the value of an intervention, feasibility, applicability and 'cost-effectiveness' were considered alongside the evidence on effectiveness. The analysis of the overall strength of the evidence includes all studies included in the review, no studies were excluded based on study design or risk of bias. The main report includes evidence summary tables and detailed tables on intervention characteristics, implementation and applicability and risk of bias tables for different study designs are provided in the appendices.

Public involvement

Patient and public involvement was an integral part of this review process. A public co-applicant led on public involvement with the support of regular meetings of a public advisory group convened for this review. The review team met with the public advisory group at the start of the project, to discuss emerging findings, for further discussion of review findings and a final meeting focusing on dissemination of the review findings and to discuss their potential involvement in the final report including the plain English and reporting on the public involvement.

Results

The database search retrieved 16,845 unique references after deduplication. Searches on EPPI-Reviewer were conducted to prioritise references for screening. Screening of the titles of 6141 references by a single reviewer was followed by screening of abstracts of 576 references by two reviewers and full-text screening of 234 potentially relevant records by two reviewers. The citation search and items from the 'grey' literature searches were also screened.

The review included 124 studies, of which 30 were from the UK, 44 from the USA, 24 from Australia, 4 from New Zealand, 20 from other countries and 2 from multiple countries. Integrated working was the

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most common type of intervention in the UK and Australia and QI programmes were particularly common in the USA.

The review found that integrated care and QI programmes providing additional support to care homes (e.g. the English Care Homes Vanguard initiatives and hospital-based services in Australia) appeared to reduce unplanned admissions relative to usual care. Effective interventions often involved different staff groups, frequently organised in multidisciplinary teams. Simpler training and staff development initiatives showed mixed results, as did interventions aimed at tackling specific problems (e.g. medication review).

Advance care planning was key to the success of most QI programmes included in the review but 'do not hospitalise' orders were problematic. Qualitative research identified tensions affecting decision-making involving paramedics, care home staff and residents/family carers. The best way to reduce end-of-life admissions through access to palliative care was unclear in the face of inconsistent and generally low-quality evidence.

Common barriers to implementation of interventions were high staff turnover, competing pressures on staff time and failure to secure support from care home managers for proposed interventions. Common factors that facilitated successful implementation of interventions were having champions within care homes, funding for implementation of initiatives and a policy environment that prioritises reducing unplanned admissions.

We identified a wide range of issues that could affect applicability of international evidence. Examples included mixtures of long-stay and short-stay residents in some nursing homes (USA), cultural attitudes to advanced care planning/palliative care (USA/Europe), workforce regulations and roles of different grades, especially nurses (United States USA/Australia) and public ownership of care homes (the Netherlands/Denmark). Evidence also showed that the cohorts of residents living in care homes are very similar around the globe, suggesting that it is possible to transfer approaches between countries so long as new models from overseas are evaluated in parallel with implementation when introduced for the first time.

A total of 11 UK and 14 international studies provided some data on costs or 'value for money'. Most of these studies were not designed as full economic evaluations, meaning that not all relevant costs and benefits may have been taken into account. The majority of studies reported cost savings, but weak study designs and limited reporting meant that findings should be interpreted with caution.

Conclusions

Implications for service delivery

- Opportunities to reduce unplanned admissions exist at all stages of residents' care journeys from routine care to palliative care at the end of life.
- Types of intervention such as QI programmes or integrated working between care homes and primary care/community services differ in workforce requirements, technology, intensity of the intervention etc. Services can consider adapting described interventions to their own context, including possibilities for simplification.
- Evidence suggests that care home managers and staff support proposed interventions that will help them to deliver better care for their residents. Early and genuine consultation to assess feasibility and acceptability of interventions could be a major factor in successfully implementing new service models.
- Specific work is required to build relationships between NHS and care home providers and staff at a local and regional level.

- There is some evidence to guide where changes to services are more likely to improve outcomes; for example, care homes without nurses may benefit more than those with nurses from some forms of support because of their lower baseline level of staffing and because of differences in case mix.
- In attempting to transfer approaches between countries, attention should be paid to the differences and similarities between systems, and new models from overseas should be evaluated in parallel with implementation in the UK setting.
- Work is needed to better understand and standardise operating procedures between care homes and ambulance providers seeking to negotiate care for residents during medical crises, particularly with regard to lines of responsibility and shared liability for decision-making.

Recommendations for research

We have identified the following priorities for research:

1. Researchers should carefully consider what is realistic in terms of study design and data collection given the current UK context of extreme pressure on care homes. As with changes to service delivery, genuine involvement of care home residents, family members and staff is required to design and deliver high-quality research. Development and reporting of appropriate patient-reported outcome measures is recommended.
2. Research is needed to understand better the factors that enable effective interventions to become embedded and sustained in practice over the long term.
3. There is a need for rigorous economic evaluations, ideally using measures that can be used to compare different interventions and taking into account costs associated with implementation, particularly how costs are transferred between health and social care commissioners and providers.
4. The national roll-out in England of Hospital at Home, as part of the Frailty Virtual Wards initiative, alongside Urgent Community Response, provides an opportunity to evaluate the applicability of approaches evidenced to work in Australia and in the UK setting.
5. Further research is required to evaluate approaches based on paramedic assessment and potential non-conveyance, including assessment of safety and qualitative studies of resident, family carer and care home staff/management perspectives.
6. Further research is required to better understand the role of telehealth in reducing unplanned admissions of residents with cognitive or sensory impairments.
7. Research to evaluate interventions to reduce unplanned admissions from assisted living settings in the UK is required, bearing in mind the lower levels of both resident need and on-site services.

Study registration

This study is registered as PROSPERO CRD42021289418. The full protocol can be accessed via https://fundingawards.nihr.ac.uk/award/NIHR133884 (accessed 9 January 2023).

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Chapter 1 Background

Residents in care homes for older people include a high proportion of people with complex health and care needs, including frailty and dementia.[1] Consequently, they are at high risk of experiencing unplanned hospital admissions. While they are often necessary, such admissions can be distressing for the residents, their families and friends, and care home staff, and can also be costly. A report by the Health Foundation concluded that around 40% of unplanned admissions from care homes may be avoidable (conditions potentially manageable outside hospital).[2]

Action to reduce unnecessary and/or unhelpful/potentially harmful unplanned admissions among people in care homes and the wider community is an important priority for health and social care both in the UK and internationally. The recent UK government White Paper *Integration and Innovation* set out plans to promote greater cooperation between health and social care.[3] The COVID-19 pandemic further demonstrates the need for health and social care systems to work together. An additional concern in the UK is 'delayed discharge' when patients admitted to hospital are unable to be discharged because of lack of social care support, which in turn affects patients requiring admission from emergency departments (EDs).[4] Reduction of unplanned admissions from care homes can help to alleviate this pressure on the wider health-care system and enable more holistic person-centred place-based care to be provided in the person's home setting.

Interventions to reduce unplanned admissions from care homes or the community can potentially be implemented at various points in the health and social care system.[5] The University of York Centre for Reviews and Dissemination (CRD) conducted a scoping review on the topic for Northumberland Clinical Commissioning Group in 2014.[6] This review focused on interventions that were categorised as community geriatrician services, case management, discharge planning, integrated working between primary care and care homes, medicines management, the prevention of delirium and end-of-life care. The key finding of the CRD report was that 'there is little good quality comparative evidence to inform strategies for reducing unplanned admissions from care homes'. The authors noted, however, that closer working between health-care and care home staff, training for care home staff and advanced care planning at end of life all appeared promising.

A systematic review of interventions to reduce admissions from care homes was published by Graverholt *et al.* around the same time as the CRD report.[7] This review included 4 systematic reviews and 5 primary studies, covering 11 different interventions. These were categorised as interventions to structure or standardise clinical practice, geriatric specialist services, and influenza vaccination. Both the CRD report and Graverholt *et al.* concluded that the quality of evidence was low but some interventions [e.g. advance care planning (ACP), palliative care, care pathways and 'geriatric specialist services'] represent promising approaches that require further research. The need for an update is justified by the substantial volume of new research. An initial scoping search of Medline, the Cochrane Library and Cumulative Index to Nursing and Allied Health Literature (January 2014 to January 2021) identified 647 unique references.

We were not aware of any subsequent broad reviews of this topic at the outset of our review, which was commissioned in 2020. However, initial literature searching identified a more recent review by Buck *et al.* published in 2021.[8] We compare our findings with those of Buck *et al.* in the Discussion section of this review but our systematic treatment of issues related to implementation and applicability gives our work a broader focus.

The aim of this systematic review was to update the literature on health and/or social care interventions that might support home-based care for people living in care homes with or without nursing. Relevant interventions could be delivered in care homes, hospitals, or a mixture of the two, and could involve many different health and social care professionals. This means that the research evidence identified and synthesised in this review is of key importance in enabling further development of integrated working between health and social care.

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Chapter 2 Methods

Patient and public involvement

The project was planned to incorporate public involvement led by a public co-applicant (Lynne Wright, who replaced Cynthia Atkin) supported by regular meetings of a public advisory group. The strategic public advisory group of the Sheffield Health and Social Care Delivery Research Programme (HS and DR) Evidence Synthesis Centre also discussed the review at an early stage and advised on recruitment of the public advisory group.

The topic-specific public advisory group and review team had four one-hour meetings, covering:

1. introductions and discussion of the project context, the methods used (including the public involvement plan and offer of optional training on evidence synthesis methods) and the objectives
2. discussion of 'emerging' findings
3. further discussion of review findings
4. focus on dissemination of the review findings and production of the final report (including plain language summary and reporting public involvement).

Members of the group contributed to the review by

- highlighting issues from their own experience, primarily related to how services work in practice, for example inadequate needs assessment of people with complex problems leading to placement in a care home that is unable to meet their needs and hence increasing risk of unplanned hospital admission. Members also discussed examples of paramedic assessment and decision-making about taking people to hospital, and raised awareness of pressures on some care home managers to adopt a 'risk averse' approach to managing residents' health
- providing details of potentially relevant research based on involvement in other research projects, specifically a tool for identifying people at risk of deterioration
- suggesting channels for disseminating review findings outside academia, for example charities such as Age UK, local carers' groups (with links to both the NHS and local authorities), the Care Quality Commission and possibly Parliament (Health and Care Select Committee or All-Party Parliamentary Groups)
- suggesting that many carers were unlikely to access material on academic websites even when this was labelled as being in plain language. Short printed summaries were seen as being more suitable for decision-makers than for carers, care home residents and the general public.

We also made contact with an existing group based in Leicester with an interest in older people's health and care and we hope to work with them on the dissemination of the research findings.

We encountered a number of challenges:

- The public co-applicant was unable to participate as planned for personal reasons. A member of the patient and public involvement (PPI) group, Lynne Wright, took on the role and attended meetings with the research team and clinical experts as well as contributing to the report.
- Despite our best efforts, we were only able to recruit three active members for the topic-specific PPI group. This was obviously not ideal, although the members were knowledgeable and enthusiastic, represented different geographical areas and had diverse experiences of the care home sector.
- We were unable to attend a meeting until late in the project with the existing PPI group based in Leicester but the group was interested in the project and we hope to work with them on dissemination of the review findings.

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Statement by Lynne Wright

I joined this research project because I am very concerned about the present state of social care and the availability of care homes in the UK that are able to offer care to frail elderly people with complex needs. I am also concerned about the increasing number of care home residents being sent to accident and emergency (A&E) or 'shipped off to hospital' because their care needs are not being fully met. I feel that this research is extremely worthwhile and will hopefully be a valuable source of information.

The meetings have been productive and well run, and I feel that myself and my fellow PPI members have been listened to and given the opportunity to put across our own thoughts and perspective on the research.

I was the carer for my husband, who sadly died earlier this year; he had Parkinson's with Lewy body dementia and other comorbidities. Three and a half years ago, as I was no longer able to meet my husband's care needs at home, we made the sad joint decision that he should move into residential care. As a family, we put much thought and effort into finding a suitable care home that was close to our home, where he would be happy and that was able to meet his needs at that time. As my husband had a degenerative condition, we did realise that, as his condition progressed, he would probably need to move to a home that could offer more specialised care.

From my experience it is very important to find the right type of residential care to meet the resident's specific care needs. This has been made more difficult of late due to the COVID-19 crisis.

Sending residents to A&E following minor injuries – where a paramedic or GP is called out – is something that should, if at all possible, be avoided. Residents are often taken alone by ambulance. The home may try to contact a relative, but it is not always possible for someone to get to A&E to be with their relative. This can be extremely upsetting and confusing for the resident. In the south-west, we now have two paramedics who are able to carry out minor interventions in situ. On two occasions one of these paramedics attended my husband and was able to treat minor cuts (by stitching or glueing) thus avoiding a visit to A&E. Hopefully, more paramedics will be trained and available to carry out these procedures.

More and more elderly people are being admitted to acute hospitals because a suitable care home cannot be found or their care package fails at the residential home they are living in. They are not 'ill' as such – they need care. This is not an ideal situation. There is a lack of elderly care wards and people find themselves on a busy acute ward where staff have little training in the needs of someone with multi-morbidity and also sometimes mild or severe dementia. Often, they do not understand why they are in hospital and for many due to lack of stimulation and help with mobilising their condition can quickly deteriorate. It is a similar scenario for many elderly people who after completing inpatient treatment are fit to be discharged but are no longer able to be safely discharged back to their home.

There is a shortage of homes, particularly nursing/dementia homes that are able meet the needs of someone with multimorbidities and dementia. My husband's care package failed three times and he was admitted to an acute hospital twice. The second time he spent six months on an acute hospital ward (where his condition drastically deteriorated) before we were offered a placement that could meet his complex care needs and give him the care and support he needed and also give me 'peace of mind' knowing that he was in a safe and caring environment.

Equity, diversity and inclusion

As a systematic literature review, this project did not involve care home residents, family carers or members of the public as research participants. The research team included a public co-applicant (Lynne Wright, who replaced Cynthia Atkin) with extensive experience of the care home sector as carer for

her late husband (see *Patient and public involvement*). The strategic and topic-specific public advisory groups included people from a diverse range of backgrounds (age, ethnicity and place of residence), although those involved in the topic-specific group tended to be older. We also discussed the project with a Leicester-based PPI group with a specific focus on health of older people (see *Patient and public involvement*).

Direct involvement of care home residents with appropriate capacity and interest would have made the project more inclusive but would have required considerable time and resources. The project was a systematic review, which meant that most of the research team had backgrounds in this field and lacked informal links with the care home sector. This probably acted as a barrier to including funding for this type of work in the research proposal.

The academic members of the research team were all highly experienced in their respective fields, reflecting the knowledge and experience required to gain funding and deliver the research. The overall team was balanced in terms of gender. The project was a development opportunity for the principal investigator (a late entrant to academic research) who undertook this role on a separately commissioned project for the first time.

Reflections on equity, diversity and inclusion arising from the review findings are presented below (see *Chapter 5*).

Review questions

The overall research questions were:

1 What interventions are used in the UK health and social care system to minimise unplanned hospital admissions of care home residents?
2 What candidate interventions used in other applicable settings could potentially be used in the UK?
3 What can we learn from research studies and 'real-world' evaluations about the effects of such interventions on admissions?
4 What is known about the feasibility of implementing such interventions in routine practice and their acceptability to care home residents, their families and staff?
5 What is known about the costs and value for money associated with these interventions?

Identification of evidence

A broad search was conducted to identify published and peer-reviewed literature on interventions to reduce unplanned admissions from care homes in the UK and other high-income countries. Additionally, a search was undertaken to retrieve relevant grey literature.

The search strategy was developed on MEDLINE and then agreed with the research team (see *Appendix 1*). The search includes thesaurus and free-text terms and relevant synonyms for the population (residents in care homes for older people) and intervention (interventions to reduce unplanned admissions and named interventions) and makes use of proximity operators where appropriate and the different terms for each concept were combined using the Boolean operator OR. Population and intervention search terms were then combined using the Boolean operator AND. Outcome terms were not included in the search as information on outcomes is not always included in title or abstracts, so including these terms could mean that relevant studies would potentially not be retrieved. The search was limited to research published in English from 2014 to December 2021 to reflect developments since the previous review. Methodological search filters were not applied to keep the search broad and to ensure that all relevant study types were retrieved. However, an attempt was

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made to remove non-empirical research using the Boolean operator NOT for letters, editorials, news, historical articles, comments and case reports. Additionally, to ensure that studies retrieved were on humans not animals, the Boolean operator NOT was used to remove terms likely to be in studies on animals not humans. The National Institute for Health and Care Excellence filter for Organisation for Economic Co-operation and Development countries was used to aid retrieval of studies from UK and other high-income countries.[9]

Once the MEDLINE search had been agreed it was translated to the other major medical and health-related bibliographic databases in December 2021.

The following databases were searched:

- Cumulative Index to Nursing and Allied Health Literature
- EMBASE
- PsycINFO® (American Psychological Association, Washington, DC, USA)
- Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews
- Science and Social Sciences Citation Indexes
- Health Management Information Consortium
- Social Care Online
- Social Service Abstracts.

Following the main search, an extra focused search was conducted to identify studies investigating interventions to reduce falls in care homes in January 2022. The search used the MeSH term Accidental Falls/pc (Prevention and Control) and free-text terms, and was then combined with the main search population terms; the MEDLINE search is provided in *Appendix 1*.

Targeted grey literature searches were carried out to identify reports, guidelines and policy in January 2022. The websites of the following organisations were searched:

- Department of Health and Social Care (https://www.gov.uk/government/organisations/department-of-health-and-social-care)
- Health Foundation (www.health.org.uk)
- National Institute for Health and Care Excellence (www.nice.org.uk)
- Nuffield Trust (www.nuffieldtrust.org.uk)
- The database OpenGrey (https://easy.dans.knaw.nl/ui/advancedsearch) was searched, although it is now an archive and no new items are being added.

Citation searching of the 49 initially included studies, from the screen of the main and extra falls searches, was undertaken on Web of Science on 9 March 2022.

Reference checking of included studies and relevant existing reviews was completed. Search results were downloaded to a bibliographic management database (EndNote X9, Clarivate, Philadelphia, PA, USA) and deduplicated. Records were exported to EPPI-Reviewer (EPPI Centre, University College London, London, UK) systematic review software for coding and analysis.

Inclusion and exclusion criteria

Population and participants

The population of interest is residents of care homes for older people, including both those with and without nursing. Studies in which the main participants belong to other groups (e.g. families and social networks of residents; care home staff, other health and social care professionals providing services for care home residents, and health and social care policy makers/service commissioners) were included

if they met the other criteria with a focus on reducing residents' unplanned hospital admissions. We also included residents in assisted living or extra-care housing (with a wide range of services available on-site).

Studies involving residential care for children/young people and vulnerable working age adults (e.g. people with learning disabilities) were excluded, as were studies of older adults living in the community, including sheltered housing and those receiving care at home. Studies of mixed samples with a separate subgroup analysis of care home residents were eligible for inclusion.

Interventions

Interventions delivered in care homes or hospitals to reduce unplanned admissions were included. The taxonomy used to classify interventions is presented in *Table 1*. The final version was modified from the provisional version presented in the protocol based on discussion among the review team during the study selection process.

Comparator/control

Optimally, included studies compared an intervention with an alternative (such as continuing current practice) using an experimental (e.g. a cluster randomised trial comparing two groups of care homes)[10] or quasi-experimental design such as interrupted time series. We also included before/after studies with or without a control setting and noncomparative qualitative or mixed-methods studies.

Outcomes

The primary outcomes were measures of impact on unplanned admissions among care home residents (e.g. absolute numbers or statistical effect measures from comparative studies), perceived feasibility of implementing the intervention in UK settings (barriers/facilitators), and acceptability to care home residents, their families and staff involved in delivering the intervention. Secondary outcomes included other measures of admissions, costs/resource use and any measure of 'cost-effectiveness' (value for money). Patient-reported outcome measures (i.e. those reported directly by the patient or carer without interpretation by clinicians or others) were included where available.

Study types

We included studies of any design providing data on the outcomes of interest. This includes:

quantitative research studies of any design
qualitative research involving interviews, focus groups, etc.
mixed-methods studies
service evaluations from the UK only
UK-relevant guidelines, policy documents and grey literature.

We also included systematic literature reviews but in view of the volume of primary literature retrieved these were used for reference checking only.

Settings

The setting of interest is the UK social care and health system. Studies from other high-income countries (as defined by the World Bank) were included but synthesised separately and assessed for relevance to the UK context using the Framework for Intervention Transferability Applicability Reporting (FITAR) tool.[11]

Additional exclusion criteria

Editorials, commentaries, opinion surveys, news and discussion articles, books, book chapters, theses and conference abstracts were excluded, as well as articles in languages other than English.

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Study selection

Selection of studies for the review was carried out in stages. In view of the large number of records retrieved, keyword searching of EPPI-Reviewer for relevant terms in titles and abstracts was used as a preliminary filter. Search terms included 'care home(s)', 'nursing home(s) (NHs)', 'assisted living', 'extra-care', 'ambulance', 'paramedic', 'skilled nursing facility' and 'residential aged care facility (RACF)'. Records that contained relevant terms but were obviously not relevant based on their title were excluded by a single reviewer. Titles and abstracts of remaining records were screened by two reviewers independently using the inclusion criteria above. Discrepancies were resolved by discussion and, if necessary, by reference to a third reviewer. Full-text items that appeared potentially to meet the inclusion criteria were obtained and evaluated by two reviewers independently, with disagreements resolved as above. Records of the process were maintained in EPPI-Reviewer.

Data extraction and quality (risk of bias) assessment

Data were extracted from included studies in EPPI-Reviewer Web (EPPI Centre, University College London, UK) using a customised set of codes covering the study characteristics, key findings/conclusions and strengths/limitations. Effect measures were extracted as reported by study authors. Data on intervention components and delivery were extracted using the Template for Intervention Description and Replication (TIDiER-Lite) checklist. We used the Promoting Action on Research Implementation in Health Services (PARIHS) framework to support extraction of relevant data on implementation of interventions from included UK studies and the FITAR tool to assess applicability of international evidence to the UK context. PARIHS incorporates domains covering evidence, context and facilitation.[12] FITAR covers elements of the intervention/initiative, features of workforce, features of services, systems leadership, financial and commissioning processes and patients/populations.[11]

We assessed risk of bias for studies using recognised research designs using the following tools:

- Joanna Briggs Institute checklists for randomised controlled trials (RCTs) and quasi-experimental studies.[13]
- National Heart, Lung and Blood Institute checklist for cohort and cross-sectional studies.[14]
- Mixed Methods Appraisal Tool for mixed methods and qualitative studies.[15]

Assessments were performed by two reviewers independently, with discrepancies resolved by consensus or referral to a third reviewer.

In addition to risk of bias assessment, we extracted data on the strengths and limitations of each included study. Strengths and limitations were those reported by study authors and/or identified by members of the review team. Evidence sources with major limitations, namely absence of a control group and/or a small sample size (judged qualitatively) were described as low quality to reflect the need to treat such studies with caution as evidence of intervention effectiveness. This does not mean that the research was poorly conducted or not of value in its own setting.

Synthesis of evidence

The synthesis of evidence adopted a narrative synthesis approach as specified in the review protocol. Narrative synthesis has been described as 'an approach to the systematic review and synthesis of findings from multiple studies that relies primarily on the use of words and text to summarise and explain the findings of the synthesis'.[16] Narrative synthesis typically involves four stages: developing a theoretical model of how the intervention(s) of interest might work; developing a preliminary synthesis; exploring relationships in the data; and assessing robustness of the synthesis (strength of evidence).[16]

Interventions to reduce unplanned hospital admissions of care home residents are diverse and involve different health and care professionals intervening at different stages of residents' care pathways. Our taxonomy of interventions (see *Table 1*) identified these and formed the theoretical model for the narrative synthesis.

We grouped studies by type of intervention and setting (UK or international) and the preliminary synthesis was performed within these groups. We summarised study characteristics, findings and study quality (risk of bias assessment where applicable plus strengths and limitations) for each group, together with any general issues about implementation or applicability to the UK setting using the PARIHS and FITAR tools, respectively. For studies that reported sufficient detail, we extracted information on intervention characteristics and delivery using the TIDiER-Lite checklist. Studies were assigned to one intervention group, but the synthesis took account of links between intervention types; for example, ACP can be a stand-alone intervention, part of a quality improvement (QI) programme or linked to an approaching need for palliative/end-of-life care. We used the totality of extracted data for each type of intervention to seek to identify factors that might make the interventions more or less effective and/or influence their implementation in routine practice (described as 'exploring relationships in the data' by Popay *et al.*).[16]

We classified the overall strength of evidence for intervention effectiveness as 'stronger', 'weaker', 'very limited' or 'inconsistent' based on the following criteria:[17]

- 'stronger evidence' represents generally consistent findings in multiple studies with a comparator group design
- 'weaker evidence' represents generally consistent findings in one study with a comparator group design and several noncomparator studies or multiple noncomparator studies
- 'very limited evidence' represents an outcome reported by a single study
- 'inconsistent evidence' represents an outcome for which less than 75% of the studies agree on the direction of effect.

TABLE 1 Taxonomy of included interventions

Type of intervention	Setting	Definition	Comments
QI programme	Care home	Complex intervention centred on improving staff skills and processes of care	
Integrated working	Care home	Complex intervention centred on improving links between external health care providers and care homes	
Training and workforce development	Care home	General training courses; vocational/educational qualifications	Simpler than QI programmes
Dealing with specific problems	Care home	Management of common causes of unplanned admissions (e.g. delirium, inappropriate prescribing, hydration and nutrition)	Includes specific training courses
Paramedic assessment/ non-conveyance	Pre-hospital	Paramedic assessment and possible treatment at the scene	Includes qualitative studies of decision-making
ED interventions	ED	Specialist treatment during and shortly after admission	
ACP	Care home	Interventions to encourage ACP by residents and/or family carers	
Palliative/end-of-life care	Care home	Access to specialist palliative care services	
Other	Any	Relevant interventions not included elsewhere (e.g. protective flooring)	

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Evidence on effectiveness was considered alongside that on feasibility, acceptability and 'cost-effectiveness' to assist decision-makers in forming an overall assessment of the value of the intervention. We specifically aimed to identify which interventions are best supported by UK evidence and which interventions in use elsewhere may be suitable for adaptation and evaluation in the UK context. All studies included in the review were included in the analysis of the overall strength of evidence, with no exclusions based on study design or risk of bias.

Evidence summary tables are presented in the main text. Detailed tables on intervention characteristics, implementation and applicability are presented in (see *Appendices 2* and *3*, *Tables 33–41*). Risk of bias tables for different study designs are presented in *Appendix 4*, *Tables 42–45*.

Variations from protocol

As noted above, keyword searches were undertaken to prioritise records for screening in EPPI-Reviewer because of the large number of records retrieved by the search. A random 10% sample of remaining records was checked and no further references were selected for abstract or full-text screening. One relevant reference that would have been overlooked was subsequently discovered by chance as part of a separate EPPI-Reviewer search.

Chapter 3 Results

Results of literature search

The database searches retrieved 24,656 references which were imported into Endnote X9. After the removal of 7691 duplicates there were 16,965 unique references. The unique references were then imported in EPPI-Reviewer systematic reviews software and a check for duplicates found a further 120 duplicates leaving 16,845 unique references. The large number of references would have taken up too much time and resources to screen; thus keyword searches were undertaken on EPPI-Reviewer to prioritise references for screening (see *Variations from protocol*). Single-reviewer title screening was then undertaken on 6141 references and 576 were then screened on abstract by two reviewers with 234 included for full-text screening. A total of 96 references were included in the full review from the original database search.

The extra focused database search for falls prevention retrieved 198 references after duplicates within the falls and from the original search were removed. All 198 references were screened on title and 22 were included for abstract screening; 17 references were included for full-text screening and 7 were included in the review.

Citation searches retrieved 620 references. After deduplication within the citation search results and the Endnote library, 406 references were imported into Endnote for screening. Title screening included 84 of these references for abstract screening and 32 were included for full-text screening with 15 included in the final review.

Reference checking of included studies found four further studies for inclusion in the review. A further two included studies were found from alerts. Search of websites of relevant organisations retrieved six potential additional publications, none of which were included.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram[18] (see *Figure 1*) illustrates the study selection process. In summary, 124 publications were included in the review. Given that some interventions/programmes were represented by multiple publications, and that we included qualitative and implementation research as well as trials and service evaluations, the term 'study' is used to refer to any type of publication (primarily peer-reviewed journal articles) or report (primarily grey literature).

Summary of included studies

Of the 124 studies from which we extracted data, 30 were from the UK, 44 from the USA, 24 from Australia, 4 from New Zealand, 20 from other countries and 2 from multiple countries (see *Table 2*). The most common types of intervention were integrated working (particularly in the UK and Australia) and QI programmes (particularly in the USA).

In terms of study design, the largest single group was cluster RCTs (17 studies), followed by uncontrolled before–after (15), controlled before–after (13), non-RCTs (11), qualitative studies (11) and mixed-methods studies (10). Four studies used a step-wedge design, involving randomisation to introduce the intervention at different times during the study. Thirty-two studies used other designs, including cohorts and secondary data analyses. The studies reported a wide range of quantitative and qualitative outcomes but no patient-reported outcome measures were recorded.

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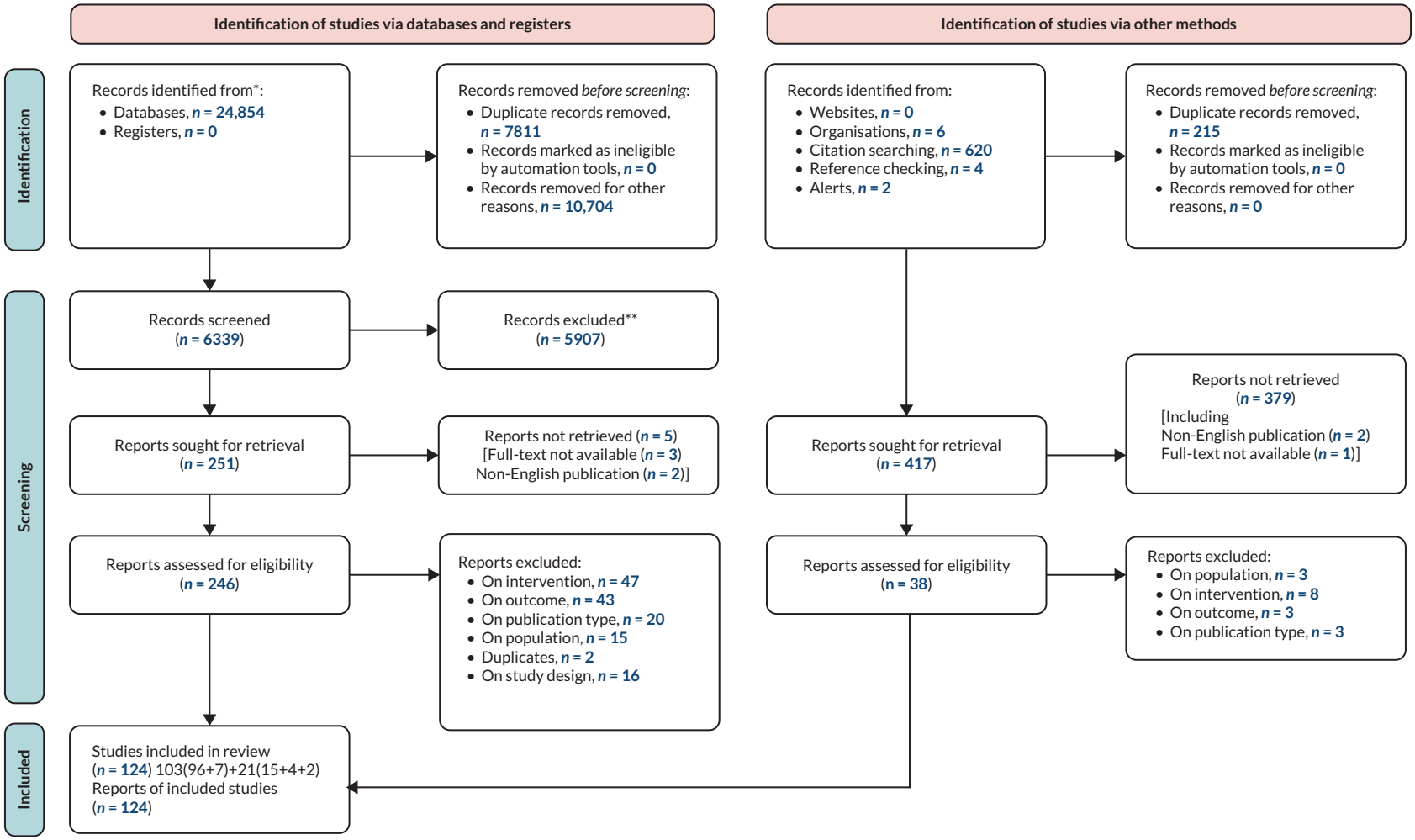

FIGURE 1 PRISMA 2020 flow diagram.[18]

TABLE 2 Distribution of included studies by intervention and country

	UK (*n*)	Australia (*n*)	USA (*n*)	New Zealand (*n*)	Other (*n*)
QI programme	3	1	19	4	1
Integrated working	13	15	4	0	5
Training/workforce development	4	0	1	0	2
Management of specific problems	4	1	5	0	4
Paramedic assessment/non-conveyance	0	0	0	0	1
ED interventions	0	1	0	0	1
Advance care planning	4	1	6	0	5
Palliative/end-of-life care	4	5	6	0	3
Other	0	0	3	0	1

Quality improvement programmes

UK evidence

We included three studies of interventions in UK settings that were classified as QI programmes.[19–21] The key feature of QI programmes is an emphasis on developing skills and expertise within the care home. Studies in which the intervention included elements of QI but the main emphasis was on integrating health and social care using expertise from outside the care home are discussed under *Integrated working*.

Two of the studies were regionally based and involved around 30 care homes each,[19,20] while the third was smaller, with just three care homes involved.[21] Care homes in the study by Damery *et al.*[19] were predominantly care homes with nursing, while the study by Giebel *et al.*[20] included a mixture of care homes with and without nursing. All three studies used a before–after type of design with no separate control group. Formal risk of bias assessments were not performed because all the studies were potentially at high risk of bias. Study characteristics are summarised in *Table 3*; *Appendix 2*, *Table 33* gives more details of the interventions. Two studies reported a significant improvement in at least one outcome following implementation of the QI intervention, while one reported a small increase in admissions.[1] These mixed results, together with the weak design of the included studies, suggest that evidence for the effectiveness of QI programmes in the UK is both weak and inconsistent.

Implementation

The two larger studies reported in some detail on implementation of the programmes while information was more limited for the smaller study by Steel *et al.*[21] (see *Appendix 2*, *Table 34*). Barriers to implementation centred around high staff turnover and resistance from some care home managers. Factors that acted as facilitators included active facilitation by programme staff, an emphasis on opportunities for career progression in one study[20] and a policy environment in which reducing unplanned admissions is a high priority.

International evidence

The international evidence on QI programmes comes mainly from the USA (18 studies), with additional evidence from New Zealand (4 studies), Australia and Switzerland (1 study each).

The 18 US studies mainly reported on three QI programmes: Interventions to Reduce Acute Care Transfers (INTERACT); Missouri Quality Initiative (MOQI); and Optimising Patient Transfers, Impacting Medical Quality and Improving Symptoms: Transforming Institutional Care (OPTIMISTIC). Two studies summarised the results of an initiative launched by the US Centers for Medicare and Medicaid Services (CMS) in 2012.[26,36] This initiative covered QI programmes in seven US states, including MOQI and OPTIMISTIC (Indiana).

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TABLE 3 Summary of UK QI studies

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Damery *et al.*[19]	Mixed methods	Nursing home: 28/29 provided nursing care	Care homes: 29 care homes from two localities in the West Midlands. Individuals: over 1000 care home staff received QI training	Standard care (before/after)	All admissions; transport to ED; feasibility of intervention	No effect: non-significant increase in admissions (p = 0.052); no effect on ED attendance
Giebel *et al.*[20]	Interrupted time series	Nursing home: 15; residential home: 17	Care homes: 32 care homes with 1314 beds. Individuals: unclear (no individual patient data were collected)	Standard care (before/after): 1 year pre and 4 years post implementation	Unplanned/preventable admissions: conveyance to hospital appears to be considered as a 'potentially avoidable admission'; transport to ED; other (specify); emergency calls	Significant positive effect: 19% reduction in conveyance to hospital
Steel *et al.*[21]	Uncontrolled before–after	Residential home	Care homes: 3 residential homes. Individuals: 34 care home residents	Standard care (before/after)	All admissions; costs/cost-effectiveness; other (specify); advance care planning; polypharmacy	Significant positive effect: 75% reduction in admissions at one care home

The 18 included studies are listed in *Tables 4* and *5*, which summarise the key reports (those providing original data on intervention effectiveness). *Table 6* summarises details of the INTERACT, OPTIMISTIC and MOQI interventions as extracted from the key study reports.

Initial evaluations of OPTIMISTIC[22] and MOQI[32] used a before–after design with no control group, placing them at high risk of bias. Subsequently, Ingber *et al.*[26] and Vadnais *et al.*[36] strengthened the evidence base by using administrative data to create comparison groups (matched by propensity scoring) for both intervention groups, together with five other initiatives funded by the CMS (see *Table 5*). INTERACT was the only programme to undergo a randomised trial, as well as a number of secondary data analyses (see *Table 4*). The trial was subject to unclear risk of bias as key details including method of randomisation were not reported in the paper.[27]

The main component of INTERACT is a series of tools for care home staff to recognise acute changes in residents' condition, document communication with physicians and use care pathways to avoid hospital admission when safe to do so. The trial performed by Kane *et al.*[27] compared implementation support for INTERACT with standard care in nursing homes that could be using INTERACT tools without support. By contrast, OPTIMISTIC and MOQI both involved study nurses working in nursing homes to improve staff skills and promote best practice. The MOQI programme also involved use of some of the QI tools developed by INTERACT (see *Table 6*).

In terms of effectiveness, the trial of implementation support for INTERACT[27] reported a reduction in avoidable admissions that was not robust after correction for multiple comparisons. Subsequent analyses revealed that nursing homes in the intervention or control group reporting high usage of INTERACT achieved reductions in potentially avoidable admissions of 0.221 per 1000 resident-days, representing an 18.9% relative reduction.[25] The MOQI and OPTIMISTIC studies reported reductions in unplanned admissions, but both were at high risk of bias, as noted above.

TABLE 4 Included US QI studies[a]

Reference	Programme name	Effect?	Comments
Blackburn *et al.*[22]	OPTIMISTIC	Yes	Before/after; highlights variation across facilities
Ersek *et al.*[23]	OPTIMISTIC		Qualitative study
Galambos *et al.*[24]	MOQI		Stakeholder surveys
Huckfeldt *et al.*[25]	INTERACT	Yes	Varies by degree of implementation
Ingber *et al.*[26]	Summary of 7 initiatives	Yes	Relative to comparison groups
Kane *et al.*[27]	INTERACT	No	RCT of implementation support
Ouslander *et al.*[28]	INTERACT		Secondary data analysis
Ouslander *et al.*[29]	INTERACT		Secondary data analysis
Popejoy *et al.*[30]	MOQI		Evaluates use of INTERACT tools
Rantz *et al.*[31]	MOQI	Yes?	Single-facility before–after
Rantz *et al.*[32]	MOQI	Yes	Before–after; main results paper
Rantz *et al.*[33]	MOQI		Implementation, role of advanced practice registered nurse
Rantz *et al.*[34]	MOQI		Estimated cost savings
Tappen *et al.*[35]	INTERACT		No negative effect on safety
Vadnais *et al.*[36]	Summary of 7 initiatives	Yes	Follow-up to Ingber *et al.*[25]
Vogelsmeier *et al.*[37]	MOQI		Analysis of avoidable transfers
Vogelsmeier *et al.*[38]	MOQI		Implementation: role of support team
Vogelsmeier *et al.*[39]	MOQI	Yes	6-year follow-up before/after

a Key study reports in **bold**.

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TABLE 5 Summary of key US QI study reports

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Blackburn *et al.*[22]	Uncontrolled before/after	Nursing home	Care homes: 19 facilities in Indiana enrolled in OPTIMISTIC programme October 2012	Standard care (before/after)	All admissions: Kaplan–Meier curves estimating the probability of a resident being hospitalisation-free from time of eligibility were calculated overall and separately for each facility	Significant positive effect: probability of having no hospitalisations within 1 year, increasing from 0.51 to 0.57, which was statistically significant ($p < 0.001$)
Ingber *et al.*[26]	Controlled before–after, mixed methods	Nursing home	Care homes: 7 ECCP organisations, 143 ECCP facilities, 262 comparison facilities. Individuals: 61,636 facility residents, 22,442 from 143 ECCP facilities, 38,194 from 262 comparison facilities	Standard care (before–after)	Unplanned/preventable admissions: all admissions; feasibility of intervention; processes, successes, challenges, lessons learned, and unintended consequences; acceptability to residents/families; costs/cost-effectiveness; Medicare expenditure	Significant positive effect
Kane *et al.*[27]	Cluster RCT	Nursing home	Care homes: 85 (33 intervention, 52 control). Individuals: 23,478 (9050 intervention, 14,428 control)	Standard care (parallel control group)	Unplanned/preventable admissions: based on Medicare/Medicaid criteria; all admissions; transport to ED; ED visits without admission; other (specify); 30-day readmissions	No effect: effect for avoidable admissions not robust after correction for multiple comparisons
Rantz *et al.*[32]	Uncontrolled before–after	Nursing home	Care homes: 16 within 80 miles of a major city in Missouri. Individuals: 5186 enrolled; average 1750 each day	Standard care (before–after)	Unplanned/preventable admissions; all admissions	Significant positive effect: for all-cause admissions in some quarters
Vadnais *et al.*[36]	Controlled before–after: pooled evaluation of 7 separate QI programmes in different US states under the CMS initiative to reduce avoidable hospitalisations among nursing facility residents	Nursing home	Care homes: not reported but target of 15–30 intervention homes per state. Individuals: baseline period intervention 24,978, comparison 41,986. Intervention period: intervention 67,315, comparison 117,383	Standard care (before–after)	Unplanned/preventable admissions; all admissions	Significant positive effect: reduction in all-cause and potentially preventable hospital transfers compared with controls

ECCP, enhanced care and coordination provider.

TABLE 6 Characteristics of the INTERACT, OPTIMISTIC and MOQI QI interventions

Study ID	By whom	What	Where	To what intensity	How often
Blackburn *et al.*[22]	Full-time registered nurses working with care home staff	Working together to assess changes in resident condition and implement QI measures. Additionally, OPTIMISTIC nurse practitioners provide in-person evaluations, and management of residents with acute condition changes. Evidence-based processes implemented under OPTIMISTIC include coordination of care through collaborative care reviews, advance care-planning facilitation, and the use of tools from INTERACT	Nursing home	Nurses employed full time	Not applicable
Kane *et al.*[27]	INTERACT study team; INTERACT champion and co-champion in each NH	Training and support (primarily telephone/online) for implementing INTERACT, including tools to help nursing home staff identify and evaluate acute changes in nursing home resident condition and document communication between physicians; care paths to avoid hospitalisation when safe and feasible; and ACP and QI tools	Participating nursing homes	1-year intervention period (March 2013 to February 2014)	Not reported
Rantz *et al.*[32]	APRN (nurse practitioner or clinical nurse specialist) at each nursing home; project medical director; other MOQI team members, including QI coach, care transitions coach (coordinating ACP and end-of-life care) and health information technology coordinator; other stakeholders, including social services, primary care and nursing staff (see also Vogelsmeier *et al.*)[38]	Early recognition, assessment and management of residents' condition (APRNs); education of APRNs, advice to MOQI team, liaison with participating physicians (medical director); use of INTERACT tools, including root cause analysis for all hospital transfers; regular feedback to nursing home leadership; proactive discussions about end-of-life care and ACP	Participating nursing homes and other treatment settings	Full-time APRN in each nursing home supported by MOQI team	Not reported

APRN, advanced practice registered nurse.

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The initial analysis of the seven CMS-funded initiatives with a controlled before–after design reported mixed results for reductions in potentially avoidable admissions.[26] Three of the seven programmes reported statistically significant reductions against matched controls in 2014 and four did so in 2015. Only two programmes (MOQI and OPTIMISTIC) reported significant reductions in both years. These findings suggest the existence of 'publication bias' in the reporting of this initiative, with only the more successful programmes publishing their results in full. In a subsequent analysis, Vadnais *et al.* combined data from 2014–16 for all intervention and control groups to produce a single effect estimate.[36] The combined analysis reported an annual decrease in potentially avoidable admissions of 2.01 percentage points [95% confidence interval (CI) 2.86 to 1.15], representing an 18% relative reduction. Reductions in potentially avoidable acute care transfers and ED visits were also reported.

In summary, the studies of QI programmes implemented in US nursing homes broadly meet the criteria for 'stronger' evidence but the findings should be interpreted with caution because of possible confounding factors in uncontrolled studies and unclear risk of bias. The inclusion of MOQI and OPTIMISTIC as separate publications and as part of the combined analysis should also be taken into account.

Other studies

Three studies (four publications) described QI programmes evaluated in New Zealand care homes (see *Table 7*). The studies were performed by the same group of authors, were relatively large and performed in a diverse range of settings. Two studies were cluster RCTs and one was a repeated measures before/after study. The study by Boyd *et al.*[40] was at unclear risk of bias because of limited reporting and lack of blinding. The Aged Residential Care Healthcare Utilisation Study (ARCHUS) trial[41] was better reported and appeared to be at lower risk of bias, although as usual with this type of intervention, only limited blinding was possible. The third study was at high risk of bias because there was no control group.[42]

The interventions used in the three studies are summarised in *Table 8*. The first study involved a relatively simple intervention with gerontology nurse specialists providing on-site support to care home staff.[40] The ARCHUS study added a wider multidisciplinary team (MDT)[41] and this intervention was also evaluated in the third study with some minor changes.[42]

Neither of the randomised trials found that the intervention reduced potentially preventable admissions compared with standard care. A subsequent 'post hoc' analysis of the ARCHUS data reported a reduction in admissions for a group of five conditions (cardiac failure, ischaemic heart disease, chronic obstructive pulmonary disease, stroke and pneumonia) responsible for many admissions among care home residents[43] but as an unplanned analysis this should be treated with caution. Connolly *et al.*[42] reported a reduction in admissions post intervention but causality is uncertain in the absence of a control group. This suggests that the evidence for QI programmes involving gerontology nurse specialists with or without MDT support in New Zealand is at best inconsistent.

Turning to single studies in other countries, the Early Detection of Deterioration in Elderly residents (EDDIE) programme was evaluated in a before/after study in Queensland, Australia.[44] The intervention involved advanced clinical skills training, decision support and access to additional diagnostic equipment, plus targeted collaboration with a wide range of external stakeholders. Implementation was supported by an on-site clinical lead and 'clinical champions'. The EDDIE programme was associated with a 19% reduction in annual hospital admissions and a 31% reduction in the average length of stay from baseline, comparable to effects reported in other studies but with a relatively high risk of bias. One additional study evaluated a QI programme in Switzerland using a stepped-wedge design.[45] The intervention, designated INTERCARE, was similar to the US programmes described above, with a nurse appointed to each participating care home as a link between care home staff and physicians. INTERCARE also used tools from the INTERACT programme. As this was a non-randomised study, the risk of bias was higher than for similar stepped-wedge studies with randomisation. The study reported a significant reduction in unplanned hospital transfers compared with the pre-implementation period, thus strengthening the international evidence base for QI programmes of the INTERACT type.

TABLE 7 Summary of New Zealand QI studies

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Boyd *et al.*[40]	Cluster RCT	Nursing home, residential home	Care homes: intervention facilities 29, comparison facilities 25. Individuals: intervention facilities 1425 residents, comparison facilities 1128 residents.	Standard care (parallel control group)	Unplanned/preventable admissions. Medical admissions considered as potentially preventable. All admissions. All resident hospitalisations	No effect. Acute hospitalisation rates increased for both groups, although less for intervention group
Connolly *et al.*[41]	Cluster RCT	Nursing home; mixture of 'private hospital care' for those requiring assistance with activities of daily living and 24-hour nurse availability; dementia care (secure rest homes); and psychogeriatric care (for those with dementia and additional needs). Residential home: 'rest homes' not providing 24-hour nursing care	Care homes: 36 (18 in each group). Individuals: 1998 (1123 intervention; 875 control)	Standard care (parallel control group)	Unplanned/preventable admissions (defined as ambulatory-sensitive hospitalisations; i.e. admission for specific conditions); all admissions (all acute admissions); length of hospital stay; other (specify); mortality	No effect. No difference in avoidable admissions (RR 1.07, 95% CI 0.85 to 1.36) or mortality
Connolly *et al.*[42]	Uncontrolled before–after	Nursing home; residential home; similar to Connolly 2015[41]	Care homes: 21 facilities with higher than expected ED presentation/admission rates. Individuals: 1296 beds	None: repeated measures before–after	Unplanned/preventable admissions; emergency admissions for specific conditions; paper appears to use presentation and admission interchangeably (authors note ED presentation more directly under control of care home staff); transport to ED	Significant positive effect: 25% reduction in ED admissions after intervention

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TABLE 8 Details of interventions used in New Zealand QI studies

Study ID	By whom	What	Where	To what intensity	How often
Boyd *et al.*[40]	GNS working with care home staff and primary and secondary health care services	Clinical support; education and clinical coaching; and care coordination for high-risk residents	Care home	The GNS was on site at each facility for a mean of 1.9 hours per month. GNSs provided care coordination and comprehensive geriatric assessments for residents of concern as needed (mean 2.6 assessments per facility in 12 months). The GNS also provided care coordination for residents transitioning across healthcare settings, although much of this work was not well captured in GNS records	On-site visits every other month and delivery of standardized gerontology education sessions for nurses and care assistants (mean 5.5 sessions per facility in 12 months). Ad hoc on-site clinical coaching to discuss residents of concern (mean 2.3 sessions per facility in 12 months) occurred at the request of facility staff
Connolly *et al.*[41]	GNS and study MDT	Facility baseline assessment and care plan; monitoring and benchmarking of indicators linked to care quality; MDT meetings to review individual residents' needs; gerontology education and clinical coaching for care home nurses	Care home/ facility	GNS support/education began with weekly visits and gradually reduced in intensity over the 9-month intervention period	Benchmarking: 3 times during the intervention period; MDT meetings monthly for the first 3 months at each site
Connolly *et al.*[42]	GNSs and study MDT	Facility baseline assessment; clinical coaching for nurses and care givers; MDT meetings, including medication review	Care home/ facility	Increased clinical coaching time at each facility (relative to ARCHUS)	Three 1-hour MDT meetings at each facility

GNS, gerontology nurse specialist; RR, relative risk.

Applicability

Three of the US studies of QI programmes (four publications) provided data relevant to assessing applicability to UK settings: a summary of the 2012 CMS initiative,[26] one of its component studies (MOQI[32,33]) and the trial of implementation support for INTERACT.[27]

The major differences between the US and UK health systems (insurance-funded vs. publicly funded) are less acute for care home research because many US care home residents are covered by the publicly funded Medicare (for older people) and/or Medicaid (for people on low incomes) programmes. Both the CMS initiative and the INTERACT trial stated that included participants were Medicare/Medicaid recipients, although MOQI included some privately paying residents in state-licensed beds.

A further difference from the UK is that many US care homes include a mixture of long-term residents and those admitted for short-term rehabilitation following hospital treatment – although this difference is becoming less marked over time with the widespread commission of short-term 'discharge to assess' beds in the care home sector. The CMS initiative included only long-stay residents, increasing applicability to the UK, but this was unclear for the INTERACT study.

Other relevant factors captured by the FITAR framework for assessing intervention transferability/applicability were:

- Population (residents seemed to be comparable to UK populations in terms of age and sex or gender and representative of the general US population)
- Organisation/finance (Medicare financial penalties for readmissions; not currently relevant to UK setting)
- Leadership:
    - supportive and stable nursing home leadership was associated with success in reducing admissions
    - a high level of facilitation in the INTERACT study (which was a trial of implementation support)[27] and MOQI (intervention support team)
- Services/workforce/initiative:
    - care homes participating in MOQI had high standards of care and high admission rates (comparable to some UK care homes)
    - INTERACT largely provided support to existing workforce
    - MOQI was heavily dependent on advanced practice registered nurses and other specialist nurses working full-time in care homes (difficult to apply in UK with current workforce shortages)
    - legal restrictions affected services provided by advanced practice nurses in some states[26]
    - NH staff turnover limited buy-in to QI initiatives[26]
    - the CMS initiative lasted four years but researchers reported that attitudes and practices were only beginning to shift at the end of the study period.

Applicability data were extracted from three publications from New Zealand.[40–42] The setting was urban (Auckland) and participating care homes had a higher than expected level of potentially preventable admissions. Most participating facilities were equivalent to residential care homes, although the ARCHUS study also included some 'private hospitals' providing higher levels of long-term care.[41] The health and care system appeared to be more closely integrated than in the UK, with a district health board responsible for supporting and certifying care homes and also providing acute hospital services. Few details of leadership and facilitation were provided, although the ARCHUS study achieved good 'buy-in' from participating facilities.[41]

Workforce is a key factor in evaluating the applicability of this New Zealand research to the UK. The interventions were led by gerontology nurse specialists with at least 10 years of gerontology experience

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who were employed by the district health board.[40] The ARCHUS study authors noted that nurse practitioners, most of whom can prescribe medications, might be able to provide a faster response for some conditions, but the study was unable to employ nurse practitioners. Boyd *et al.*[40] pointed out that employment of nurse practitioners in the care sector in New Zealand was low. Nurse practitioners are not currently employed in UK care homes, but they are increasingly employed by NHS providers, mainly as advanced clinical practitioners, to support care homes as part of the Enhanced Health in Care Homes (EHCH) model. However, Boyd *et al.*[40] noted that their intervention was relatively low in intensity compared with other interventions involving nurse specialists.

The one QI programme study from Australia[44] shared some features with the English EHCH model and other initiatives, being initially developed by care home nursing staff with input from community healthcare providers. The presence of active implementation support in this study should be taken into account in assessing its applicability to the UK. Finally, the Swiss INTERCARE study[45] involved an urban care home population with a median age and sex or gender distribution similar to the UK. Participating care homes were highly motivated and committed to implementing the complex study intervention, based on the use of registered nurses in extended roles.

Integrated working

UK evidence

We used 'integrated working' to cover interventions in which the central feature was enhanced health service support for care homes, albeit often as part of a complex intervention with several elements, for example staff training and patient advocacy. We included 13 UK studies in this group, most of which were part of the Care Home Vanguard Initiatives, which developed the model of care now delivered nationally through EHCH.[2,46–53] Data from these studies were analysed by the Health Foundation, Nuffield Trust and other independent organisations. The remaining publications described or evaluated local initiatives and were mainly published as grey literature.[54–56]

Five of the Care Home Vanguard studies (six publications) reported on initiatives in specific English cities or districts (Nottingham, Sutton, Rushcliffe, outer East London and Wakefield) with support from local commissioners and health and social care organisations. Details of the interventions varied (see *Appendix 2*, *Table 35*) and all had multiple elements but strengthening links between care homes and local general practices was a key feature. One intervention differed from the others by including availability of support from a geriatrician.[51]

Characteristics of these studies are summarised in *Table 9*. The studies used linked care home and hospital data to compare outcomes of residents in participating care homes with those of a matched control group in homes with similar characteristics but not receiving enhanced support. This means that the comparison was not randomised and limited data on resident characteristics were available. A further study used administrative data to estimate the effect of new integrated care models (including the Care Home Vanguards) on hospital admissions at the national level.[50]

Four of the five local interventions reported a decrease in emergency admissions, potentially preventable emergency admissions or both compared with matched control groups. The exception was the initiative in Sutton, which the authors suggested may have been evaluated too early for any effect to be detected.[5] Relative reductions of between 18% and 39% were reported but CIs suggested a range of effects from less than 5% to over 50%. A subgroup analysis of the Rushcliffe study indicated that the reduction in admissions was present for residential homes but not for nursing homes,[48] possibly because the lower baseline level of support in these homes gave more scope for improving outcomes. Overall, this group of studies constitutes 'stronger' evidence for the effectiveness of integrated working initiatives but with uncertainty about the size and clinical significance of any effect.

TABLE 9 Summary of UK integrated working studies (see text for local initiatives)

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Brine *et al.*[46]	Controlled before–after	Nursing home, residential home	Care homes: 15 nursing and 23 residential care homes. Individuals: 782 residents	Standard care (before–after)	Unplanned/preventable admissions; all admissions; transport to ED; length of hospital stay; other (specify); proportion of deaths that took place outside hospital (as a proxy for dying in preferred place of death)	Significant positive effect: emergency admissions were 18% lower for the intervention group and potentially avoidable emergency admissions 27% lower. Differences were only significant for residential homes. There was no difference between groups in ED attendance
Conti *et al.*[47]	Controlled before–after	Nursing home, residential home	Care homes: intervention group – 17 nursing homes and 11 residential care homes; matched control group – 97 care homes. Individuals: intervention group – 297 residents; matched control group – 243 individuals, 296 records	Standard care (before–after)	Unplanned/preventable admissions: subset of 'potentially avoidable' emergency admissions, based on a list of conditions considered to be manageable in community settings or preventable through good quality care; emergency admissions; transport to ED; ED attendances; length of hospital stay; hospital bed days; other (specify); outpatient appointments; admissions with urinary tract infection as principal diagnosis; proportion of death occurring outside hospitals (taken indicator of successful end-of-life planning)	No effect
Lloyd *et al.*[49]	Controlled before–after	Unclear or not available 'care homes'	Care homes: 23 Principia care homes; comparison group was from 64 care homes. Individuals: 588 residents from Principia care homes, 588 residents in comparison group	Standard care (before–after)	Unplanned/preventable admissions; emergency admissions; all admissions; transport to ED; length of hospital stay; other (specify); outpatient attendances; death	No effect: significant reduction in emergency admissions only

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TABLE 9 Summary of UK integrated working studies (see text for local initiatives) (*continued*)

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Lloyd *et al.*[48]	Controlled before–after	Nursing home, residential home	Care homes: nursing homes 10 intervention, 27 control; residential homes 13 intervention, 47 control. Individuals: 68 in each group	Standard care (before–after)	Unplanned/preventable admissions; potentially preventable emergency admissions; all admissions; emergency admissions; transport to ED; length of hospital stay; other (specify); proportion of deaths outside hospital	Significant positive effect: residential care homes only
Morciano *et al.*[50]	Controlled before–after	Nursing home, residential home	Care homes: not reported (care homes participating in 6 care home Vanguards were included). Individuals: not reported (residents in care homes participating in 6 care home Vanguard pilot projects were included)	Standard care (parallel control group); compares data from care home Vanguard sites with non-Vanguard sites; appears to be total hospital admissions and bed days	All admissions; emergency admissions; length of hospital stay; hospital bed days	Significant positive effect: significant reduction in rate of emergency admissions for care home Vanguard vs. non-Vanguard areas
Sherlaw-Johnson *et al.*[51]	Mixed methods	Nursing home	Care homes: 4 [intervention (Health 1000) group]; 19 (comparator group). Individuals: 431 (intervention group); 1495 (comparator group)	Standard care (before–after)	All admissions; emergency admissions; transport to ED; length of hospital stay; acceptability to care home staff; costs/cost-effectiveness	Significant positive effect: 35% marginal reduction in emergency admissions (95% CI 6% to 55%)
SQW Ltd 2017[52]	Mixed methods	Nursing home, residential home	Care homes: all Sutton (CCG and local authority) care homes invited to participate. Individuals: not reported	None	Unplanned/preventable admissions; non-elective admissions; emergency admissions; transport to ED; length of hospital stay; acceptability to residents/families; costs/cost-effectiveness; other (specify); preferred place of death	No effect

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Vestesson 2019[53]	Controlled before–after	Nursing home; residential home; assisted living/ extra care housing; 2 supported living schemes received some parts of the support given to care homes	Care homes: 15 in intervention (Vanguard) and 30 in matched control group. Individuals: 526 residents in each group	Standard care (parallel control group); matched controls in similar care homes	Unplanned/preventable admissions; emergency admissions for specific conditions; emergency admissions; transport to ED; length of hospital stay; emergency and elective hospital bed days; other (specify); deaths in hospital	Significant positive effect: significant but not conclusive evidence for potentially avoidable admissions
Wolters 2019[2]	Other (specify): summary of learning from Health Foundation evaluations of initiatives in Sutton, Rushcliffe, Nottingham and Wakefield	Nursing home, residential home	Care homes: not reported (see reports on individual initiatives). Individuals: not reported (see reports on individual initiatives)	Standard care (before–after)	Unplanned/preventable admissions; emergency admissions; transport to ED; feasibility of intervention	Significant positive effect: varied across sites/outcomes

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Implementation

Studies with data extracted on implementation are summarised in *Table 10*. In terms of the PARIHS framework, none of the studies reported evidence as a barrier to implementation. By contrast, numerous barriers associated with the background context in the UK were identified. Some general practitioners (GPs) were opposed to alignment of specific GP practices with care homes,[46] and in another study alignment proved difficult for reasons connected to organisational boundaries.[51] In Bradford and Airedale, some GPs preferred direct referral rather than referral via a telehealth hub and some care homes continued to turn to GPs first rather than contacting the telehealth service.[57] Several studies reported barriers arising from within the care home, including resistance from managers and staff,[57] difficulties in ensuring that staff had time to attend training,[52] low levels of information technology literacy, internal processes that conflicted with study protocols[51] and high staff turnover.[57]

At the organisational level, implementation of the intervention across the Nottingham city area was inconsistent.[46] The East and North Hertfordshire care home vanguard encountered barriers associated with recruitment and time/resources required to obtain information governance approval.[57] Evaluation was also hampered by a lack of baseline data for comparison.

Implementation of support for integrated working was supported by cited evidence of similar interventions proving effective in other settings[51,52] and evidence of variation in use of hospital services between care homes, suggesting potential for improvement.[2]

Contextual factors that favoured implementation were generally based on pre-existing services or partnerships (see *Table 10*). Rushcliffe and outer East London benefited from low baseline levels of socioeconomic deprivation and relatively low levels of staff turnover which reduced care home sector instability, respectively.

Some details of facilitation of implementation were reported from Sutton, Hertfordshire, Rushcliffe and outer east London (see *Table 10*). Two studies highlighted the role of committed individuals in key positions[47,51,52] and these sites also received funding to support implementation of their interventions.

International evidence

The largest body of international evidence on integrated working interventions comes from Australia (15 studies), followed by the USA (4) and other countries (4).

The 15 publications from Australia reported on 10 different interventions. Of these, seven were delivered by hospital-based teams. The studies used a wide range of designs (see *Table 11*). Sample size for quantitative studies ranged from 1 to 81 care homes. The number of participants involved also varied widely but was less clearly reported, for example as the number of beds rather than the number of individuals recruited or analysed. Many of the studies were at high risk of bias because of weak study designs or small sample sizes. Of the RCTs included, one was small (45 participants)[58] and the other used a step wedge rather than a parallel control group design.[59] Details of risk of bias for individual studies can be found in *Appendix 4*.

Table 12 summarises the interventions evaluated in the Australian studies. Interventions delivered by hospital-based teams were described as 'residential in-reach', 'acute geriatric outreach', 'regular early assessment post-discharge' (REAP), 'hospital in the nursing home' (HiNH), 'aged care emergency service' (ACE; with or without telehealth) and 'geriatrician-led outreach service' (Residential Care Intervention Program in the Elderly). Services described as 'in-reach' and 'outreach' overlapped in terms of intervention content and the distinction between them was unclear. The REAP programme differed from the others by being delivered after discharge with a view to reducing unplanned readmissions.

Core components of the interventions included geriatrician and/or nurse practitioner leadership; telephone advice and case review; visits to care homes as required; tests and investigations; and hospital-level treatments such as cannulation. However, most services were only available during set hours and mainly on weekdays.

TABLE 10 Factors affecting implementation in UK integrated working studies

Study setting	Evidence as barrier	Context as barrier	Evidence as facilitator	Context as facilitator	Role of facilitation
Nottingham City[46]	Not reported	Inconsistent implementation across area; GP and resident resistance	Not reported	CCG supported initiatives to improve health in care homes from 2007	Evaluation covered a range of existing services
Sutton[47,52]	Not reported	Difficulties arranging staff time for training; lack of information technology literacy; e-learning underused; some staff unfamiliar with link nurse role	Intervention components based on evidence of what works elsewhere	Some intervention components already existed in some form; small group of committed senior staff did initial groundwork	Facilitation by steering group and programme staff; funding from NHS England to support spread of Vanguard
East and North Hertfordshire[57]	Not reported	Lack of baseline data; time and resource demands of information governance	Not reported	Single trade association providing training across area; pre-existing collaboration between local authority and CCG	'Complex care champions' appointed; homes received funding to backfill posts
Bradford and Airedale[57]	Not reported	Some reluctance to use remote service; care homes continued to contact familiar GPs or community teams	Use of highly trained staff as first point of contact rather than relying on pathways or algorithms	Involvement of all staff, including those not directly using the service; telehealth hub as single first point of contact	Not reported
Rushcliffe[46,49]	Not reported	Varying standard of 'usual care' within and between homes	Residential home residents identified as potentially more likely to benefit from additional support	Area with relatively low levels of admissions and socioeconomic deprivation	Residential home staff received additional training compared with nursing home staff
Outer east London[51]	Not reported	Nursing homes in 'geographically difficult' locations, difficult to align with general practice; homes privately owned, potential conflict between existing practice and intervention procedures	Model of care based on Wagner's chronic care model	Mutual trust between care homes and GPs; high staff turnover not seen as a problem locally	Initiative driven forward by a group of committed individuals providing 'strong leadership and clear vision'; support from prime minister's Challenge Fund
Wakefield[53]	Not reported	One GP practice per care home model was not implemented	Not reported	Care home Vanguard formed in March 2015	Not reported

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TABLE 11 Summary of Australian studies on integrated working

Reference	Intervention	Delivered from	Study design and sample size	Effect measure
Amadoru *et al.*[64]	Residential in-reach	Hospital	Qualitative; 8 care homes, 40 staff	N/A
Chan *et al.*[65]	Acute geriatric outreach	Hospital	Before–after; 12 nursing homes	Rate ratio 10% reduction[a]
Cordato *et al.*[58]	Post-discharge visits (REAP)	Hospital	RCT; 21 care homes, 45 residents	Readmissions, ⅔ reduction[a]
Craswell *et al.*[60]	Nurse practitioner candidate: enhanced primary care	Primary care	NRCT 1 intervention site	ED admissions 44.6 vs. 59%[a]
Dai *et al.*[62]	Acute geriatric outreach	Hospital	ITS; 12 care homes	Admissions 42.8 to 27.1/month[a]
Dwyer *et al.*[61]	Nurse practitioner: community-based residential acute care service	Community	Qualitative; 10 care homes, 15 interviewees	N/A
Fan *et al.*[63]	HiNH	Hospital	CBA; 1 hospital catchment area, > 2000 beds	Admissions rate ratio 0.62[a]
Fan *et al.*[67]	HiNH	Hospital	Economic evaluation of Fan *et al.*[63]	Reduction in net costs to health service[a]
Haines *et al.*[59]	In-house GPs	Primary care	Step wedge RCT; 15 care homes	Unplanned hospital transfers rate ratio 0.53; admissions 0.52[a]
Hullick *et al.*[68]	ACE; nurse-led telephone triage+	Hospital (ED)	CBA; 4 intervention, 8 control homes	40% reduction in ED admissions[a]
Hullick *et al.*[69]	ACE	Hospital	Stepped wedge; 81 facilities, 9 EDs	ED admissions rate ratio 0.79[a]
Hullick *et al.*[70]	ACE + video-tele-health	Hospital	CBA; 5 intervetion, 8 control homes	No difference in ED visits and admissions
Hutchinson *et al.*[71]	Geriatrician-led outreach service (RECIPE)	Hospital	Cohort/ITS; 73 facilities in hospital catchment area	Reduction in admissions from 3.03 to 2.4/resident/quarter[a]
Kwa *et al.*[72]	Residential in-reach (linked to Amadoru *et al.*[63])	Hospital	Uncontrolled before–after; 52 care homes	Unplanned ED presentations 2.4 vs. 0.8%[a]
O'Neill *et al.*[65]	Hospital avoidance	Care home collaborating with specialist in-reach team and other specialists	Qualitative; 1 care home, 21 interviewees	N/A

a Statistically significant effect.
ACE, aged care emergency service; CBA, controlled before–after study; ITS, interrupted time series; RECIPE, Residential Care Intervention Program in the Elderly.

Primary care or community-based studies evaluated nurse practitioner-led services[60,61] and a model of care supervised by in-house GPs supported by a clinical manager.[59] This latter model was unusual and the study was affected by difficulties in recruiting GPs to work in and across care homes.

TABLE 12 Details of interventions evaluated in Australian integrated working studies

Study ID	By whom	What	Where	To what intensity	How often
Amadoru *et al.*[64]	RACF staff, GPs and residential in-reach RNs	A residential in-reach service operating in Melbourne. It is geriatrician-led and operates seven days a week, from 9 a.m. to 5 p.m.. This service offered telephone advice, geriatrician or nursing reviews, acute interventions such as intravenous antibiotics and hydration, palliative care, changing or reinsertion of urinary catheters and percutaneous endoscopic gastrostomy tubes, management of elective hospital day admissions for blood transfusions and acute medical admissions, discharge follow-up and coordination of specialist consultations	Care homes in an urban setting	Operates seven days a week, from 9 a.m. to 5 p.m.	Occurred per referral from GP or care home staff
Chan *et al.*[66]	Acute geriatric outreach service: 2 part-time geriatricians initially, subsequently joined by 1 nurse; advanced trainee in geriatric medicine available both pre and post intervention but not consistently	Geriatric outreach service targeting acute conditions such as pneumonia, cellulitis and urinary tract infections. Members could cannulate, order blood tests on the same day and order imaging investigations. They sometimes also provided staff education and training	Participating nursing homes	Geriatricians each work 0.5 FTE; service operates 9 a.m. to 5 p.m. Monday to Friday	Not applicable
Cordato *et al.*[58]	7 geriatricians and 1 nurse practitioner	Usual post-discharge care (as for the control group) plus regular joint geriatrician and nurse practitioner evaluations. Additional investigations and/or treatments recommended/arranged in concert with the resident's GP/primary care physician, who retained ultimate responsibility	Nursing home	Visits involved both geriatrician and nurse practitioner; length of sessions not reported	First visit within 1 week after discharge from hospital admission, then monthly visits for 6 months
Craswell *et al.*[60]	NPC working with GPs and care home staff	NPC provided triage, assessment, preliminary diagnosis and primary care for acutely unwell or deteriorating residents to reduce potentially preventable transfer to hospital. Identification was achieved by regularly visiting all resident areas, discussing resident conditions with all levels of clinical staff of the facility and visiting residents with a history of known comorbid conditions. NPC also collaborated with the GP in the care of residents, promoted ACP, and provided opportunistic education to care staff	Care home	During the 12-month study period, NPC completed 1790 consultations with 266 residents, the median number of consultations per resident 4	Not applicable

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TABLE 12 Details of interventions evaluated in Australian integrated working studies (*continued*)

Study ID	By whom	What	Where	To what intensity	How often
Dai *et al.*[62]	Geriatricians and nurse triage referrals and visit care homes to assess and manage patients there with 'hospital in the home' interventions	'Hospital at home interventions' including cannulation, intravenous drugs (antibiotics, furosemide), and subcutaneous fluids. Other interventions provided include symptom management, difficult urinary catheterisations, ACP, and medication reviews. The service relies on private pathology and radiology providers for investigations. It works collaboratively with private wound nurse practitioners and community nursing services. Hyperacute problems such as stroke and acute coronary syndromes are excluded	Care homes in catchment area	Available during weekdays, staffed by 1 FTE geriatrician, 1 FTE aged care nurse, and 1 FTE geriatric trainee	Not applicable
Dwyer *et al.*[61]	2 nurse practitioners (1 gerontology and 1 chronic disease endorsed), care home nurse managers, RNs, allied health professionals and residents' GPs	Community-based 'in-reach', service called RACS. RACS team respond to calls from care facilities and provide a responsive, mobile triage service	Care home	Two FTE NPs working office hours Monday to Friday	Not applicable
Fan *et al.*[63]/Fan *et al.*[67]	ED-based nurses working in partnership and coordinating with RACF staff and other health providers (further details not reported)	Four main components: (1) HiNH staff manage acute symptoms in nursing home residents who might otherwise require transfer to ED; (2) support and education for nursing home staff and GPs; (3) HiNH team seeks senior medical decision-making at an early stage after presentation to ED and coordinates subsequent care; (4) HiNH team coordinates discharge of residents from ED and inpatient care	Care home and ED	Programme involved '2 or 3' ED-based nurses as main programme staff; Fan *et al.*[67]	Not applicable
Haines *et al.*[59]	In-house GP; clinical manager; RN in charge; community RNs/EENs; care staff	Clinical manager supports the GP in managing medical practice, RN in overall charge; other RNs/EENs act as team leader for a small group of personal care attendants responsible for a 'community' of residents. Personal care attendants assist residents with their medications	Nursing home	1 full-time GP was employed for each 150 residents	Not applicable
Hullick *et al.*[68]	ED advanced practice nurse led and coordinated the service, working with care home and ambulance staff, GPs, ED staff and the primary care organisation	Clinical care manual to support care in the facility; nurse led telephone triage line; education of care home staff; establishing goals of care prior to ED transfer; case management when in the ED; and development of collaborative relationships between stakeholders	Care home and ED	Over 20 evidence-based algorithms; 2-hour educational presentation with extra education as required; telephone advice 12 hours/day, 7 days/week	Not applicable
Hullick *et al.*[69]	See Hullick *et al.*[68]	24-hour nurse-led telephone consultation service for care facilities; evidence-based algorithms for common problems; establishing goals of care before transfer to ED; case management by specialist aged care nurses in the ED; empowerment and education of care facility staff; community of practice involving all stakeholders; ongoing change management and coordination among stakeholders. See also Hullick *et al.*[68]	Participating care facilities and EDs	Telephone advice 24 hours/day; education used a 'train the trainer' approach with a 2-day workshop at each 'step'	Quarterly meetings of community of practice

Study ID	By whom	What	Where	To what intensity	How often
Hullick *et al.*[70]	Care home staff, ED/ aged care RN/advanced practice RN supported the programme 1 day per week including trouble shooting	The video telehealth pathway was available 7 days a week for calls between 8 a.m. to 4 p.m. This involved two-way, real-time interactive communication between the resident with support from care home staff and nursing staff in the ED. Care home staff member activated the call, managed the patient, managed the camera and equipment and undertook tasks to support the telehealth call. They also considered the recommendations from the ED regarding management including whether transfer to the ED was needed. Out of hours, telephone support continued to be provided by the primary health organization as part of the Aged Care Emergency programme, with no video enhancement. The video telehealth technology was also used to provide follow-up of patients discharged from hospital up to 1 week following their discharge to ensure clinical handover was complete	ED and care homes	7 days a week 8 a.m. to 4 p.m.	As needed
Hutchinson *et al.*[71]	Referral by hospital staff (ED, ambulance or other), care home staff or primary care; triage and care home visit by aged care specialist (nurse specialist, registrar or geriatrician); additional services as required	Triage (same day or same week response); care home visit: assessment, care planning, arrange interventions/pathology, referral to hospital in the home if required, development of long-term care plan (including ACP with advance directive if appropriate) with primary care and care home staff	ED and care home	Same day or same week response depending on needs	Additional visits if required once enrolled in the programme
Kwa *et al.*[72]	Hospital RIR team serving care homes within the catchment area	Change of medical staff from rotating ED physician support to a consistent consultant geriatrician; co-location of an existing ward-based RAC liaison nurse role to work with the RIR team; stakeholder engagement to encourage referral for review and continued care after hospital discharge	Care homes and tertiary referral hospital	Before implementation, the RIR team consisted of a nurse (1.0 FTE) and consultant physician (0.5 FTE), Monday–Friday, 9 a.m. to 5 p.m. In 2014, the service was redesigned without incurring any increase in operating cost or FTE allocation	Not applicable
O'Neill *et al.*[65]	Primarily nursing staff at nursing homes, but also community clinical staff including geriatricians and wound care nurses	Decision-support tools; advanced clinical skills training; specialist clinical support and collaboration; medical equipment	Nursing home and hospital (to support early discharge)	Not clear but package of training and referral pathways which appear to be continuously implemented	Continuous

EEN, endorsed enrolled nurse; FTE, full-time equivalent; NPC, nurse practitioner candidate; RACS, residential aged care service; RIR, residential in-reach; RN, registered nurse.

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With one exception, all the quantitative studies reported a significant reduction in one or more outcomes related to admissions, ED visits or health service costs. The size of effect and the effect measure used varied but controlled studies typically reported relative reductions of a third or more compared with standard care for both hospital-based[62,63] and primary care/community-based[60] interventions (see *Table 11*).

Qualitative studies reported that the rate of referral to in-reach services was influenced by the perceived responsiveness of the service and outcomes of care.[61,64] In a further study, care home staff welcomed the introduction of a hospital avoidance programme involving collaboration with community-based specialists alongside use of QI tools.[65] The qualitative studies were all from the perspective of care home staff, mainly nurses.

Of the four US studies (see *Table 13*), two evaluated the use of telemedicine for remote consultation[72,73] and the others evaluated specific models of care.[75,76] Further details of the interventions are presented in *Appendix 3*, *Table 39*.

Other studies

Of the four remaining studies, three examined measures to strengthen medical support for care home residents (see *Table 14*) and one (two publications) evaluated early geriatrician follow-up after discharge. Same-day access to a physician, assignment of a dedicated GP to nursing homes and changes in reimbursement policy were all associated with reductions in admissions in single studies. While all the studies had some kind of control group, study designs were observational and/or non-randomised, suggesting that the findings should be interpreted cautiously. These studies add to the UK and international body of evidence for the effectiveness of improving access to primary care physicians in reducing unplanned admissions.

Two studies by Pedersen *et al.*[77,78] evaluated early follow-up visits by a nurse and doctor from a geriatric team following hospital discharge as a way of reducing early readmissions. The first study recruited a general population of older people with frailty admitted to hospital (with care home residents as a subgroup)[77] while a later paper reported specifically on care home residents.[78] In the 2018 study,[78] readmissions were reduced by 37% in the intervention group relative to standard care. The study was at risk of bias from non-random assignment to treatment groups and possible differences between groups at baseline. A similar intervention evaluated in Australia by Cordato *et al.*[58] reported a two-thirds reduction in readmissions (see *Table 11*). Taken together, the two studies represent 'weaker', albeit promising, evidence for this type of intervention.

Applicability

Applicability data were extracted from 12 of the 15 Australian studies (see *Table 15*). Key points relevant to applicability/transferability were as follows:

TABLE 13 Summary of US integrated working studies

Reference	Intervention	Delivered from	Study design and sample size	Effect measure
Brickman *et al.*[75]	MDT	Hospital ED	Non-randomised trial; 1 intervention, 101 control sites	Annual unplanned admissions: 55% reduction
Grabowski *et al.*[73]	Out-of-hours telemedicine	Medical call centre	Step-wedge RCT; 11 care homes	Hospitalisation rate: significant reduction for higher users
Hofmeyer *et al.*[74]	Telemedicine consultations	Telemedicine 'hub' with on-call specialists	Uncontrolled pilot study	Transfer rate decreased from 54% in 2013 to 17% in 2015
Stadler *et al.*[76]	MDT	Hospital (tertiary geriatric centre)	Uncontrolled before/after; 3 rural facilities	35% reduction in monthly ED transfers and 30.5% reduction in monthly hospitalisations

TABLE 14 Summary of integrated working studies from other countries

Reference and country	Intervention	Delivered from	Study design and sample size	Effect measure
Kobewka *et al.*[79] Canada	Same-day physician access	Not applicable (association study)	Retrospective cohort; 161 care homes	Hospitalisations 21% reduction (rate ratio 0.79)
Kumpel *et al.*[80] Germany	Additional reimbursement for physicians	Policy change	Controlled before–after; 22,000 nursing home residents	8% (absolute) reduction in ambulatory care-sensitive admissions
Pedersen *et al.*[77,78] Denmark	Follow-up visit by geriatric team after discharge	Hospital geriatric team	Quasi-randomised trial; 648 (330 intervention, 318 control) in 2018 study	Readmissions 37% reduction (adjusted hazard ratio 0.63; 95% CI 0.42 to 0.95)
Weatherall *et al.*[81] Denmark	Dedicated GPs attached to nursing homes	Primary care	Non-randomised trial; 16 nursing homes	Preventable admissions, 27% relative reduction

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TABLE 15 Applicability considerations for Australian integrated working studies

Reference	Population	Organisations/finance	Leadership	Services/workforce/initiative
Amadoru *et al.*[64]	Not reported; limited details reported above under 'limitations'	Not reported	Not reported	Not reported
Chan *et al.*[66]	Mean age of treated patients was 85.7 years and 52% were females; 69.4% were acute patients (deemed to require ED transfer if not seen the same day)	Service established by geriatric and ED specialists to serve NHs in hospital catchment area. Additional funding was obtained to establish the acute geriatric outreach service	Not reported	Referrals from nursing home staff and patients/carers increased from 29% in 2013 to 76%
Cordato *et al.*[58]	Catchment area of study generally middle-income and culturally diverse. Patients unable to complete study questionnaires (e.g. with severe dementia) were excluded	Care homes were within the catchment area of St George's Hospital (specific local government areas of Sydney). Authors note findings relevant to most developed nations as they face similar challenges to Australia and there is overlap in delivery of health and social care. About 2/3 of hospital beds in Australia publicly funded through Medicare. Care homes provided by private and not-for-profit organisations, subsidised by federal government, with ongoing medical care through Medicare	Not reported	Support of residents' GPs pivotal to success of the intervention. Key elements include targeting the post-hospitalisation period and regularity and frequency of follow-up
Craswell *et al.*[60]	Residents referred to the NPC were on average 86 years of age and 67% were female	Intervention facility described as 'multisite'; ED described as 'local' so relatively close to intervention and other facilities. Study was funded via a competitive grant from the Department of Social Services (now Commonwealth Department of Health)	Not reported	Intervention delivered by nurse practitioner candidate undertaking advanced training so could potentially mitigate a shortage of qualified nurse practitioners. Intervention of relatively low complexity and limited spread; part of larger research project: Care coordination through ED, residential aged care and primary health collaboration
Dai *et al.*[62]	Care home residents from 17 residential aged care facilities in the Bankstown catchment area. Not clear if nursing or non-nursing care.	Bankstown-Lidcombe Hospital introduced the acute geriatric outreach service. The service was provided by the hospital but not clear how it was funded/commissioned. Service also involves private providers	Not reported	Service was designed to improve on previous sub-acute model. During the study period, Australia funded more home care support, which may have meant people entering residential care had more complex health needs than previously. Service delivered by 1 full time geriatrician, 1 full time aged care nurse, and 1 full time geriatric trainee. Service was hospital-based; no other details reported. Service successfully delivered since January 2015, suggesting good longevity

Reference	Population	Organisations/finance	Leadership	Services/workforce/initiative
Fan *et al.*[63]	Residents presenting to ED were mainly aged 75–94 and about 63% were female	All nursing homes in the catchment areas of the intervention and control hospitals were federal funded, and their performance was assessed against a set of legislated accreditation standards. The composition of nursing homes in the 2 areas was also similar, with comparable percentage of high- and low-care beds. HiNH programme funded by Queensland State Government	Not reported. Lack of reporting may reflect HiNH programme operating since 2006	See above; elements of intervention delivered in care home and ED. ED nurses key to intervention but grade and hours worked not reported. HiNH programme implemented at intervention hospital since 2006, hence long-lasting initiative
Haines *et al.*[59]	Not reported	Intervention initiated by Bupa Aged Care. GPs and other staff employed directly by Bupa Aged care	Not reported	Trial sites in different cities/states; common ownership implies similar standards of care. Intervention aimed to improve access to GPs and expand role of RNs; four facilities were unable to recruit GPs during the study. Complex initiative requiring significant reorganisation of roles; 30-month trial plus pre- and post-intervention periods supports longevity
Hullick *et al.*[68]	Mean resident age approximately 86 years in both groups	Setting was a local health district in New South Wales, Australia with a range of tertiary and primary services. The tertiary referral hospital, in which the intervention ED is located, is surrounded by a number of RACFs that refer patients to the ED. Three of the intervention RACFs were not-for-profit organisations and one for-profit, with a total of 413 residents. Three of the intervention facilities had RNs onsite 24 hours a day. One facility had RNs on call overnight. Care in RACFs is subsidised by the Australian federal government with the majority of services provided by not- for profit organisations. State governments fund acute care services. The context for the study was that there was no additional funding for RNs in RACFs	Development of collaborative relationships among stakeholders a key part of the intervention	High rate of ED attendance in intervention facilities; intervention and control sites matched on number of total beds, dementia specific beds, and ratio of high to low care beds. RNs in RACFs account for 15 % of the direct care workforce with the majority of staff being AINs or PCAs. RNs in provide oversight of entire facilities with supervision of AINs and PCAs. Nurse practitioners are advanced practice nurses whose numbers are limited and closely controlled by state and federal funding (0.2% of staff). Intervention operates before and during transfer to the ED; advice and coordination provided by ED staff

continued

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TABLE 15 Applicability considerations for Australian integrated working studies (*continued*)

Reference	Population	Organisations/finance	Leadership	Services/workforce/initiative
Hullick *et al.*[69]	Study covered the Hunter New England Health Local Health District in northern and western New South Wales, Australia, including the metropolitan region of Greater Newcastle along with regional and rural communities	Participating 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. For financial information, see Hullick *et al.*[67]	Two advanced practice nurses provided leadership for the programme. Community of practice brought together key stakeholders	Participating facilities varied in baseline rate of ED transfer. For workforce details, see Hullick *et al.*[67] Intervention operates before and during transfer to the ED; advice and coordination provided by ED staff and staff from the local primary care/general practice organisation
Hullick *et al.*[70]	Nursing home population in Australia, homes varied in provision of dementia care and respite care	The 5 intervention RACS all belonged to 1 not-for-profit aged care organisation. Intervention and control homes referred patients to the same community hospital ED	Initiative for the study came from the care home organisation running the intervention sites	ACE hospital avoidance programme operating for at least 9 months before study data collection started. Local health district telehealth personnel were available by telephone when required; they recommended equipment and assisted with training both hospital and care home staff. An APRN supported the programme 1 day per week including trouble shooting, change management and training as well as monthly project meetings with stakeholders. The RN trained the care home and hospital administrative and nursing staff. Stakeholders included a nurse educator and nurse practitioner from the care home organisation, the ACE program advanced practice RN, local health district telehealth support as well as ED and older persons' ward representatives from the hospital. Video consultation to help evaluate unwell residents and provide follow-up of residents recently discharged from hospital. The ACE program has engaged 81 RACS that primarily transfer residents to nine EDs across a large regional local health district of Northern and Western New South Wales, Australia, including regional and rural communities

Reference	Population	Organisations/finance	Leadership	Services/workforce/initiative
Hutchinson *et al.*[71]	Median age of 84 years, 61% female	Not reported	Not reported	Service based on assessment by aged care specialists; authors note shortage of trained staff a barrier to providing palliative care services in residential care settings. RECIPE service introduced in 2002, so high longevity
Kwa *et al.*[72]	Patients seen by RIR were marginally older in the second period (median age pre: 86 years, IQR: 80–91, vs. post: 87 years, IQR: 81–91). The 5 most common conditions that were treated during RIR visits were skin conditions; respiratory; 'other geriatric assessment'; end-of-life care; and catheter care	Service provided by tertiary referral hospital to 52 care homes in its catchment area, covering three local government areas. Authors state that service redesign did not incur any additional costs	Not reported but this was redesign of an established service rather than introduction of a completely new service	Service redesign required a consultant geriatrician with experience in acute care of the older patients including in care home settings and a ward-based liaison nurse integrated with the RIR team. RIR service began in 2009 and was restructured in 2014
O'Neill *et al.*[65]	Nursing home staff in general population nursing home Queensland	Not reported	Intervention included 'clinical champions'	Partial integration; early evaluation in one setting

AIN, assistants in nursing; IQR, interquartile range; PCN, personal care assistants; RECIPE, Residential Care Intervention Program in the Elderly; RIR, residential in-reach; RN, registered nurse.

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- Population:
  - Most studies reported some details of the patient population (e.g. age, gender or sex distribution) and setting. There were no specific issues affecting applicability (e.g. highly selected or indigenous populations) but the type of setting could influence applicability.
- Organisation/finance:
  - Cordato *et al.*[58] noted that their findings were 'relevant to most developed nations' because different countries face similar challenges and have overlapping health and social care systems. In Australia, Their summary provides further details relevant to the applicability of study findings from Australia to the UK setting. In Australia, about two-thirds of hospital beds are publicly funded through Medicare. Care homes are provided by private and not-for-profit organisations, subsidised by federal government, with continuing medical care through Medicare.[58] State governments fund acute care.[68]
  - The Australian studies involved a wide range of organisations. Although EHCH in England is based upon a national specification across England, it is coordinated at a regional level through integrated care systems. This mirrors, in many ways, the regional organisation of approaches described in Australian literature. Services were designed to cover care homes within the catchment area of particular hospitals[66] or at the level of the local health district.[68] In another study, the care home provider, Bupa Aged Care, implemented and evaluated an intervention involving employment of GPs to work within care homes.[59] This latter intervention could have limited application to the UK, where GPs are generally external to care homes and serve patients in the community as well as care home residents.
  - Most studies involved all care homes in the study area that wished to participate, generally a mixture of privately owned and not-for-profit homes.[63,66,68] Others involved working with homes belonging to a single care organisation.[70]
  - Some studies reported limited details of the organisations involved.[71]
  - Across the range of studies, financial support was reported from an unspecified source of 'additional funding';[66] the Department of Social Services;[60] and the Queensland State Government.[63] One study reported that service redesign incurred no extra costs.[72]
- Leadership:
  - Details of systems leadership were not reported for most studies. Hullick *et al.*[69] reported that advanced practice nurses provided leadership and a community of practice brought together key stakeholders. In another study by the same group,[70] the initiative was originated by the owners of the care homes where the intervention was implemented. The hospital avoidance programme reported by O'Neill *et al.*[65] included 'clinical champions'.
- Services/workforce/initiative:
  - One study reported that the research took place at a time of increased public funding for care homes, which may not be applicable to the UK.[62]
  - The role of government accreditation of care homes, highlighted in one study,[63] is similar to that seen across all four UK nations.
  - In terms of workforce, the included studies identified issues that appear applicable to the UK, including the importance of support from residents' GPs[58] and the need to take into account shortages of healthcare professionals, including GPs,[59] specialist nurses[68] and geriatricians.[72]
  - Specific features of workforce and organisations were of uncertain applicability to UK practice but should be taken into account. These include key roles for particular staff such as nurse practitioners in advanced training;[60] the overall balance of the workforce, about 15% of care staff in Australia being registered nurses and just 0.2% nurse practitioners;[68] and the role of staff based in different settings,[68] staff from EDs working more closely with care homes in Australia than the UK.

Other studies

Applicability data were extracted from three of the four integrated working studies conducted in the USA.[73–76] Key findings related to applicability were:

- Population:
  - Two studies involved facilities catering for both long- and short-term residents, limiting applicability to the UK.[73,75]
  - The third study was in a rural setting with a single dominant healthcare provider and an ethnically homogeneous population (mixed applicability).[76]
- Organisations/finance:
  - Authors reported that the US fee for service system[75] and Medicaid[73] have the effect of discouraging interventions to reduce admissions.
  - One study involved care homes owned by a single provider, likely reducing applicability.[75]
- Leadership:
  - In a study of telemedicine, some care homes made little use of the service, likely a generalisable outcome of lack of leadership at that level.[73]
  - Prior to implementation of the reducing avoidable facility transfers intervention, members of the provider's geriatric team served as medical directors of participating facilities[76] (not readily applicable to the UK).
- Services/workforce/initiative:
  - Of the two MDT-type interventions, one identified issues applicable to UK settings (complexity of intervention, requirement for training of care home staff).[75]
  - The other study reported that internal medicine physicians with little experience of working in care homes were assigned to provide out-of-hours medical coverage, an issue unlikely to be applicable to UK care home settings.[76]

Looking at studies conducted in other countries, applicability data were extracted from the Danish studies by Pedersen *et al.*[78] (early geriatric follow-up) and Weatherall *et al.*[81] (dedicated GPs). A major difference from the UK is that nursing homes in Denmark are publicly owned, with relatively uniform staffing and resources; this facilitates integration with the health-care system.[78] Pedersen *et al.*[78] also noted that hospital admissions in Denmark tend to be short (hence the potential value of early geriatric follow-up), suggesting that the problem of delayed transfer of care is less acute than in the UK. The study of dedicated GPs[81] found recruitment challenging (despite GPs being able to continue their own practice alongside work in nursing homes) and this would likely be applicable to a similar intervention in the UK.

Training/workforce development

Interventions classified as training/workforce development were more specific than QI programmes. These interventions focused on training within a specific speciality, for example dementia, or to manage a specific problem such as delirium or recognising acute physiological deterioration.

UK evidence

We included four studies of interventions in UK settings that were classified as training/workforce development.[52,82–84] All of the studies were regionally based.[52,82–84] The vanguard study included all care

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homes in the London Borough of Sutton: 81 in 2018, although numbers varied during the study period.[52] The other studies were smaller, with 23 care homes,[84] 14 care homes[83] and, in the smallest study, 4 care homes.[82] Care homes in three of the studies were a mix of nursing and residential homes,[52,82,83] the type of care homes was unclear in the other study.[84] Two of the studies designs were mixed methods,[52,84] one was a feasibility cluster RCT[83] and the other an uncontrolled before–after study.[82] Formal risk of bias assessment was conducted for the RCT,[83] identifying possible concerns over differences between treatment groups at baseline and lack of blinding. The other studies were at high risk of bias because of weak design and small sample size.[82,84]

The studies investigated a variety of different training and workforce interventions; a dementia learning community,[84] the PiTSTOP study of 'STOP Delirium!' a delirium educational package,[83] a self-contained training intervention on recognising deterioration and other topics[82] and training/workforce development within the Vanguard programme,[52] which is discussed in greater detail within the integrated working section. Study characteristics are summarised in *Table 16*; *Appendix 2*, *Table 37* gives more details of the interventions. The STOP Delirium! educational package outcomes measured were feasible and a larger trial following further modification to the intervention is feasible and needed to assess the impact of the education package, for which this trial was not designed.[83] Establishing a dementia community was also found to be feasible with 'plan, do, study, act' cycles the more active 'active ingredient' of the community.[84] No significant differences were found for intervention homes compared with control care homes in changes in rate of ambulance call-outs and across all sites change in rate of all admissions was not associated with changes in Quality of Life in Dementia Scale scores or more specifically the rates of emergency admissions. This was a small trial of just 23 care homes and further larger studies over a longer period could be needed to determine the impact of the learning community on unplanned hospital admissions. The self-contained training intervention on recognising deterioration and similar topics[82] found that the training programme was well-received by carers but attendance rates for staff were low from 5% to 28%, indicating that the programme was not reaching all care home staff. The study did observe reductions in hospital admissions and specifically avoidable admissions, but these reductions were not analysed statistically and it was hard to demonstrate causality for this small QI project. Another promising intervention that could be investigated in a larger trial. The UK training/workforce development intervention evidence is weak. The included studies demonstrate potentially promising interventions for care homes but would all require further larger trials to properly demonstrate their potential impact.

All of the UK training/workforce development studies reported on implementation of the programme as this is an important part of investigating the feasibility of a new intervention, this information is provided in *Appendix 2*, *Table 38*. Barriers to implementation included, competing pressures on staff time making it hard for them to have time to attend training,[52,82] information technology facilities and support,[52,82] high staff turnover,[82] low attendance rates at training,[82] shift work.[82] Facilitators to implementation of these interventions were having champions from within the care homes,[83,84] a flexible delivery approach including evening sessions, webinars, podcasts to enable more care home staff to participate,[82] information technology systems to enable virtual meetings[82] and stable management.[82] Recently set government targets for dementia training acted as a facilitator for care home management in establishing a dementia learning community.[84] Armstrong *et al.*[82] also discussed the training material highlighting the importance of an activity-based curriculum, embedding of key messages with each session and aligning topics with admissions data.

International evidence

We included three studies, from countries other than the UK, of intervention classified as training and workforce development, one study from Canada,[85] Norway[86] and USA,[87] respectively (see *Table 17*). The Canadian study had the largest sample, 135 nursing homes in the province of Saskatchewan, the US study investigated 85 assisted living facilities across three states and the study from Norway

TABLE 16 Summary of UK training/workforce development studies

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Armstrong *et al.*[82]	Uncontrolled before/after	Nursing home, residential home	Care homes: 4 care homes in Enfield, UK. Individuals: about 190 residents and 206 staff (varying over the course of the project)	Standard care (before–after)	Unplanned/preventable admissions; all admissions; other (specify); percentage of staff completing training	No effect: reductions observed but not analysed statistically
Sheaff *et al.*[83]	Mixed methods realist evaluation	Unclear	Care homes: 23 (13 intervention, 10 control). Individuals: control 330 residents, 245 staff; intervention 288 residents, 298 staff	Standard care (parallel control group)	Emergency admissions; Feasibility of intervention; evaluated presence/absence of elements of intervention programme theory; other (specify); ambulance call-outs end-of-life planning	No effect: emergency admissions did not change
Siddiqi *et al.*[82]	Feasibility cluster RCT	Nursing home, residential home	Care homes: 14 care homes. Individuals: 215 care home residents	Standard care (parallel control group)	All admissions; costs/cost-effectiveness; other (specify); delirium; delirium severity; medications; falls; deaths	No effect
SQW 2017[52]	Mixed methods	Nursing home, residential home	Care homes All Sutton (CCG and local authority) care homes invited participated in intervention. January 2017, Sutton CCG had: 81 care homes. Care home population not static, residents moved in and died and care homes, opened and closed. 2015–16 focused on nursing homes from Autumn 2016 residential homes more involved. Individuals: not reported	None	Unplanned/preventable admissions; non-elective admissions; emergency admissions; transport to ED; length of hospital stay; acceptability to residents/families; costs/cost-effectiveness; other (specify); preferred place of death	No effect

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TABLE 17 Summary of international training/workforce development studies

Study ID and country	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
McGregor *et al.*[85] (Canada)	Retrospective observational study	Nursing home	Care homes: 135 care homes in Saskatchewan. Individuals: 15,214 residents in included facilities	Standard care (parallel control group)	All admission; transport to ED	Significant positive effect: lower nurse availability associated with increased risk of admission
Resnick *et al.*[87] (USA)	Cluster RCT	Assisted living/ extra care housing	Care homes: 85 assisted living facilities; facilities across 3 states: 32 in Maryland, 33 in Pennsylvania and 19 in Massachusetts. Individuals: 781; treatment group 440, control group 341	Standard care (parallel control group)	All admissions; transport to ED; other (specify); falls; cognition function; transfer to nursing homes	No effect
Romoren *et al.*[86] (Norway)	Step wedge RCT	Nursing home	Care homes: 30 nursing homes. Individuals: 330 cases in 296 nursing home residents	Standard care (parallel control group)	Unplanned/preventable admissions; number treated in nursing home instead of hospital; length of hospital stay; harms of intervention; mortality at 30 days; other (specify); number of days treated; type of antibiotics used	Significant positive effect

investigated 30 nursing homes from one county. The studies from Norway and USA were both RCTs; one was a cluster RCT[87] and the other a step-wedge RCT;[86] risk of bias for these studies is provided in *Appendix 4*, *Table 42*. Randomisation and a reasonably sized sample were strengths of the cluster RCT and limitations were missing data due to COVID-19, a relatively homogenous white sample and timing for data collection varied meaning that percentages could not be compared between periods. The step-wedge RCTs' strengths were the reasonably sized sample and design and limitations were problems collecting data, the two groups for comparison were not identical and the original power calculation was for a standard RCT not a step wedge.[86] The study from Canada had a retrospective observational study design; formal risk of bias was not undertaken due to the high risk of bias inherent in this study design. Characteristics of these studies are summarised in *Table 17*; *Appendix 3*, *Table 40* gives more details of the interventions. The study investigating training in function-focused care for care home staff in assisted living facilities in USA found no effect on emergency room or hospital transfers although there was a decrease in falls in the intervention group at 12 months.[87] A structured educational programme in intravenous treatment of dehydration and infections had a positive effect on the number of nursing home residents treated in the nursing home instead of the hospital.[86] The study investigating the legislation that long-term care facilities need to have a registered nurse on duty 24 hours a day, 7 days a week found that lower nurse availability was associated with an increased risk of hospital admission.[85]

The applicability of the international evidence to the UK is limited due to the specific regions investigated,[85] the type of facilities included in the study which were all public/not-for-profit facilities which is different to the UK where the majority are facilities are run for profit[85] and where there are differences in health care systems.[87]

There is limited evidence from the international studies of the impact of training/workforce development interventions due to potential biases in all of the included studies.

Management of specific problems

UK evidence

We included three UK studies (four publications) of interventions to reduce unplanned admissions by tackling specific problems that were not primarily training interventions (see *Table 18*). The Better Health in Residents of Care Homes with Nursing (BHiRCH-NH) study[88,89] evaluated a complex intervention to improve early detection and treatment of urinary tract and respiratory infections, chronic heart failure and dehydration. The other studies in this group evaluated pharmacist-led medication review[90] and delirium prevention.[83] Two of the studies were cluster randomised trials at low risk of bias[83,88,89] but the study of medication review was at high risk of bias as there was no control group.[90]

Details of the interventions are presented in *Table 19*. The BHiRCH-NH and 'Stop Delirium!' interventions were relatively complex while the remaining study reported a relatively simple intervention (medication review) that could be delivered by a single health professional. The medication review study was the only one that reported a positive effect, constituting 'very limited' evidence, with 'inconsistent' evidence for this heterogeneous group of interventions as a whole.

Implementation

Implementation data were collected for the two complex interventions (see *Table 20*). Despite active implementation support in both studies, various contextual factors within the participating care homes produced substantial barriers to implementation of the study interventions.

International evidence

The international evidence for interventions to manage specific problems comprised 10 studies, of which 5 evaluated medication review/deprescribing, 4 evaluated vaccination of residents and/or care workers and 1 evaluated pharmacological prophylaxis of influenza (see *Table 21*). Four of the studies

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TABLE 18 Summary of UK studies aimed at managing specific problems

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Downs *et al.*[88]	Cluster RCT	Nursing home	Care homes: 14 NHs recruited but 2 withdrew before the intervention began. Individuals: 148 nursing home staff; 95 family carers; 245 residents	Standard care (parallel control group)	All admissions; feasibility of intervention; costs/cost-effectiveness	No effect: intervention not implemented as planned
McKee *et al.*[90]	Service evaluation	Nursing home	Care homes: 16 nursing homes. Individuals: 727 patients had medication reviews	Standard care (before–after)	Emergency admissions; monthly presentations; all admissions; costs/cost-effectiveness; estimated drug cost savings; other (specify); to enable comparisons between clinics where the consultant pharmacist worked alone and where they worked with a consultant geriatrician extra data were collected for 100 patients on type of clinical intervention by pharmacist and medication appropriateness.	Significant positive effect
Sampson *et al.*[89]	Cluster RCT	Nursing home	Care homes: 14 nursing homes (7 intervention, 7 control) in London and West Yorkshire. Individuals: 245 residents, 95 family carers, 148 staff	Standard care (parallel control group)	Unplanned/preventable admissions; all admissions; transport to ED; feasibility of intervention; acceptability to care home staff; acceptability to residents/families; costs/cost-effectiveness; harms of intervention; no evidence of harm	No effect
Siddiqi *et al.*[83]	Feasibility cluster RCT	Nursing home, residential home	Care homes: 14 care homes. Individuals: 215 care home residents	Standard care (parallel control group)	All admissions; costs/cost-effectiveness; other (specify); delirium (delirium severity; medications; falls; deaths)	No effect

TABLE 19 Details of UK interventions aimed at managing specific problems

Study ID	By whom	What	Where	To what intensity	How often
McKee *et al.*[90]	Consultant pharmacist working alone or with geriatrician; nursing home staff	Comprehensive medication review; meeting with nursing home staff 6 weeks later to assess uptake of recommendations and identify educational needs	Nursing home	Comprehensive review of medication prescribed	One clinic per participating nursing home
Sampson *et al.*[89]	Care home nursing staff and assistants	3 key components, adapted from the INTERACT programme and paper based as UK nursing homes have variable use of electronic records: (1) Stop and Watch early warning tool: care assistants or nurses used this when they noted a change in a resident's condition. They circled observed changes, notified the nurse and placed the tool in the resident's nursing home records. (2) Care pathway: this was a two-step clinical guidance and decision-support system, focusing on symptoms and signs of four key ACSC conditions (acute exacerbation of congestive heart failure, respiratory and urinary tract infections, dehydration). The initial 'primary' assessment comprised screening questions with the potential to trigger a more detailed 'secondary' assessment. If the primary or secondary assessment result was ambiguous, the care pathway was administered at 6-hour intervals, until concerns had resolved and/or appropriate intervention was instigated. The nurse recorded the outcome of the primary and secondary assessment and their care plan in the resident's records and decided on the next course of action. This may have included further monitoring using the Stop and Watch early warning tool, treatment initiated in the nursing home, or communication with primary care using the SBAR tool. Copies of the completed care pathway were kept with the resident's record. (3) The SBAR method: a structured method for communicating critical information to primary care used by nurses to seek primary care intervention for the resident after the care pathway indicated a risk of decline	In the nursing home	For deteriorating residents	As required
Siddiqi *et al.*[83]	Specialist delirium practitioner (mental health nurse with expertise in delirium) Delirium champion from each home	Stop Delirium! intervention – a multifaceted enhanced educational package incorporating multiple strategies to change practice delivered to each care home over 16 months. Specialist delirium practitioner delivered education sessions. Facilitated working groups of care home staff, groups identified targets around delirium prevention and developed solutions for their care home. Delirium champion from care home staff was training by practitioner. Each home had delirium box of resources to support learning	Care homes	3 education sessions	Not provided

SBAR, situation, background, assessment, recommendation.

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TABLE 20 Implementation of UK studies aimed at managing specific problems

Reference	Barriers	Facilitators	Active facilitation
Downs *et al.*[88]	Barriers to implementation at the level of the care home included insufficient support from management with respect to staff workload allocation. Nursing home managers were not sufficiently visible in their endorsement of this new way of working. The education strategy for the intervention may not have been sufficient to lead practice change and only included a 1-day training workshop and telephone support that was not acted on	Intervention development included a rapid research review, interviews and consensus workshops	Implementation support included identifying two practice development champions (PDCs) in each intervention home, and supporting them with a training workshop, practice development support group, monthly coaching calls, handbooks and web-based resources. PDCs from five of six intervention homes attended the training workshop, following which they had variable engagement with implementation support
Siddiqi *et al.*[83]	Summary home-level data for hospital admissions (obtained from care homes) were missing for two homes, and rates were lower than estimated from other sources. Recording of falls differed markedly with some homes recording any instances where a resident was found on the floor as a fall, and others limiting recording to observed falls only; falls data were not, therefore, analysed further. However, only two-thirds of hearing tests were conducted due to lack of appropriate space in the care home. Resident-level data collection diaries were found not to be feasible for completion by residents and too burdensome for staff. Care-home-level diaries were also only partially completed by staff due to time pressures. It was uncommon for friends and family members to be either present to complete proxy forms or to have spent sufficient time observing the resident to be able to comment	A delirium champion was identified in four, and there was evidence of outputs from working groups being used in 5 of the 7 homes	Specialist delirium practitioner delivered training and facilitated working groups. Working groups consisted of care home staff and they set targets and decide on solutions that suited their home. Delirium champions in each home. Overall, 84.4% of staff completed at least one education session; in four homes, over 90% of staff completed all three sessions. Working groups were established in all homes. Delivery of the intervention was compromised in the later part of the study due to first sickness absence and then maternity leave of the delirium practitioner (9 of 22 months)

TABLE 21 Summary of international evidence on medicine review and infection prevention

Reference (country)	Intervention	Study type	Type of care home	Sample size	Comparator	Intervention effect
Frankenthal *et al.*[98] (Israel)	Medication review	Individual RCT	Nursing home	Individuals: 359	Standard care (parallel control group)	No effect: there was no significant group difference in the average number of hospitalisations (p = 0.10), and the trend toward a reduction in the average number of hospitalisations in the intervention group was not significant (p = 0.40)
Gorisek *et al.*[96] (Slovenia)	Pharmacological influenza prophylaxis	Observational	Nursing home	Care homes: 3 nursing homes in Slovenia. Individuals: 208, 167 and 164 residents in the participating homes	Standard care (parallel control group); prophylaxis for all residents was compared with prophylaxis for directly exposed residents only and no pharmacological prophylaxis. Non-pharmacological measures were the same in all nursing homes	No statistical analysis of differences between nursing homes
Gravenstein *et al.* [92] (USA)	Influenza vaccination	Cluster RCT	Nursing home	Care homes: 823 facilities were recruited to the study between March and August, 2013	Standard care (parallel control group)	Significant positive effect: incidence of respiratory-related hospital admissions was significantly lower in facilities where residents received high-dose influenza vaccines than in those that received standard-dose influenza vaccines (0–185 per 1000 resident-days or 3.4% over 6 months vs. 0.211 per 1000 resident-days or 3·9% over 6 months; unadjusted RR 0.888, 95% CI 0.785 to 1.005; p = 0.061, and adjusted RR 0.873, 95% CI 0.776 to 0.982; p = 0.023). For all-cause admissions: 3509 (1.021%) high dose group vs. 3788 (1.113%) standard group. Unadjusted RR 0.920 (95% CI 0.859 to 0.985) 0.017

continued

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TABLE 21 Summary of international evidence on medicine review and infection prevention (*continued*)

Reference (country)	Intervention	Study type	Type of care home	Sample size	Comparator	Intervention effect
Junius-Walker *et al.*[99] (Germany)	Medication review	Cluster RCT	Nursing home	Care homes: 44 nursing homes with 862 residents were randomised, 23 of them (with 452 residents) to the intervention group and 21 (with 410 residents) to the control group	Standard care (parallel control group)	No effect; there were no significant differences in terms of the number of hospitalisations or the proportion of nursing-home residents requiring emergency or rescue services on at least one occasion in the preceding 6 months
McConeghy *et al.*[93] (USA)	Influenza vaccination	Cluster RCT	Nursing homes	Care homes: 823 nursing homes, housing 50, 012 eligible residents, to adjuvant or standard vaccine	Standard care (parallel control group)	Significant positive effect
Nymberg *et al.*[94] (Sweden)	Medication review	Controlled trial (non-randomised); follow-up of RCT with control group members able to receive intervention	75% of participants were nursing home residents	Care homes: not reported. Individuals: 369 (182 intervention, 187 control; 139 and 140, respectively, were nursing home residents)	Standard care (parallel control group); compared randomised intervention and control groups	No effect: significant at 12 months if control patients who received MRI were excluded
Mor *et al.*[95] (USA)	SARS-CoV-2 vaccination	Controlled trial (non-randomised)	Nursing home	Care homes; 280 nursing homes in 21 states	Standard care (parallel control group)	Significant positive effect
Niznik *et al.*[91] (USA)	Deprescribing	Cohort study	Nursing home	Not reported	Standard care (parallel control group); compares residents with and without evidence of deprescribing	Significant positive effect: reduced likelihood of hospitalisation due to falls or fractures
Pop-Vicas *et al.*[94] (USA)	Influenza vaccination	Retrospective cohort	Nursing home	Care homes: across 122 cities under influenza surveillance. Individuals: not applicable	Compares seasons with high and low match between circulating strains and vaccines	Significant positive effect
Sluggett *et al.*[100] (Australia)	Medication review	Cluster RCT	Nursing home	Care homes: 8 South Australian residential homes: 99 residents participated in the intervention arm and 143 in the comparison arm	Standard care (parallel control group)	No effect: no significant differences in the rate of falls, hospitalisations, or mortality were observed between the 2 study arms at follow-up in both the unadjusted and adjusted analyses

MRI, magnetic resonance imaging; RR, relative risk.

reported no significant effect on hospital admissions, which may reflect the fact that these studies were not primarily focused on admissions. Niznik *et al.*[91] reported that deprescribing acetylcholinesterase inhibitors was associated with reduced risk of hospitalisation from falls and fractures in residents with dementia, with no increase in the overall risk of adverse events. Risk of bias assessment did not identify any major issues with this study other than lack of blinded outcome assessment.

Turning to prevention of common infections, large RCTs in the USA reported that high-dose influenza vaccine is more effective than low-dose[92] and adjuvanted vaccine more effective than non-adjuvanted[93] for preventing hospital admission of care home residents. A further retrospective cohort study of influenza vaccination reported that a 50-percentage-point increase in the A/H3N2 match rate (from < 25% to > 75%) reduced long-stay nursing home resident deaths by 2.0% and pneumonia/influenza hospitalisations by 4.2%.[94] For SARS-CoV-2 vaccination, a trial of earlier compared with later vaccination found that facilities with earlier vaccination had fewer hospitalisations and deaths over the short-term (five to eight weeks) than those vaccinated later.[95] These trials support the effectiveness of vaccination policies but as would be expected none had a control group without vaccination. A study of oseltamivir prophylaxis of influenza compared hospitalisation rates in homes with prophylaxis for all residents (3.6%), directly exposed residents (7.8%) and no prophylaxis (16.1%).[96] The study involved only three care homes, numbers of residents were small and there was no statistical analysis, making the findings difficult to interpret.

Applicability

Applicability data were extracted from seven of the studies (not tabulated). Issues that could potentially affect applicability of individual study findings to UK settings were possible differences in influenza strains and vaccination rates of care home staff (USA vs. UK);[92] Medicare coverage (USA vs. UK);[93] mixed population and well established and funded programme of medication review (Sweden vs. UK);[97] and reliance on a single vaccine provider (USA vs. UK).[95]

Paramedic assessment/non-conveyance

Only one included study dealt with paramedic assessment and decision-making when there is uncertainty about taking a care home resident to hospital or treating them in situ.[101] This qualitative focus group study involved 18 German paramedics. Participants perceived that hospital transfers were potentially avoidable in some cases of urinary catheter complications, infections and falls. Uncertainties about legal liability were seen as a key factor favouring transfer of residents to hospital. Although not a UK study, the findings may be applicable to UK paramedics and could inform implementation of specialist paramedic services and training for paramedics attending care homes. See also the qualitative study of decision-making at the end of life by Murphy-Jones *et al.*[102] described below (see *Palliative/end-of-life care*).

Emergency department interventions

ED interventions were defined as interventions which were initiated in the ED or conducted by ED staff. Two studies met this definition (see *Table 22*) and were both conducted in Australia.[70,103] Both studies are before and after studies conducted at single regional EDs which receive admissions from multiple care homes within their catchment area. One study included 5991 and the other study included 1271 ED attendances in analysis. Marsden *et al.*[103] included no control group and was rated as higher risk of bias than Hullick *et al.*,[70] which included control care homes which did not receive the intervention; however, allocation was not randomised.

Marsden *et al.*[103] present a nurse-led multidisciplinary intervention delivered in the ED who receive referrals from care homes and expedite geriatric assessment and other clinical management in the ED. When

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TABLE 22 Summary of ED interventions

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Hullick *et al.*[70]	Controlled before–after	Nursing home	13 (5 intervention, 8 control) care homes; 1271 ED attendances	Standard care	Hospital admissions and ED visits	No significant difference in hospital admission or ED visits after the introduction of telehealth
Marsden *et al.*[103]	Uncontrolled before–after study	Unclear	5991 ED presentations from care homes over the study period (pre-GEDI 1209; interim GEDI 3324; and post-GEDI 1458)	Standard care	Hospital admissions	When controlling for all other variables, the hazard ratio for discharge for those patients presenting in the post intervention period was 1.15 (95% CI 1.05 to 1.26), indicating a significant reduction in hospital admission in the post-intervention period

GEDI, geriatric emergency department intervention.

controlling for all other variables, the hazard ratio for discharge for those patients presenting in the post intervention period was 1.15 (95% CI 1.05 to 1.26), indicating a significant reduction in hospital admission in the post-intervention period. When controlling for all other variables the hazard ratio for reduced length of hospital stay for those patients presenting in the intervention period was 1.49 (95% CI 1.24 to 1.78) and 1.44 (95% CI 1.30 to 1.60) for the interim intervention period. Hullick *et al.*[70] evaluated a video telehealth consultation with hospital ED staff in addition to an existing QI programme aimed at reducing ED attendances from care homes. Fourteen months' pre- and post-intervention data were analysed. There was no significant difference in hospital admission or ED visits after the introduction of telehealth.

The evidence is low quality from single centres outside the UK setting. Therefore, we are unable to recommend use of either intervention. That said, models of geriatric assessment in the ED like that described by Marsden *et al.* are used in some centres in the UK as part of a frailty service[104,105] and both the clinical and cost effectiveness require evaluation.

Advance care planning

Promoting ACP was part of most QI interventions included in the review. This section includes studies of 'stand-alone' interventions to encourage ACP.

UK evidence

We included four UK studies of ACP interventions (see *Table 23*). A mixed-methods study[106] and a service evaluation[107] evaluated effects on outcomes. A further mixed-methods study[108] and a qualitative study[109] explored feasibility and acceptability to care home staff.

The interventions comprised an 'appreciative enquiry' intervention designed to improve end-of-life care for residents with dementia[106] and a service combining training for staff with ACP for residents with dementia[107] (details not shown). Both studies were at high risk of bias because of weak study designs. Both studies included residents with dementia, so their relevance to general care home populations is uncertain. The study by Amador *et al.*[106] focused on residential care homes without on-site nursing.

Amador *et al.*[106] reported cost reductions related to reduced health service use following the intervention but the effect on admissions was unclear.[106] By contrast, the service evaluation found that admissions fell by 37% from baseline in the first year and 55% in the second and third years.[107] This limited body of evidence meets our criteria for 'inconsistent' evidence. Overall, the evidence for promotion of ACP suggests that it is best undertaken as part of a clearly specified QI programme.

Alcorn *et al.*[108] examined 109 cases of care home residents who died in hospital and reported that ACP regarding hospital admission was recorded in 44% of cases. Barriers to care home staff looking after dying residents were uncertain trajectories of decline, acute events, challenges of ACP, relationship with family and lack of external support.[108] The qualitative interview study by Harrad-Hyde *et al.*[109] identified some similar issues. Care home staff favoured ACP in principle but were concerned about possible repercussions, especially when residents' families wanted them to be taken to hospital. A key finding was that hospital transfers are more likely to occur if plans are not specific enough for care home staff to interpret them confidently.[109]

Implementation

Implementation data were extracted for the two intervention studies (see *Table 24*). These studies reported relatively few barriers to implementation, possibly reflecting their early publication dates.

International evidence

International evidence around ACP comprised 12 studies (see *Table 25*): 6 from the USA, 1 from Australia and the remainder from other countries (including 1 multinational study).[115]

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TABLE 23 Summary of UK studies of ACP

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Alcorn *et al.*[108]	Mixed methods; case review of notes of care home residents who died in hospital plus interviews	Care homes with either on site nurses or district nurses – medical care provided by GPs	Care homes: 2 teaching hospitals serving 89 care homes were eligible and residents identified were from 61 of these care homes. Individuals: 109 residents who died over a 6-month period. Interviews with 26 staff from 14 care homes discussing 26 of the 109 patients	None	Advanced care planning preferences for patients who eventually died in hospital.	Not applicable
Amador *et al.*[106]	Mixed methods: costed health and social care services used by residents, including medication and accommodation in phase one. In phase two worked with care homes in which some of these residents lived and undertook an intervention. Compared total cost and cost components for residents whose care homes had participated in the intervention	Residential home	Care homes: 6 care homes for older people, offering personal care and specialist support in dementia care without onsite nursing care and representing a range of demographic characteristics	Standard care (before/after); Wilcoxon matched pairs sign-rank tests were conducted to compare total cost and cost components during phases 1 and 2 for those residents who participated in both	Emergency admissions; length of hospital stay; feasibility of intervention; qualitative evidence; costs/cost-effectiveness; cost reduction related to reduced health service use, both community and hospital	No effect

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Garden *et al.*[107]	Service evaluation	Residential home	Care homes: 7 care homes in Boston. Individuals: 283 places registered for care of people with dementia	Standard care (before–after); data were collected from the local hospital information department for the calendar years before and after introduction of the service	All admissions; feasibility of intervention; costs/cost-effectiveness; other (specify); place of death; staff confidence following training; carer satisfaction with how care planning was conducted	Significant positive effect: first-year admissions fell by 37% from baseline and in second and third years they fell by 55%. 102 care plans in place by April 2013. Of the residents who died during follow-up 67/68 died in their preferred place. Significant improvements in staff confidence following training. 64 carers completed a questionnaire on their satisfaction with ACP; 92% of the 64 carers rated the service > 9/10
Harrad-Hyde *et al.*[109]	Qualitative	Nursing homes; residential homes	Care homes: 6 care homes (3 nursing, 2 residential and 1 dual registered). Individuals: 30 (7 managers, 3 deputy managers, 7 registered nurses, 7 senior carers and 6 carers)	Not applicable	Acceptability to care home staff	Not applicable

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TABLE 24 Implementation data for UK studies of ACP

Reference	Barriers	Facilitators	Active facilitation
Amador *et al.*[106]	2 homes from phase 1 of the study declined to take part in phase 2	Availability of standard cost data and data on service use and characteristics of residents; participating care homes had favourable Care Quality Commission inspection reports	Co-design approach to intervention development facilitated by research team
Garden *et al.*[107]	Not reported	Initial funding, leadership and implementation; empowerment of care home staff, families and doctors by affirming knowledge and using care planning to manage the uncertain end-of-life trajectories of people with dementia. This service was implemented in an urban setting where proximity between care homes and acute hospital may favour high admission rates	Nurse seconded to implement service, support of consultant liaison psychiatrist

TABLE 25 Summary of international evidence on ACP

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Adekpedjou *et al.*[110] (Canada)	Retrospective cohort	Unclear or NA; described as 'long-term care homes'	Care homes: not reported. Individuals: 123,003	Standard care (parallel control group); compares people with and without 'do not resuscitate' or 'do not hospitalise' orders	All admissions	Significant positive effect; both types of order were associated with decreased odds of hospitalisation but 'do not hospitalise'orders were often ignored
Cohen *et al.*[111] (USA)	Qualitative; semistructured interviews of nursing home staff	Nursing home	Care homes: 8 facilities, 4 with high hospitalisation rates, 4 with low hospitalisation rates. Individuals: 31 interviews	Standard care (parallel control group); this was not an intervention study but 2 groups were compared: those with high hospitalisation rates and those with low hospitalisation rates	All admissions; acceptability to care home staff; acceptability to residents/families	Not applicable
Galambos *et al.*[112] (USA)	Service evaluation	Nursing home	Care homes: 16 nursing homes. Individuals: (2013) 1876 records reviewed acted as comparator, (2014) 1711 records reviewed, (2015) 1730 records reviewed, (2016) 1544 records reviewed	Standard care (before–after); baseline data from 2013 used for comparison	Unplanned/preventable admissions; all admissions; transport to ED; other (specify); number of advance directives in medical records of MOQI participants – through annual AD record/chart inventory	Significant positive effect: residents who did not have an AD were 29% more likely to be transferred. Using a logistic mixed model, results indicated statistical significance ($p < 0.001$) for increased AD documentation
Hendriks *et al.*[113] (the Netherlands)	Prospective cohort	Nursing home	Care homes: 28 facilities in the Netherlands. Individuals: 372 newly admitted nursing home residents with dementia	None	All admissions; other (specify); treatment goals, do-not-treat (resuscitate/hospitalise) orders	No effect: study could not determine causation

continued

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TABLE 25 Summary of international evidence on ACP (*continued*)

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Hickman *et al.*[114] (USA)	Observational cohort study (part of larger OPTIMISTIC programme)	Nursing home	Care homes: 19 urban and suburban nursing facilities in Indiana. Individuals: 1482 residents	Standard care (parallel control group); outcomes compared for residents with (1) physician orders for scope of treatment comfort measures or do not hospitalise orders; (2) ACP orders with no hospitalisation limit (e.g. code status only); and (3) no ACP	Unplanned/preventable admissions; all admissions	No effect: no significant difference after adjusting for age, functional status and cognitive functioning
Honinx *et al.*[115] (multinational)	Cross-sectional survey	Nursing home	Care homes: 322 nursing homes. Individuals: 1707 deceased residents	None	All admissions; other (specify); place of death	Not applicable
Houttekier *et al.*[116] (Belgium)	Cross-sectional survey	Nursing homer	Care homes: 69 nursing homes in Flanders. Individuals: 198 deceased residents	None	All admissions	Not applicable
Martin *et al.*[117] (Australia)	Cluster RCT	Nursing home; RACF is the term used to refer to permanent nursing care homes providing care to those no longer able to live independently in Australia	Care homes: 45 homes approached, 8 agreed to participate; 6 were placed into 3 clusters of 2 homes per cluster. Individuals: total potential study population was 445 residents, with 418 fitting inclusion criteria and 326 continuing to randomisation. In the 6 RACFs involved, the mean study participation rate was 78%. In total, at study commencement, there were 145 residents in the control group and 181 in the intervention group	Standard care (parallel control group)	Emergency admissions; transport to ED; length of hospital stay	Significant positive effect: intervention did not result in a statistically significant change at 6 months; however, at 12 months, it reached statistical significance with 40% reduction in ED visits and hospitalisations compared with controls, with an incident rate ratio 0.63 (95% CI 0.41 to 0.99; $p = 0.044$). Mortality rates show increased likelihood of dying in the RACF, with statistical significance at 6 months at a relative risk ratio of 2.19 (95% CI 1.16 to 4.14; $p = 0.016$)

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Moyo *et al.*[118] (USA)	Cluster RCT	Nursing home	Care homes: 119 intervention and 241 control. Individuals: 923 intervention and 1925 control	Standard care (parallel control group)	All admissions; (1) hospital transfers in the last 90 days of life (admissions, ED visits without admission and observation stays); (2) 3 or more hospital transfers in the last 90 days of life; (3) late transition (defined as hospital transfer in the last 3 days of life or hospice admission in the last day before death); other (specify): outcome of 'burdensome treatment use' which defined as experiencing any of tube feeding, parenteral therapy (for medication delivery or hydration), admission to an intensive care unit, and invasive mechanical ventilation	Significant positive effect: receipt of 1 or more potentially burdensome treatments was less common in the intervention compared with the control arm (21.7% vs. 25.7%; p = ¼0.02); statistically significant reduction in the prevalence of 90-day hospital transfers among decedents with advanced illness (marginal proportion differences: 1.7%, 95% CI 3.2% to 0.1%)
Mullaney *et al.*[119] (USA)	Mixed methods; a convergent mixed-method design. Quantitative data collected on the MRA scores as undertaken by nurse practitioners and patient outcomes. Qualitative approach to explore nurse practitioner perceptions of the impact of MRA on advanced care planning discussions and patient outcomes	Nursing home	Individuals: 187 individuals newly enrolled in Medicare; advantage across 3 states; 14 nurse practitioners from 80 invited across a sample from 2 of the 3 states in which the Medicare individuals were enrolled	None	All admissions	Significant positive effect: significant difference was found in relationship between the number of ACP discussions and the number of hospitalisations. The more ACP discussions that occurred the less likely a patient was to be admitted to hospital (p = 0.0025)

continued

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TABLE 25 Summary of international evidence on ACP (*continued*)

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Nakashima *et al.*[120] (USA)	Cross-sectional	Nursing home		Standard care (parallel control group); residents who did not have an advance directive (36%)	All admissions; hospital stays; transport to ED; ED visits	Significant positive effect: residents with DNH orders had significantly fewer hospital stays in the past 90 days than those without DNH orders (3.0% vs. 6.8%, $p < 0.0001$) and residents with DNH orders also had significantly fewer ED visits (2.8% vs. 3.6%, $p = 0.03$). Dementia residents with DNH orders had significantly fewer hospital stays than those without DNH orders (2.7% vs. 6.3%, $p < 0.0001$) but no difference in ED visits (2.8% vs. 3.5%, $p = 0.11$)
Overbeek *et al.*[121] (the Netherlands)	Cluster RCT	Nursing home; residential care homes including adults receiving home care; assisted living/extra care housing; residential care homes including adults receiving home care	Care homes: 16 residential homes and people receiving home care who lived near to the homes. Individuals: at study initiation, 97 in intervention group and 100 in control group; at follow-up, 77 in intervention group and 83 in control group	Standard care (parallel control group)	Other (specify); primary measure – patient activation measure (measures individual knowledge, skills and confidence to manage health and healthcare). Secondary outcome measures were quality of life, satisfaction with healthcare, documentation of care preferences in an AD, appointment of a surrogate decision-maker and use of medical care	No effect: no effect of ACP on use of hospital care, diagnostic procedures or a selection of medical interventions

AD, advance directive; MRA, mortality risk assessment.

On closer examination, two of the US studies, although focused on ACP, were reporting results from named QI programmes (MOQI[112] and OPTIMISTIC[114]) and are not discussed further in this section. Two studies involved 'do not hospitalise' (DNH) orders (see next paragraph). The remaining studies evaluated a video-assisted ACP intervention using a cluster RCT design[118] and nurse practitioner-led ACP discussions using a mixed-methods design with no control group.[119] Both studies found a significant positive effect in terms of reduced hospitalisations and together constitute 'weaker' evidence of effect in the US setting.

Two further US-based studies dealt specifically with DNH orders. A quantitative cross-sectional study reported that residents with DNH orders were significantly less likely than those without to be transferred to hospital, although those with DNH orders only comprised 6% of the study sample.[120] However, a qualitative study of nursing home staff found that they do not tend to interpret DNH orders literally. Rather, DNH orders were seen as 'a signal that hospitalisation should be questioned and discussed with the family when an acute event occurred'.[111]

Settings outside the USA provided 'inconsistent' evidence for the effect of interventions to promote ACP on residents' hospital admissions at the end of life. A cluster RCT of the 'goals of patient care' process in Australia reported a 40% reduction in hospitalisations compared with control after 12 months.[117] In Europe, cross-sectional data from six countries indicated that residents without an advance directive were more likely to be hospitalised in the last month of life. Absence of conversation about ACP increased the risk of dying in hospital.[115]

Three further studies of DNH orders from Canada,[110] the Netherlands[113] and Belgium[116] complemented evidence from the United Statea that these orders reduce but by no means eliminate hospitalisations. The study from Belgium (a cross-sectional survey) reported that residents with dementia without a DNH 'general physician order' were more likely to be hospitalised.[116]

Considering the international evidence as a whole, there appears to be 'stronger' evidence that DNH orders are not fully effective for reducing hospital admissions at the end of life. Evidence for interventions promoting discussion of ACP is 'inconsistent'.

Applicability

Applicability of findings about ACP from international settings to UK practice needs to take into account legal and cultural differences with regard to end-of-life care. The relevance of DNH (as distinct from 'do not resuscitate') orders to UK practice is uncertain.

Palliative/end-of-life care

UK evidence

Three UK studies evaluated palliative care interventions (see *Table 26*). Authors reported that the palliative care programmes described resulted in avoided admissions at the end of life and/or a reduction in deaths in hospital. However, statistical significance was unclear for two of the studies. All the studies had methodological weaknesses and constitute borderline 'very limited' or 'weaker' evidence.

An additional qualitative study[102] analysed data from semistructured interviews with six paramedics relating to decision-making about taking residents nearing the end of life to hospital. Tensions between the perceived best interests of residents and those of others resulted in contrasting approaches by paramedics.

International evidence

We included five palliative care studies from Australia, of which four publications evaluated nurse-led palliative care needs rounds (including one focused on feasibility[127]). The fifth study evaluated a similar

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TABLE 26 Summary of UK studies of palliative/end-of-life care interventions

Reference	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Kinley *et al.*[122]	Service evaluation	Residential home	Care homes: 2011–12, 4 homes (baseline?); 2012–13, 16 homes; 2013–14, 28 homes; 2014–15, 23 homes. Individuals: number of deaths 2011–12, 18; 2012–13, 68; 2013–14 136; 2014–15, 115	Standard care (before–after); audit data were collected from the records of all deceased residents 1 year prior to start of programme and then continuing every month	Feasibility of intervention; other (specify); number of deaths in care home; number of residents with a document ACP; numbers of residents with a DNACPR form	Significant positive effect: audit of 4 years of programme, showed an increase of the number of deaths in the care homes from 44% (8/18) in 2011–12 in 4 care homes to 64% (74/115) in 2014–15 in 23 residential care homes
Smith *et al.*[123]	Uncontrolled before/after; 1-year pilot study	Nursing home	Care homes: 3 nursing homes in North Brent. Individuals: not reported	Standard care (before–after)	Other (specify); deaths in hospital (admissions not explicitly reported)	Not reported; 25% reduction in hospital deaths for 2015–16 vs. 2014–15
Springett *et al.*[124]	Service evaluation	Nursing home; residential home	Care homes: 11 (6 nursing, 5 residential). Individuals: not reported	None	Unplanned/preventable admissions; prticipating care homes reported 95 admissions and 30 avoided admissions over 1 year	Not reported; magnitude/significance of effect unclear

nurse-led palliative care consultative service.[128] The studies that reported on effectiveness produced 'inconsistent' evidence overall (see *Table 27*).

Six publications from the USA, of which three came from the same group, evaluated palliative care teams, hospice enrolment and integration of palliative care with infection management (see *Table 28*). The majority of studies reported a positive effect for palliative care consultations (borderline 'stronger'/'weaker' evidence) while evidence for the other interventions was 'very limited' (one study each).

Finally, studies on an integrated palliative care programme involving telemedicine (Singapore);[136] a multicomponent palliative care programme comprising staff education and organisational support (seven European countries);[137] and a palliative care training programme for care home staff (Finland)[138] all reported no significant effect of the intervention.

Other interventions

A single study from the USA evaluated a decision aid in a mixed-methods RCT.[139] Residents and families rated the decision aid as very helpful but it did not decrease hospital transfers compared with the control group. Installation of 'compliant flooring' to reduce fall-related injuries and hospitalisations also had no effect in a randomised trial conducted in Canada.[140]

The Veterans' Administration Medical Foster Home Programme is discussed below.

Interventions applied in assisted living and similar settings

Only one study reported on an intervention to reduce unplanned admissions in residents in assisted living settings. In a US cluster RCT, 'function-focused care' was shown to be safe but there was no treatment effect on ED or hospital transfers.[87]

The Veterans' Administration Medical Foster Home programme involves people receiving nursing-home-level care in small units owned by the primary care provider with medical support from Veterans' Administration staff. Two publications from the same group reported reductions in potentially preventable admissions following enrolment in the programme.[141,142]

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TABLE 27 Summary of Australian studies of palliative/end-of-life care interventions

Reference	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Chapman *et al.*[125]	Controlled trial (non-randomised)	Nursing home; nursing home care mentioned in abstract	Care homes: 4 care homes. Individuals: 104 intervention, 173 historical controls	Standard care (parallel control group)	All admissions; length of hospital stay; costs/cost-effectiveness	No effect; significant reduction in length of stay
Forbat *et al.*[126]	Step-wedge RCT	Nursing home; nursing aides are most of the staff in care homes in Australia with a small number of registered nurses	Care homes: 12 care homes. Individuals: 1700 residents	Standard care (parallel control group); stepped-wedge RCT: intervention commenced with 2 sites with other sites crossing over from control bimonthly in clusters of 2–3 sites. Trial finished 6 months after final site started receiving intervention. Control condition involved usual care, which consisted of the specialist palliative care clinicians providing ad hoc reactive clinical consultations when referred by facility staff	All admissions; overall number of admissions; length of hospital stay; length of staff calculated for those residents who were hospitalised for longer than 24 hours; costs/cost-effectiveness; cost of admissions	Significant positive effect: significantly reduced length of stay in hospital; clinically significant reduction in the number of hospitalisations; reduced admissions led to annual net cost-saving
Koerner *et al.*[127]	Qualitative; interviews embedded in a larger RCT	Residential home; care home	Care homes: 11 care homes. Individuals: 21 staff members	Not applicable	Feasibility of intervention Acceptability to care home staff	Not applicable

Reference	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Mitchell *et al.*[128]	Mixed methods	Unclear or not available; level of nursing care not explicitly stated	Care homes: 3 facilities in Queensland, Australia. Individuals: facilities cared for 277 residents, with 24 deaths in the pre-intervention period and 44 during the intervention	Standard care (before–after); 12 months before and after intervention for quantitative outcomes	All admissions; acceptability to care home staff; acceptability to residents/families; other (specify); qualitative data on improvements in palliative care	Significant positive effect: hospital transfers decreased between pre-and post-intervention periods
Rainsford *et al.*[129]	Controlled trial (non-randomised)	Residential home; RACF	Care homes: 2 RACFs with a total of 112 beds. Individuals: all residents who died between April 2018 and March 2019 were included in the intervention group (43). There was a subgroup of decedents who were discussed in needs rounds (17/43). Control cohort consisted of all residents who died during the 3-year period prior to the introduction of needs rounds (113)	Standard care (before–after)	Unplanned/preventable admissions; emergency admissions; transport to ED	No effect; no statistical differences in overall number of ED presentations, hospital admissions or length of hospital stay

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TABLE 28 Summary of US studies of palliative/end-of-life care interventions

Study ID	Study type	Type of care home	Sample size	Comparator	Outcomes	Intervention effect
Harrison *et al.*[130]	Other (specify); cross-sectional observational study	Nursing home	Care homes: 838 nursing homes providing complete data. Individuals: 143,223, including 42,761 with advanced dementia, CHF or COPD	None	All admissions; also admissions due to infection	Significant positive effect: significant association between integration and all-cause or infection-related admission for some groups
Miller *et al.*[131]	Other (specify): observational cohort	Nursing home	Care homes: 286 nursing homes in 24 counties. Individuals: not reported	Standard care (parallel control group); compared nursing homes with and without palliative care consultations over 10 years (2000–10)	All admissions; admissions in the last 30 days of life; other (specify); hospital death rates	Significant positive effect: reduction in end-of-life hospitalisations
Miller *et al.*[132]	Retrospective cohort study	Nursing home	Care homes: 46 nursing homes in 2 US states. Individuals: 1651 (477 consultation recipients, 1174 controls)	Standard care (parallel control group); residents without consultation matched by propensity scoring	All admissions; admissions in last 7, 30 and 60 days of life; transport to ED; ED visits in last 30 and 60 days of life; other (specify); other 'potentially burdensome care transitions'	Significant positive effect; residents with consultations had lower hospitalisation rates
Miller *et al.*[133]	Cohort with matched controls	Nursing home	Care homes: 31 NHs in 2 US states; Individuals: unclear	Standard care (parallel control group); matched control group without consultation	All admissions; hospitalisation and acute care use 7 and 30 days before death; other (specify): potentially burdensome transitions of care	Significant positive effect: rduction in hospitalisations and burdensome transitions
Temkin-Greener *et al.*[134]	Multi-armed RCT; 2-armed controlled trial with a third nonrandomised group to assess placebo effect of the RCT	Nursing home	Care homes; treatment nursing homes 14; control nursing homes 11; nonrandomised 'facilities' 609	Standard care (parallel control group) plus a nonrandomised control group	All admissions; number of hospitalisations	No effect; overall, no statistically significant effect of the intervention
Zheng *et al.*[135]	Controlled before–after	Nursing home	Care homes: 14,030 nursing homes. Individuals: 747,641 individuals included in modelling – 505,851 in nonhospice group and 241,790 in hospice group	Standard care (parallel control group)	All admissions; other (specify): staff competencies	Significant positive effect

CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease.

Chapter 4 Economic evidence

A total of 28 included studies reported costs or 'cost-effectiveness' (broadly defined) as an outcome measure: 5 for QI programmes, 11 for integrated working, 2 for training/workforce development, 4 for management of specific problems, 2 for ACP, 3 for palliative care and 1 for other interventions. Most of these studies were not designed as full economic evaluations, meaning that not all relevant costs and benefits may have been taken into account.

UK economic evidence

Table 29 summarises UK studies reporting economic outcomes. The majority of studies reported cost savings but weak study designs and limited reporting mean that the findings should be treated with great caution. One report extrapolated findings from one area across the whole of England to estimate possible cost savings.[56] Some reports were produced by manufacturers[56] or professional bodies[55] with a potential conflict of interest. One report indicated that the intervention increased costs in the first two years,[52] probably reflecting the introduction of new ways of working. The programme would require reductions in costs (preferably from reduced hospital admissions) to be sustainable without additional funding.

The two most rigorous studies[83,89] collected promising economic data but they were both feasibility trials and in one case the intervention proved impossible to implement, making a full trial unviable.[89]

International economic evidence

Table 30 summarises the international evidence base. Economic evaluations are sensitive to differences in context between countries and changes in costs and currency fluctuations over time also need to be taken into account.

As with the UK studies, most of the international studies reported cost savings associated with the study intervention, including QI programmes, various types of integrated working, palliative care and the Veterans' Administration Medical Foster Home Programme. Most of the studies were primarily designed to evaluate effectiveness and many had methodological flaws such as absence of a control group. For this reason, risk of bias assessment using a tool designed for economic evaluations was not attempted. It should be noted, however, that the more rigorously designed studies, such as the cost analysis of the Queensland HiNH programme,[67] produced estimates of large cost savings similar to those derived from smaller or uncontrolled studies.

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TABLE 29 UK studies reporting on costs or value for money

Reference	Type of intervention	Main findings	Comments
Steel *et al.*[21]	QI programme	Admission costs fell from £55,678 pre intervention to £49,653 post intervention	Data for 1 care home; no comparator
Holder *et al.*[57]	Integrated working (telemedicine)	Incremental difference in costs found in evaluation between telemedicine and control group were £1.2 million with a return on investment of £6.74 per £1 spent by the clinical commissioning group	Airedale NHS Foundation Trust
Royal Pharmaceutical Society[55]	Integrated working (MDT)	Net annualised savings of £184 per person could be achieved by medication review and, for every £1 invested in intervention, £2.38 could be released from medicines budget	Comparison unclear
Sherlaw-Johnson *et al.*[51]	Integrated working (dedicated primary care service)	Marginal reduction in commissioners' costs associated with emergency admissions was £1032 (95 % CI £30 to £1673)	
SQW Ltd[52]	Integrated working (Sutton Homes of Care)	Vanguard saved £466,282 in 2016/17 but spent £1.05 million in same period. Report notes that achievement of net savings will depend on maintaining or continuing to reduce activity levels such as nonelective admissions without such high levels of programme funding	
Tunstall[56]	Integrated working (telehealth and telecare)	Based on case studies, the report estimates that, if clinically led technology-enabled models in care homes were scaled up across NHS England, it would save approximately £1billion per annum and avoid over 226,000 emergency admissions and 2.5 million bed days	Extrapolated findings from local area initiatives with no comparator
Siddiqi *et al.*[83]	Training in delirium prevention	Using data obtained directly from hospitals overall cost for intervention home residents was estimated at £3281 and in the control homes £7210	Feasibility trial
Downs *et al.*[88] Sampson *et al.*[89]	Complex intervention to tackle specific problems	The incremental cost per quality-adjusted life year gained of BHiRCH-NH vs. TAU was £12, 633. Residents receiving the intervention accrued a nonsignificantly higher cost and a very small increase in quality-adjusted life years; the intervention has a 65% probability of being cost-effective at a WTP of £20, 000	Pilot trial, full trial not recommended
McKee *et al.*[90]	Medication review clinics	Total estimated drug cost savings for the project over 2-years were £213,000	
Amador *et al.*[106]	ACP for residents with dementia	Following intervention, total service costs fell by 43% and hospital care costs by 88%	
Garden *et al.*[107]	ACP for residents with dementia	Estimated cumulative net savings over 3 years between £150,000 and £300,000	No details of methodology reported

TABLE 30 International studies reporting on costs and value for money

Reference	Country	Type of intervention	Main findings	Comments
Carter *et al.*[44]	Australia	QI programme	Intervention more effective and less costly than usual care	Cost-effectiveness data from cohort study
Ingber *et al.*[26]	USA	QI programme (data from 7 different states)	In 2015, average per resident Medicare expenditures were reduced by $60–2248 for all-cause hospitalisations and by $98–577 for potentially avoidable hospitalisations	
Rantz *et al.*[33]	USA	QI programme (MOQI)	Programme improved outcomes while reducing costs	Uncontrolled before–after study
Rantz *et al.*[34]	USA	QI programme (MOQI)	Savings to payers in participating nursing homes between 2015 and 19 were over $30 million	As above
Chan *et al.*[66]	Australia	Integrated working	For every $1 spent, a saving of $5.50 was realised	Uncontrolled beforeafter study
Cordato *et al.*[58]	Australia	Integrated working	Total costs were 50% lower in the intervention group, with lower total hospital inpatient and total ED costs	Data from small RCT
Craswell *et al.*[60]	Australia	Integrated working (REAP)	Lower costs for residents transferred to hospital	Data from controlled trial
Fan *et al.*[67]	Australia	Integrated working (HiNH)	95% certainty that the values of net costs would fall within the range from −AU$15,018,055 to −AU$3,358,820.	Cost study suggesting substantial savings
Grabowski *et al.*[73]	USA	Integrated working (telemedicine)	Average savings to Medicare for a nursing home that was more engaged with telemedicine was estimated at $151,000 per nursing home per year, relative to the less-engaged facilities. Annual cost of telemedicine service was $30,000 per nursing home, implying net savings of roughly $120,000 per nursing home per year in the more-engaged facilities	Covers selected nursing homes rather than whole sample
Kwa *et al.*[72]	Australia	Integrated working (residential in-reach)	ED cost and inpatient admission costs were each lower in the period following changes to care model	Uncontrolled before–after study
Chapman *et al.*[125]	Australia	Palliative care (needs rounds)	Cost savings associated with shorter admissions	Controlled (quasi-experimental) study
Forbat *et al.*[126]	Australia	Palliative care (needs rounds)	Across 12 care homes, a conservative estimate of annual net cost-saving from reduced admissions was AU$1,759,011 (US$1.3 m; UK£0.98 m).	Stepped wedge RCT
Lamppu *et al.*[138]	Finland	Palliative care (training)	Total hospital costs were similar in the intervention and control groups.	Data from cluster RCT
Pracht *et al.*[142]	USA	VA Medical Foster Home Programme	Costs associated with avoidable admissions fell by 39% over 180 days following enrolment in the programme	Uncontrolled before–after study

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Chapter 5 Discussion and conclusions

This review had broad inclusion criteria and covered interventions ranging from improved access to primary care through to palliative care for residents nearing the end of life. We discuss the findings in relation to the specified review questions. Overall strength of evidence for UK and international studies is summarised in *Tables 31* and *32*.

Interventions in use in the UK

That the quantity of the evidence was lower for the UK compared with other countries combined is to be expected, given that the UK is only one country, but it covered almost all the intervention categories in our taxonomy.

A particular focus in the UK literature has been on links with primary care and community services through the care home vanguards programme, which has subsequently provided the basis for EHCH. The vanguards, and subsequently EHCH, combined elements of integrated working with QI and locally important elements. The vanguards programme involved substantial support being given to the localities selected as pilot sites, something that has not been continued at the same level for national roll-out of EHCH, raising questions about how easy it might be to embed and sustain such programmes longer term. Early research has outlined the considerations during implementation that enable care home interventions to embed and sustain, but this has been based upon a small number of studies, largely focussed around QI.[143] There is much potential for researchers and practitioners to both test these processes and learn from successes and failures during national roll-out of EHCH.

Other interventions used in the UK included local QI and training programmes, initiatives to tackle specific problems such as delirium and inappropriate prescribing, or to introduce components of ACP and palliative/end-of-life care. Quantitative studies of paramedic-led interventions were lacking, although qualitative research highlighted the complexities and tensions involved in decision-making. These findings reinforce long-standing findings about the difficulty of negotiating care during acute crises in care homes due to uncertain organisational boundaries, roles and responsibilities when residents' health deteriorates.[144,145] A decade after these findings first appeared, work is needed to better standardise operating procedures between care homes and ambulance providers during medical crises.

UK care home research is in its infancy,[144,145] but research considering those receiving social care in other settings, for example assisted living (with more limited services available on site), is even less well developed. It was to a certain extent unsurprising that we found a paucity of publications around such settings.

International interventions

The range of interventions used in other high-income countries was broadly similar to that seen in the UK. The US Medicare system has evaluated a range of QI programmes with memorable acronyms such as INTERACT and OPTIMISTIC. New Zealand is also a source of important studies of QI interventions.

An important group of studies from Australia evaluated responsive services provided to groups of care homes by hospital-based MDTs, often with an emergency medicine background. Details of the service models varied (e.g. in-reach, outreach, HiNH) but studies suggested substantial reductions in unplanned admissions and other outcomes, albeit sometimes with weak study designs. Such models are not standard in the UK. Hospital at Home in the UK mirrors some of the approaches undertaken in Australia. Care homes were excluded from the largest RCT of Hospital at Home in the UK,[146] but are

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TABLE 31 Summary of overall strength of evidence from UK studies

Type of intervention	Relevant studies	Strength of evidence	Comments
QI programmes	Damery *et al.*,[19] Giebel *et al.*,[20,a] Steel *et al.*[21,a]	Inconsistent	Evidence strengthened by significant QI elements in most integrated working interventions (next row)
Integrated working	**Brine** *et al.*,[46,a] **Conti** *et al.*,[47]/SQW Ltd,[52] **Lloyd** *et al.*,[49,a] **Lloyd** *et al.*,[48,a] **Morciano** *et al.*,[50,a] **Sherlaw-Johnson** *et al.*,[51,a] **Vestesson** *et al.*[53,a]	Stronger	
Training/ workforce development	Armstrong,[82] **Sheaff** *et al.*,[84] **Siddiqi** *et al.*,[83] SQW[52]	No evidence of effect	
Management of specific problems	**Downs** *et al.*[88]/**Sampson** *et al.*,[89] McKee *et al.*[90,a]	Inconsistent	Inclusion of Siddiqi *et al.* here rather than row above makes no difference
ACP	Amador *et al.*,[106] Garden *et al.*[107,a]	Inconsistent	
Palliative/end-of-life care	Kinley *et al.*,[122,a] Smith *et al.*,[123] Springett *et al.*[124]	Very limited	Significance of effect unclear for Smith *et al.* and Springett *et al.*

a Studies showing significant positive effect; other studies show no significant evidence of effect.

Note
Controlled studies in **bold**.

TABLE 32 Summary of overall strength of evidence from international studies

Type of intervention	Relevant studies	Strength of evidence	Comments
QI programmes	United States: Blackburn *et al.*,[22,a] **Ingber** *et al.*,[26,a] **Kane** *et al.*,[27] Rantz *et al.*,[32,a] **Vadnais** *et al.*[36,a] New Zealand: **Boyd** *et al.*,[40] **Connolly** *et al.*,[41] Connolly *et al.*[42,a]	Stronger, inconsistent Stronger, borderline stronger, inconsistent	Evidence weakened by duplication of data between reports Statistical significance unclear for some studies
Integrated working	Australia: Chan *et al.*,[66,a] **Cordato** *et al.*,[58,a] **Craswell** *et al.*,[60,a] Dai *et al.*,[62,a] **Fan** *et al.*,[63,a] **Haines** *et al.*,[59,a] **Hullick** *et al.*,[68,a] **Hullick** *et al.*,[69,a] **Hullick** *et al.*,[70] Hutchinson *et al.*,[71,a] Kwa *et al.*[72,a] USA: **Brickman** *et al.*,[75,a] **Grabowski** *et al.*,[73,a] Hofmeyer *et al.*,[74] Stadler *et al.*[76,a] Other countries: **Kobewka** *et al.*[79] (Canada); **Kumpel** *et al.*[80] (Germany); **Pedersen** *et al.*,[77,78,a] **Weatherall** *et al.*[81] (Denmark)		
Training/ workforce development	**McGregor** *et al.*[85,a] (Canada); **Resnick** *et al.*[87] (USA), **Romoren** *et al.*[86,a] (Norway)	Inconsistent	
Management of specific problems	Medicine review: **Frankenthal** *et al.*[98] (Israel); **Junius-Walker** *et al.*[99] (Germany); **Nymberg** *et al.*[97] (Sweden); **Niznik** *et al.*[91,a] (USA); **Sluggett** *et al.*[100] (Australia) Infection prevention: **Gorisek** *et al.*[96] (Slovenia); **Gravenstein** *et al.*[92,a] **McConeghy** *et al.*,[93,a] **Mor** *et al.*,[95,a] Pop-Vicas *et al.*[94,a] (USA)	Inconsistent, stronger	
ED interventions	**Hullick** *et al.*[70] (Australia); Marsden *et al.*[103,a] (New Zealand)	Inconsistent	
ACP	**Martin** *et al.*[117,a] (Australia); Houttekier *et al.*[116] (Belgium); **Adekpedjou** *et al.*[110,a] (Canada); Honinx *et al.*[115] (multinational); Hendriks *et al.*,[113] **Overbeek** *et al.*,[121] (the Netherlands); **Cohen** *et al.*,[111] Galambos *et al.*,[112,a] **Hickman** *et al.*,[114] **Moyo** *et al.*[118,a] Mullaney *et al.*[119,a] **Nakashima** *et al.*[120,a] (USA)	Inconsistent	
Palliative/ end-of-life care	Australia: Chapman *et al.*,[125] **Forbat** *et al.*,[126,a] Koerner *et al.*,[127] Mitchell *et al.*,[128,a] **Rainsford** *et al.*[129] United States: Harrison *et al.*,[130,a] **Miller** *et al.*,[131–133,a] **Temkin-Greener** *et al.*,[134] **Zheng** *et al.*[135,a]	Inconsistent, stronger	

a Studies showing significant positive effect; other studies show no significant evidence of effect.

Note
Controlled studies in **bold**.

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supported by some local Hospital at Home services.[147] Urgent Community Response, which describes short-duration intensive healthcare support in the community for older people who have experienced acute deterioration and which is part of the NHS England Ageing Well programme, also excludes care home residents from its core specification.[148] The national roll-out in England of Hospital at Home as part of the Frailty Virtual Wards initiative, alongside Urgent Community Response, provides an opportunity to evaluate the applicability of approaches evidenced to work in Australia in the UK setting. This would, though, require care home residents to be included and for focused evaluation around these questions.

Telehealth interventions have been evaluated in the USA and other settings (including to a small extent in the UK) with mixed results. There is a fairly substantial international evidence base evaluating ACP and palliative care interventions, although results have been inconsistent (see *Table 32*). The considerations when implementing telehealth in care home settings have been well described, although there remain specific challenges around implementing video consultations for residents with cognitive or sensory impairment and further research is required to better understand the role of telehealth in such groups.[149]

We found only one study based in an assisted living setting (in the USA). The Veterans' Administration Medical Foster Home model is another evaluated intervention with no apparent equivalent in the UK.

Effectiveness of interventions

We graded evidence for effectiveness according to a relatively simple scheme. Much of the evidence was graded as 'weaker' because of a shortage of controlled studies or 'inconsistent'. Interventions with 'stronger' evidence included improved links with primary/community care and QI programmes with staff attached to care homes. Diversity of outcome measures and heterogeneity of interventions precluded meta-analysis but claimed reductions (against control or baseline) were often of the order of 30–50%, which would imply significant reductions in resource use. Groupings presented in our tables are not the only ones and readers can form their own assessment (but note that single studies always constitute 'very limited' evidence).

Implementation in UK

The barriers to implementation of healthcare interventions in care homes are well described. and include staff shortages, high staff turnover and care homes changing ownership or going out of business. Problems affecting service delivery in care homes affect the wider urgent/emergency care system and vice versa. A recurrent theme, throughout the literature, both prior to and during the pandemic, is insufficient recognition or engagement with expertise held in and by the care home sector. Serial studies have shown a willingness and enthusiasm among care home staff to make healthcare better for their residents, but a tendency among NHS providers to engage with them late in service design, if at all, with services designed to give care home staff little latitude in how they are implemented at an individual care home level.[89,150–153]

Facilitators to implementation were identified, including building on existing services/relationships and the role of committed leaders in both the care home and health sectors. Key within this will be empowerment of care home providers and staff to shape the design and implementation of care home healthcare interventions. Integrated care boards bring together local authorities and NHS commissioners and providers. Care home providers, though, are predominantly corporate or third sector and remain largely 'outside the room'. There is promise that this may change with the appointment of a chief nurse for social care, who might better facilitate consultation with national care home provider organisations,

but specific work is required to build relationships with care home providers and staff at a local and regional level.[154] The situation will not improve without investment in such relationships.

Applicability of international evidence

Much is made in the literature of the differences in service delivery between care home sectors internationally. This is important in the way that it influences: the core competencies of staff employed in care homes (for example through mandatory minimum training in the USA and Australia): the availability of in situ resident medical staff (e.g. elderly care physicians in the Netherlands); the role of medical staff in determining care home policies (for example through the medical director initiative in the USA) and the sense of care homes as being 'inside' the system (more common where care homes are publicly funded, as in Denmark or the Netherlands).

An important overarching consideration, however, is that the cohorts of residents living in care homes are very similar around the globe.[155] This was evidenced in the markedly similar way that COVID-19 affected care home residents internationally.[156] Long-term care systems are no more similar or different than healthcare systems. UK and US long-term care arguably have more in common than do acute hospital systems in the respective countries. It is therefore possible to transfer approaches between countries, so long as attention is paid to the differences and similarities between systems, and so long as new models from overseas are evaluated in parallel with implementation when introduced for the first time.

The FITAR tool proved useful for identifying a wide range of issues that could affect applicability of international evidence. Examples included mixtures of long-stay and short-stay residents in some nursing homes (USA), cultural attitudes to ACP/palliative care (USA/Europe), workforce regulations and roles of different grades (especially nurses; USA/Australia) and public ownership of care homes (Denmark). Extraction of data at the level of the country rather than the individual study would have saved time in the overall review process.

Economic evidence

We identified a relatively large amount of economic evidence for the UK but this was mostly of low quality. International evidence was included for completeness but there is a a need for particular caution in extrapolating from other countries or time periods. Costing social care interventions has long provided difficulties in the UK, as NHS and social care costs are collated differently and separately.[157] Additional challenges come from understanding how costs are transferred between health and social care commissioners and providers.[158] An intervention that saves the NHS money may ultimately generate cost, opportunity cost, or both for care home providers. Finally, quality of life measures have limited applicability in care home residents because of the prevalence of dementia in this setting, and this limits some types of health economic evaluation.[159] Substantial work is required to develop frameworks to better evaluate costs, and cost-effectiveness of interventions that straddle the interface between health and social care, and in care home research more generally.

Strengths and limitations

Strengths of the review include its broad coverage of UK and international evidence, a thorough search including grey literature and citation searching into 2022 and reference list checking and use of two independent reviewers for most standard review processes.

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We extracted data on details of interventions, which is important for understanding complex interventions; the relevant tables may be a useful resource for designing new care models.

Coverage of the international literature was sufficient to answer our research question about possible candidate interventions that could be relevant to UK practice. We evaluated risk of bias for most included studies using design-specific tools. Statements about overall strength of evidence were informed by risk of bias assessment even where the key considerations are not explicitly stated.

Our findings were broadly similar to a review of specialist health-care services in care homes by Buck *et al.* published in 2021.[8] This review used a slightly different framework of interventions to ours but with many common elements. The study reported that interventions addressing residents' general health needs, assessment and management services and non-training initiatives involving medical staff can reduce hospital admissions, while there was also promising evidence for services targeting residents at imminent risk of hospital admission or post-hospital discharge and training-only initiatives. There was evidence that end-of-life care services may enable residents to remain in the home at the end of life, but the high number of poor-quality studies (authors' terminology) undermined confidence in this result. Buck *et al.*[8] used a 'vote counting' approach to evidence synthesis with binomial testing to assess statistical significance of the findings. This contrasts with our more qualitative approach to assessing strength of evidence by intervention and setting. Our assessment of implementation and applicability issues and our specific focus on unplanned admissions differentiates our approach from that of Buck *et al.*[8] Both reviews have relevance for supporting evidence-informed decision-making by service commissioners and providers.

The large number of records identified by our searches led us to prioritise items for screening by searching for relevant keywords. This is not uncommon and is allowed for in the latest version of the PRISMA flow diagram. We checked a random sample of unscreened records which confirmed that the risk of missing relevant items through this approach was likely to be low. We did not attempt any meta-analyses because of the heterogeneity of included studies for most types of intervention together with lack of availability of the required data and/or diversity of effect measures in some cases.

A further possible limitation was the framing of our analysis around a predefined taxonomy of interventions. This worked well in most cases but inevitably, there was an element of subjectivity in placement of a few studies. Our approach was to assign each study to one group but it would be possible to conduct a sensitivity analysis by adding or removing 'marginal' studies to identify any effects on the overall assessment of strength of evidence.

Our overall assessment was less comprehensive than that provided by Grading of Recommendations, Assessment, Development and Evaluation (GRADE) and similar systems. This reflects our decision to produce a broadly focused review and the recognition that much of the evidence either fell outside the domains of GRADE or would be heavily downgraded because of the use of nonrandomised study designs. It is also worth noting that qualitative evidence, while relevant to some aspects of the review, is not adequately assessed by either our system or GRADE.

Equity, diversity and inclusion

This section complements the discussion of review processes above (see *Chapter 2*). Diversity in care home populations is likely to be increasing in many countries in line with that of society as a whole, although research on this topic was outside the scope of our review. We cannot be certain how far the care homes, residents and staff in our included studies were representative of the wider care home population. However, there is evidence that care home residents worldwide are relatively similar at the population level (see *Chapter 5*). Equity and diversity issues affecting care homes may thus reflect those present in society as a whole and specifically in the health and care system.

Decision-making about admission of care home residents to hospital can raise issues of equity, although given our focus on implementing and evaluating interventions these were only touched on in our review.

Family advocacy may influence the decision-making process (see *Chapter 3*). Residents with dementia represent a particularly vulnerable group whose needs require attention to support equitable treatment.

The health and social care workforce is disproportionately female and highly diverse in terms of characteristics such as ethnicity and socioeconomic status. Research involving care home staff should seek to ensure that all groups are appropriately represented, for example in qualitative studies and surveys. Our review included too small a sample of such studies to draw meaningful conclusions, but this could be an interesting topic for further research.

Implications for service delivery

We have identified the following implications for service delivery:

- Opportunities to reduce unplanned admissions exist at all stages of residents' care journeys from routine care to palliative care at end-of-life.
- Types of intervention such as QI programmes or integrated working between care homes and primary care/community services differ in aspects such as workforce requirements, technology, intensity of the intervention etc. Services can consider adapting described interventions to their own context, including possibilities for simplification where evidence supports this.
- Evidence suggests that care home managers and staff support proposed interventions that will help them to deliver better care for their residents. Early and genuine consultation to assess feasibility and acceptability of interventions could be a major factor in successfully implementing new service models.
- Specific work is required to build relationships between NHS and care home providers and staff at a local and regional level.
- There is some evidence to guide where changes to services are more likely to improve outcomes; for example, care homes without nursing may benefit more than those with nursing from some forms of support because of their lower baseline level of staffing and because of differences in case mix.
- In attempting to transfer approaches between countries, attention should be paid to the differences and similarities between systems, and new models from overseas should be evaluated in parallel with implementation in the UK setting. Changes to how care is delivered to older people in the community, including Hospital at Home and Urgent Community Response, mirror some initiatives targeted at care homes overseas and could provide an opportunity to test and evaluate imported models of working if care homes are adopted within remit.
- Work is needed to better understand and standardise operating procedures between care homes and ambulance providers seeking to negotiate care for residents during medical crises, particularly with regard to lines of responsibility and shared liability for decision making.

Implications for research

We have identified the following priorities for research:

- Researchers should carefully consider what is realistic in terms of study design and data collection given the current UK context of extreme pressure on care homes. As with changes to service delivery, genuine involvement of care home residents, family members and staff is required to design and deliver high-quality research. Development and reporting of appropriate patient-reported outcome measures is recommended.
- Research is needed to better understand the factors that enable effective interventions to become embedded and sustained in practice over the long term.
- There is a need for rigorous economic evaluations, ideally using measures that can be used to compare different interventions and taking into account costs associated with implementation, particularly how costs are transferred between health and social care commissioners and providers.

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- The national roll-out in England of Hospital at Home as part of the Frailty Virtual Wards initiative, alongside Urgent Community Response, provides an opportunity to evaluate the applicability of approaches evidenced to work in Australia in the UK setting.
- Further research is required to evaluate approaches based on paramedic assessment and potential non-conveyance, including assessment of safety and qualitative studies of resident, family carer and care home staff/management perspectives.
- Further research is required to better understand the role of telehealth in reducing unplanned admissions of residents with cognitive or sensory impairments.
- We found only one study based in an assisted living setting (in the USA). Research to evaluate interventions to reduce unplanned admissions from such settings in the UK is required, bearing in mind the lower levels of both resident need and on-site services.

Conclusions

This updated and extended systematic review has identified a substantial body of relevant research (124 publications) published between 2014 and early 2022. Much of the evidence is of low quality because of flaws such as uncontrolled study designs and small sample size. Despite this, it is clear that interventions at various stages of residents' care pathways can reduce unplanned admissions if implemented effectively. Most interventions are complex and require co-operation between health and social care staff. This suggests that intervention effectiveness in routine practice is likely to be influenced by local contextual factors.

In the UK and internationally, integrated working and QI programmes have the strongest evidence of effectiveness. Integrated working takes a variety of forms, with primary and community care links being emphasised in UK practice and the role of hospital-based MDTs being more prominent in Australia. Simpler training and staff development initiatives have shown mixed results. ACP is key to ensuring that residents' and families' wishes are respected at the end of life but 'do not hospitalise' orders cannot be recommended. Qualitative research has identified key themes around decision-making involving paramedics, care home staff and residents/family carers but further work is required to optimise ways of working together and minimise unplanned admissions. Access to high-quality palliative care for care home residents is an ethical requirement but the best way to deliver this is unclear in the face of inconsistent and generally low-quality evidence.

The relevance of international evidence to UK practice is often debated. We were able to identify key factors that decision-makers may want to take into account in evaluating the suitability of international care models for testing in UK settings. Fundamental similarity of the characteristics of care home residents included in research studies tends to support transferability of evidence between different health and care systems.

The UK care home sector, like the health and care system generally, is under great pressure as a result of well-known problems including staff shortages, financial instability and the COVID-19 pandemic. The PARIHS framework identified these and other barriers to implementing interventions to reduce unplanned admissions. Facilitators were also identified, and the Care Home Vanguard studies included in this review led to the roll-out of the EHCH care model in England. Even when interventions have been successfully implemented, the pressures on the system mean that longer-term sustainability cannot be taken for granted and should be considered from an early stage.

Finally, we identified priorities for research, including better economic evaluations; evaluation of 'HiNH' and similar approaches; and appropriate interventions to reduce unplanned admissions from assisted living settings. Research studies should have realistic design and objectives and involve care home staff, managers and residents/families from the outset.

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Ethical review

Not required.

Information governance statement

As a literature review, this study did not handle any personal data.

Data-sharing statement

Any additional data not included in this report and its appendices are available on request. All queries should be submitted to the corresponding author.

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Appendix 1 MEDLINE search strategies

Main search strategy

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review and Other Non-Indexed Citations and Daily <1946 to 14 December 2021>

Search strategy:

1. residential facilities/or homes for the aged/or nursing homes/(47,896)
2. 'residential care'.ab,ti. (3754)
3. 'care home*'.ab,ti. (4721)
4. 'nursing home*'.ab,ti. (32,554)
5. Assisted Living Facilities/(1528)
6. 'assisted living'.ab,ti. (2410)
7. 'extra care housing'.ab,ti. (16)
8. or/1–7 (65,730)
9. exp *aged/or exp *geriatrics/or exp *geriatric nursing/or (centarian* or centenarian* or elder* or eldest or frail* or geriatri* or nonagenarian* or octagenarian* or octogenarian* or old age* or older adult* or older age* or older female* or older male* or older man or older men or older patient* or older people or older person* or older population or older subject* or older woman or older women or oldest old* or senior* or senium or septuagenarian* or supercentenarian* or very old*).ti,kf. (306,918)
10. 8 or 9 (355,492)
11. Patient Admission/(25,826)
12. (unplanned adj3 (admission* or hospital*)).ab,ti. (2672)
13. (avoidable adj3 (admission* or hospital*)).ab,ti. (947)
14. 'community geriatric* service*'.ab,ti. (8)
15. Case Management/(10,401)
16. 'case management'.ab,ti. (11,442)
17. (discharg* adj3 plan*).ab,ti. (5382)
18. 'Delivery of Health Care, Integrated'/(13,761)
19. (integrated adj3 (working or care)).ab,ti. (12,152)
20. Delirium/pc (Prevention and Control) (1248)
21. (prevent* adj3 deliri*).ab,ti. (1173)
22. [(medicine* or medication*) adj3 (manag* or monitor* or review*)].ab,ti. (25,092)
23. Terminal Care/(30,296)
24. 'terminal care'.ab,ti. (1553)
25. 'end of life care*'.ab,ti. (10,925)
26. care, end-of-life.ab,ti. (128)
27. eol.ab,ti. (2217)
28. Advance Care Planning/(3619)
29. 'advance care planning'.ab,ti. (3566)
30. Fluid Therapy/(21,238)
31. (hydration adj3 nutrition).ab,ti. (1154)
32. ('non convey*' or nonconvey*).ab,kw,ti. (52)
33. 'specialist paramedic*'.ab,ti. (8)
34. (paramedic* adj3 assess*).ab,ti. (196)
35. 'training course* '.ab,ti. (5569)
36. [(vocational or educational) adj qualification*].ab,ti. (804)
37. 'hydration and nutrition'.ab,ti. (232)

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38. 'geriatric* specialist'.ab,ti. (40)
39. Vaccination/(90,966)
40. [(influenza* or flu*) adj3 vaccin*].ab,ti. (26,583)
41. covid-19 vaccines/or influenza vaccines/ (32,036)
42. [(covid* or corona* or 'SARS CoV 2') adj3 vaccin*].ab,ti. (11,950)
43. Pneumococcal Vaccines/(8162)
44. 'pneumo* vaccine*'.ab,ti. (4107)
45. Oxygen Inhalation Therapy/(15,411)
46. (oxygen adj1 therap*).ab,ti. (12,517)
47. or/11–46 (320,076)
48. 10 and 47 (16,212)
49. letter/(1,162,749)
50. editorial/(589,748)
51. news/(210,552)
52. exp historical article/(406,561)
53. anecdotes as topic/(4746)
54. comment/(942,690)
55. case report/(2,232,728)
56. (letter or comment*).ti. (172,085)
57. or/49–56 (4,669,568)
58. randomized controlled trial/or random*.ti,ab. (1,404,034)
59. 57 not 58 (4,640,014)
60. animals/not humans/(4,896,931)
61. exp animals, laboratory/(924,650)
62. exp animal experimentation/(9971)
63. exp models, animal/(613,504)
64. exp rodentia/(3,391,961)
65. (rat or rats or mouse or mice).ti. (1,384,553)
66. or/59–65 (10,383,418)
67. 48 not 66 (14,900)
68. afghanistan/or africa/or africa, northern/or africa, central/or africa, eastern/or 'africa south of the sahara'/or africa, southern/or africa, western/or albania/or algeria/or andorra/or angola/or 'antigua and barbuda'/or argentina/or armenia/or azerbaijan/or bahamas/or bahrain/or bangladesh/or barbados/or belize/or benin/or bhutan/or bolivia/or borneo/or 'bosnia and herzegovina'/or botswana/ or brazil/or brunei/or bulgaria/or burkina faso/or burundi/or cabo verde/or cambodia/or cameroon/ or central african republic/or chad/or exp china/or comoros/or congo/or cote d'ivoire/or croatia/or cuba/or 'democratic republic of the congo'/or cyprus/or djibouti/or dominica/or dominican republic/ or ecuador/or egypt/or el salvador/or equatorial guinea/or eritrea/or eswatini/or ethiopia/or fiji/or gabon/ or gambia/ or 'georgia (republic)'/ or ghana/ or grenada/ or guatemala/ or guinea/ or guinea-bissau/ or guyana/ or haiti/ or honduras/ or independent state of samoa/ or exp india/ or indian ocean islands/ or indochina/ or indonesia/ or iran/ or iraq/ or jamaica/ or jordan/ or kazakhstan/ or kenya/ or kosovo/ or kuwait/ or kyrgyzstan/ or laos/ or lebanon/ or liechtenstein/ or lesotho/ or liberia/ or libya/ or madagascar/ or malaysia/ or malawi/ or mali/ or malta/ or mauritania/ or mauritius/ or mekong valley/ or melanesia/ or micronesia/ or monaco/ or mongolia/ or montenegro/ or morocco/ or mozambique/ or myanmar/ or namibia/ or nepal/ or nicaragua/ or niger/ or nigeria/ or oman/ or pakistan or palau/or exp panama/or papua new guinea/or paraguay/or peru/or philippines/or qatar/or 'republic of belarus'/or 'republic of north macedonia'/or romania/or exp russia/or rwanda/or 'saint kitts and nevis'/or saint lucia/or 'saint vincent and the grenadines'/or 'sao tome and principe'/or saudi arabia/or serbia/or sierra leone/or senegal/or seychelles/or singapore/or somalia/or south africa/or south sudan/or sri lanka/or sudan/or suriname/or syria/or taiwan/or tajikistan/or tanzania/or thailand/or timor-leste/or togo/or tonga/or 'trinidad and tobago'/or tunisia/or

turkmenistan/or uganda/or ukraine/or united arab emirates/or uruguay/or uzbekistan/or vanuatu/or venezuela/or vietnam/or west indies/or yemen/or zambia/or zimbabwe/(1,186,145)
69. 'Organisation for Economic Co-Operation and Development'/(404)
70. australasia/or exp australia/or austria/or baltic states/or belgium/or exp canada/or chile/or colombia/or costa rica/or czech republic/or exp denmark/or estonia/or europe/or finland/or exp france/or exp germany/or greece/or hungary/or iceland/or ireland/or israel/or exp italy/or exp japan/or korea/or latvia/or lithuania/or luxembourg/or mexico/or netherlands/or new zealand/or north america/or exp norway/or poland/or portugal/or exp 'republic of korea'/or 'scandinavian and nordic countries'/or slovakia/or slovenia/or spain/or sweden/or switzerland/or turkey/or exp united kingdom/or exp united states/(3,363,943)
71. European Union/(17,009)
72. Developed Countries/(21,011)
73. 69 or 70 or 71 or 72 (3,379,076)
74. 68 not 73 (1,099,831)
75. 67 not 74 (14,273)
76. limit 75 to english language (12,989)
77. limit 76 to year='2014–Current' (6385)

MEDLINE extra falls search

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review and Other Non-Indexed Citations and Daily <1946 to 14 January 2022>

Search strategy:

1. residential facilities/or homes for the aged/or nursing homes/(48,006)
2. 'residential care'.ab,ti. (3775)
3. 'care home*'.ab,ti. (4774)
4. 'nursing home*'.ab,ti. (32,705)
5. Assisted Living Facilities/(1531)
6. 'assisted living'.ab,ti. (2433)
7. 'extra care housing'.ab,ti. (16)
8. or/1–7 (65,979)
9. exp *aged/or exp *geriatrics/or exp *geriatric nursing/or (centarian* or centenarian* or elder* or eldest or frail* or geriatri* or nonagenarian* or octagenarian* or octogenarian* or old age* or older adult* or older age* or older female* or older male* or older man or older men or older patient* or older people or older person* or older population or older subject* or older woman or older women or oldest old* or senior* or senium or septuagenarian* or supercentenarian* or very old*).ti,kf. (308,664)
10. 8 or 9 (357,423)
11. Patient Admission/(25,879)
12. [unplanned adj3 (admission* or hospital*)].ab,ti. (2699)
13. [avoidable adj3 (admission* or hospital*)].ab,ti. (954)
14. 'community geriatric* service*'.ab,ti. (8)
15. Case Management/(10,408)
16. 'case management'.ab,ti. (11,481)
17. (discharg* adj3 plan*).ab,ti. (5413)
18. 'Delivery of Health Care, Integrated'/(13,793)
19. [integrated adj3 (working or care)].ab,ti. (12,255)
20. Delirium/pc (Prevention and Control) (1261)
21. (prevent* adj3 deliri*).ab,ti. (1192)
22. [(medicine* or medication*) adj3 (manag* or monitor* or review*)].ab,ti. (25,285)

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23. Terminal Care/(30,376)
24. 'terminal care'.ab,ti. (1556)
25. 'end of life care*'.ab,ti. (10,999)
26. care, end-of-life.ab,ti. (129)
27. eol.ab,ti. (2238)
28. Advance Care Planning/(3646)
29. 'advance care planning'.ab,ti. (3612)
30. Fluid Therapy/(21,285)
31. (hydration adj3 nutrition).ab,ti. (1161)
32. ('non convey*' or nonconvey*).ab,kw,ti. (53)
33. 'specialist paramedic*'.ab,ti. (8)
34. (paramedic* adj3 assess*).ab,ti. (197)
35. 'training course* '.ab,ti. (5611)
36. [(vocational or educational) adj qualification*].ab,ti. (810)
37. 'hydration and nutrition'.ab,ti. (235)
38. 'geriatric* specialist'.ab,ti. (39)
39. Vaccination/(91,649)
40. [(influenza* or flu*) adj3 vaccin*].ab,ti. (26,718)
41. covid-19 vaccines/or influenza vaccines/(32,861)
42. [(covid* or corona* or 'SARS CoV 2') adj3 vaccin*].ab,ti. (13,156)
43. Pneumococcal Vaccines/(8196)
44. 'pneumo* vaccine*'.ab,ti. (4126)
45. Oxygen Inhalation Therapy/(15,473)
46. (oxygen adj1 therap*).ab,ti. (12,610)
47. or/11–46 (322,683)
48. 10 and 47 (16,328)
49. letter/(1,166,322)
50. editorial/(592,842)
51. news/(210,646)
52. exp historical article/(407,003)
53. anecdotes as topic/(4746)
54. comment/(947,871)
55. ase report/(2,239,554)
56. (letter or comment*).ti. (173,104)
57. or/49–56 (4,685,317)
58. randomized controlled trial/or random*.ti,ab. (1,411,760)
59. 57 not 58 (4,655,618)
60. animals/not humans/(4,909,832)
61. exp animals, laboratory/(928,170)
62. exp animal experimentation/(10,021)
63. exp models, animal/(616,756)
64. exp rodentia/(3,403,886)
65. (rat or rats or mouse or mice).ti. (1,387,516)
66. or/59–65 (10,416,012)
67. 48 not 66 (15,012)
68. afghanistan/or africa/or africa, northern/or africa, central/or africa, eastern/or 'africa south of the sahara'/or africa, southern/or africa, western/or albania/or algeria/or andorra/or angola/or 'antigua and barbuda'/or argentina/or armenia/or azerbaijan/or bahamas/or bahrain/or bangladesh/or barbados/or belize/or benin/or bhutan/or bolivia/or borneo/or 'bosnia and herzegovina'/or botswana/or brazil/or brunei/or bulgaria/or burkina faso/or burundi/or cabo verde/or cambodia/or cameroon/or central african republic/or chad/or exp china/or comoros/or congo/or cote d'ivoire/or croatia/or cuba/or 'democratic republic of the congo'/or cyprus/or djibouti/or dominica/or dominican republic/or ecuador/or egypt/or el salvador/or equatorial guinea/or eritrea/or eswatini/or ethiopia/or fiji/or

gabon/or gambia/or 'georgia (republic)' /or ghana/or grenada/or guatemala/or guinea/or guinea-bissau/or guyana/or haiti/or honduras/or independent state of samoa/or exp india/or indian ocean islands/or indochina/or indonesia/or iran/or iraq/or jamaica/or jordan/or kazakhstan/or kenya/or kosovo/or kuwait/or kyrgyzstan/or laos/or lebanon/or liechtenstein/or lesotho/or liberia/or libya/or madagascar/or malaysia/or malawi/or mali/or malta/or mauritania/or mauritius/or mekong valley/or melanesia/or micronesia/or monaco/or mongolia/or montenegro/or morocco/or mozambique/or myanmar/or namibia/or nepal/or nicaragua/or niger/or nigeria/or oman/or pakistan/or palau/or exp panama/or papua new guinea/or paraguay/or peru/or philippines/or qatar/or 'republic of belarus'/or 'republic of north macedonia'/or romania/or exp russia/or rwanda/or 'saint kitts and nevis'/or saint lucia/or 'saint vincent and the grenadines'/or 'sao tome and principe'/or saudi arabia/or serbia/or sierra leone/or senegal/or seychelles/or singapore/or somalia/or south africa/or south sudan/or sri lanka/or sudan/or suriname/or syria/or taiwan/or tajikistan/or tanzania/or thailand/or timor-leste/or togo/or tonga/or 'trinidad and tobago'/or tunisia/or turkmenistan/or uganda/or ukraine/or united arab emirates/or uruguay/or uzbekistan/or vanuatu/or venezuela/or vietnam/or west indies/or yemen/or zambia/or zimbabwe/(1,192,175)

69. 'Organisation for Economic Co-Operation and Development'/(411)
70. australasia/or exp australia/or austria/or baltic states/or belgium/or exp canada/or chile/or colombia/or costa rica/or czech republic/or exp denmark/or estonia/or europe/or finland/or exp france/or exp germany/or greece/or hungary/or iceland/or ireland/or israel/or exp italy/or exp japan/or korea/or latvia/or lithuania/or luxembourg/or mexico/or netherlands/or new zealand/or north america/or exp norway/or poland/or portugal/or exp 'republic of korea'/or 'scandinavian and nordic countries'/or slovakia/or slovenia/or spain/or sweden/or switzerland/or turkey/or exp united kingdom/or exp united states/(3,372,732)
71. European Union/(17,054)
72. Developed Countries/(21,036)
73. 69 or 70 or 71 or 72 (3,387,922)
74. 68 not 73 (1,105,653)
75. 67 not 74 (14,378)
76. limit 75 to english language (13,092)
77. limit 76 to year='2014–Current' (6488)
78. Accidental Falls/pc (Prevention and Control) (10,120)
79. [fall* adj3 (prevent* or avoid* or manag* or intervention* or project* or program*)].ab,ti. (10,401)
80. 78 or 79 (16,211)
81. 8 and 80 (1071)
82. 81 not 66 (1016)
83. 82 not 74 (980)
84. limit 83 to english language (869)
85. limit 84 to year='2014–Current' (333)
86. hospitalization/or patient admission/(147,809)
87. hospitali?ation.ab,ti. (160,421)
88. 12 or 13 or 86 or 87 (267,445)
89. 85 and 88 (33)
90. 89 not 77 (21)

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Appendix 2 Additional tables for Chapter 2 (UK evidence)

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TABLE 33 TIDiER-Lite description of UK QI programmes

Short title	Reference	By whom	What	Where	To what intensity	How often
Damery *et al.*	Damery *et al.*[19]	Staff involved: 2 full-time facilitators working with care home staff	Safer Provision and Caring Excellence programme. QI intervention with 3 linked components: training in QI methods; use of QI tools to track trends in avoidable harms; and regular manager forums, 'celebrating success' events and newsletters	Care home	One-to-one coaching, small groups and larger training workshops	24-month programme (December 2016 to December 2018); 8 half/full day shared learning events; monthly training on specific topics
Giebel *et al.*	Giebel *et al.*[20]	Community matrons responsible for specific care homes; care home staff; MDT care team including district nurses, palliative care nurses, urgent care teams, community geriatricians and medicines management; televideo advanced nurse practitioner	Programme based on QI principles with the inclusion of 'plan, do, study, act' cycles. Community matron responsible for reactive care and ACP; televideo system providing access to clinical advice; 13 Care Home Innovation Programme protocols for initial management of common presentations; training of care home staff; monthly newsletter; bimonthly workstream meetings and quarterly collaborative meetings to update on progress and share good practice	Participating care homes	Community matron service 9 a.m. to 5 p.m. on weekdays; televideo service available 24 hours/7 days; regular meetings and newsletters (see above); one-off training for care home staff	One-off assessment by care manager and staff training session; regular meetings and newsletter (see above); other components as required over 4 years
Steel *et al.*	Steel *et al.*[21]	MDT including senior and trainee GPs, trainees in geriatrics, psychiatry, pharmacist and residential home senior staff	MDT reviews for residents identified as needing attention: preparation; prereview MDT meeting; patient review, including comprehensive geriatric assessment; post-evaluation MDT discussion; educational session; follow-up by GP and psychiatry trainee (where required)	Participating residential homes	Not applicable	Monthly sessions conducted over 2 cycles

TABLE 34 Implementation barriers, facilitators and role of active facilitation for UK QI programmes

Reference	Barriers	Facilitators	Active facilitation
Damery *et al.*[19]	**Evidence:** existing evidence of high workloads, high rates of staff turnover and difficulty recruiting and retaining competent staff.	**Evidence:** supports association between a positive safety culture and improved outcomes/reduced risk of harm. A previous study in south-east England found that QI training improved knowledge and awareness of resident safety and reduced harms in some homes	'Passionate facilitators with an in-depth understanding of issues within the care home sector, who tailored programme support accordingly' were identified as key to success of the SPACE intervention. In addition to training events, facilitators visited each home to give ad hoc support and one-to-one QI coaching
	Context: some managers and staff initially feared SPACE would increase bureaucracy and workloads. Programme depended on support of individual managers and ten homes changed manager at least once during the study. Annual staff turnover averaged 31% (range 9.6% to 78.3%). Engagement of individual homes also varied, with a small number showing minimal participation throughout. High staff turnover was also a potential barrier to sustaining the intervention.	**Context:** programme gave high priority to workforce development and highlighted opportunities for career progression	
Giebel *et al.*[20]	**Evidence:** not reported	**Evidence:** US study found QI intervention reduced ED attendance by 17%. Routine data on 999 calls, ED attendances and use of televideo system were available as part of contract with providers	Quarterly collaborative meetings for participating homes were considered vital for team building and promoting joined up working for a shared vision
	Context: high turnover of care home managers and staff required new staff to be trained and training repeated. Other challenges included cultural differences between homes and lack of contractual levers	**Context:** NHS Long Term Plan (2019) prioritised measures to reduce hospital admissions in older people and to strengthen NHS support for care homes. The baseline standard (CQC rating) of participating homes was 'good' in 56%, 'required improvement' in 44%, and one home was graded 'inadequate'	
Steel *et al.*[21]	**Evidence:** not reported	**Evidence as facilitator** Details Project was underpinned by the EHCH implementation framework	Limited details reported; a GP trainee took the lead role for the second cycle to encourage trainee leadership
	Context: care home where cycle 2 took place was rated 'inadequate' by CQC (December 2018)	**Context:** integrated health care for older people identified as a key NHS priority in the Long Term Plan and 5-year Forward View	

SPACE, Safer Provision and Caring Excellence.

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TABLE 35 Template for intervention description and replication (TIDiER-Lite) description of UK integrated working programmes

Reference	By whom	What	Where	To what intensity	How often
Brine *et al.*[46]	Dementia outreach team; care home nursing team (community nurses, advanced nurse practitioners and support workers, working closely with geriatricians); Age UK Nottingham and Nottinghamshire Advocacy; GPs	Specialist input and training around dementia; case management of residents with dementia; nursing support to residential homes and nursing homes where required; advocacy support for residents and families; linking specific GP practices to care homes and providing an enhanced level of support	Participating care homes	Not reported	Not applicable
Conti *et al.*[47]	Staff from partner organisations: Sutton CCG (GPs); community services; the local hospital trust; the London Ambulance Service and London Borough of Sutton (care home staff)	Pillar 1 (improving integrated care): weekly health and well-being rounds; multidisciplinary care home support team; and hospital transfer pathway; pillar 2 (supporting care home staff): tailored e-learning; resource package; and care home forum; pillar 3 (supporting quality assurance and safety): joint intelligence group with all partners represented; quality dashboard; and initiative to foster engagement with residents, carers and families	Participating care homes and local hospitals	Some interventions were available to all Sutton care homes (e.g. educational resources and the Care Home Forum). Overall, the focus of the vanguard from November 2015 to July 2016 was on NHs. Attention shifted to residential homes in November 2016	Frequency and availability of different elements varied during the study period
Lloyd *et al.*[49]	Community interest company (Principia) involving a partnership of general practices, community services and patients in Rushcliffe (Nottinghamshire) with support from the local CCG	Enhanced specification of GP care involving aligning care homes with specific practices. Includes review of new residents, comprehensive geriatric assessment within 2 weeks and regular GP visits to the home. Advocacy and independent support delivered by Age UK Notts and supported by volunteers Improved community nursing support, including peer-to-peer support and training for care home nurses Engagement with care home managers	Participating care homes	Not reported	Varied between elements, for example GP visits to care homes could be weekly or fortnightly

Reference	By whom	What	Where	To what intensity	How often
Sherlaw-Johnson *et al.*[51]	MDT, including GPs, specialist doctors, nurses, physiotherapists, occupational therapists, pharmacists, key workers and social workers	Geriatrician available to support GPs and families; comprehensive medication reviews; named clinician and key workers for each nursing home; support for providing end-of-life care; ward rounds with advice and training for nursing home staff; assessment of acute problems by Health 1000 staff in the nursing home	Participating nursing homes	Advice available 8 a.m. to 8 p.m., 7 days per week	Frequency of particular elements not reported
Vestesson *et al.*[53]	Representatives of voluntary organisations; MDT comprising professionals from areas including mental health, physiotherapy and nursing; GPs from 26 practices with patients living in Vanguard care homes	Voluntary sector: activities outside and inside care homes; signposting to services for residents identified as requiring extra help MDT: screening process to identify residents at risk of admission; falls risk assessments; training sessions for care home staff. Primary care: '1 GP practice, 1 care home' model with associated key performance indicators	Participating care homes and local community services	MDT delivered 49 training sessions to 286 care home staff. MDT planned to screen all residents for unmet needs but from April 2016 this was limited to residents considered high risk by care home staff	MDT met weekly; frequency of GP visits varied between care homes and was largely based on the practice's relationship with the care home and the Vanguard

CCG, clinical commissioning group.

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TABLE 36 Implementation barriers, facilitators and role of active facilitation for UK integrated working interventions

Reference	Barriers	Facilitators	Active facilitation
Brine *et al.*[46]	**Evidence :** not reported **Context:** elements of the intervention were not implemented consistently across the CCG area, for example the nursing team did not cover the whole area until 2017. With regard to GP support, some GPs did not want to take on all residents in a care home and some residents were unwilling to change their GP	**Evidence:** not reported **Context:** Nottingham City CCG supported initiatives to enhance health of care home residents since 2007; EHCH vanguard formed in 2015	Not reported
Conti *et al.*[47]	**Evidence:** not reported **Context:** not reported	**Evidence:** not reported **Context:** homes of care vanguard built on initiatives developed by the partner organisations that were already in place	Not reported
Lloyd *et al.*[49]	**Evidence:** not reported **Context:** not reported	**Evidence:** not reported **Context:** from April 2015, Principia was chosen as a vanguard site for the New Care Models programme that followed from the NHS 5-year Forward View area with relatively low baseline levels of admissions and socioeconomic deprivation	Not reported
Sherlaw-Johnson *et al.*[51]	**Evidence:** not reported **Context:** nursing homes were in 'geographically difficult' locations and unable to be aligned with a single general practice. Nursing homes were privately owned and had their own procedures which sometimes conflicted with the Health 1000 approach	**Evidence:** model of care based on Wagner's chronic care model **Context:** mutual trust between GPs and nursing home staff locally was cited as an important element in success. Communication between Health 1000 and nursing home managers was emphasised throughout. High staff turnover and instability among care home providers were not identified as issues locally. Development of Health 1000 was supported by the Prime Minister's Challenge Fund	Authors state that 'Health 1000 has been driven forward by a group of committed individuals' in the organisations involved and emphasise the importance of 'strong leadership and clear vision'
Vestesson *et al.*[53]	**Evidence:** not reported **Context:** '1 GP practice, 1 care home' model was not implemented during the study period	**Evidence:** not reported **Context:** EHCH Vanguard formed in March 2015 to pilot new care model announced in the NHS 5-year Forward View	Not reported

TABLE 37 TIDiER-Lite description of UK training/workforce development studies

Short title	Reference	By whom	What	Where	To what intensity	How often
Armstrong *et al.*	Armstrong *et al.*[82]	1 trainer delivered all the sessions. Research team (UCL partners staff and Medicus Health partners clinicians) involved throughout, helped with data collection, analysis and generating change ideas	Education programme: topics covered deterioration recognition, care of the dying, falls, UTIs and strokes; programme delivery flexible – some care homes opted for frequent, short sessions and others requested periodic, all-day training	4 care homes in Enfield London receiving clinical care from Medicus Health partner	Year-long programme. Programme delivery flexible (see above)	One-off programme over 1 year with evaluation at 3-, 6-, 9- and 12-month points, following evaluations change ideas were generated for the next cycle
Sheaff *et al.*	Sheaff *et al.*[84]	NHS dementia nurse specialists, care home staff	Training programme on dementia. Introduction of dementia learning community – identification of dementia champion by dementia learning facilitators. Dementia champion and care home staff trained in dementia awareness and conducting 'plan, do, study, act' cycles. Dementia learning facilitators then worked with champions	Participating homes	8-hour multimodule training programme; learning visitors regularly visit champion and also use teleconferences, awards, newsletters, etc.	'Plan, do, study, act' cycles determine by champion; monthly awards; annual conference
Siddiqi *et al.*	Siddiqi *et al.*[83]	Specialist delirium practitioner (mental health nurse with expertise in delirium); delirium champion from each home	Stop Delirium! intervention – a multifaceted enhanced educational package incorporating multiple strategies to change practice delivered to each care home over 16 months. Specialist delirium practitioner delivered education sessions. Facilitated working groups of care home staff, groups identified targets around delirium prevention and developed solutions for their care home. Delirium champion from care home staff was training by practitioner. Each home had delirium box of resources to support learning	Care homes	3 education sessions	Not provided

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TABLE 38 Implementation barriers, facilitators and role of active facilitation for UK training/workforce development studies

Reference	Barriers	Facilitators	Active facilitation
Armstrong *et al.*[82]	**Evidence:** barriers included competing priorities on time; shift work; low attendance rates. Evening sessions good way to offer flexible delivery but limited by professionals time. High staff turnover in social care sector made it difficult to train all staff.	**Evidence:** flexible delivery approach – evening sessions, webinars, podcasts; activity-based curriculum, alignment topics with admission data, embedding key messages in each tutorial	Nominating teaching monitor and developing individualised learning plans encouraged care homes to take ownership. Reminder phone calls and emails prior to teaching encouraged participation
	Context: different perception of value of teaching; internal communication systems within care home; no IT facilities for virtual meetings; instability of management	**Context :** stability of management; communication systems IT facilities enabling virtual meetings	
Sheaff *et al.*[84]	**Evidence:** our results also expose the challenging case mix, low quality of care and organisational instability of some care homes in the locality studied	**Evidence:** government had recently set targets for dementia training	Dementia learning facilitators supported and worked with 'dementia champions' in each home. Dementia champions identified by care home managers, apart from 2 who took on role themselves
	Context: not reported	**Context:** all study homes privately owned; homes volunteered to participate, DLC introduced at control homes after evaluation DLC homes with high well- and ill-being scores were generally bigger and had higher staffing ratio.	
Siddiqi *et al.*[83]	**Evidence:** summary home-level data for hospital admissions (obtained from care homes) were missing for 2 homes, and rates were lower than estimated from other sources. Recording of falls differed markedly with some homes recording any instances where a resident was found on the floor as a fall, and others limiting recording to observed falls only; falls data were not, therefore, analysed further	**Evidence: n**ot reported	Specialist delirium practitioner delivered training and facilitated working groups. Working groups consisted of care home staff who set targets and decided on solutions that suited their home. Delirium champions in each home. Overall, 84.4% of staff completed at least 1 education session; in 4 homes, over 90% of staff completed all 3 sessions. Working groups were established in all homes. Delivery of the intervention was compromised in the later part of the study due to first sickness absence and then maternity leave of the delirium practitioner (9 of 22 months)
	Context: only two-thirds of hearing tests were conducted due to lack of appropriate space in the care home. Resident-level data collection diaries were found not to be feasible for completion by residents and too burdensome for staff. Care-home-level diaries were also only partially completed by staff due to time pressures. It was uncommon for friends and family members to be either present to complete proxy forms or to have spent sufficient time observing the resident to be able to comment	**Context:** delirium champion identified in 4 homes, and evidence of outputs from working groups being used in 5 of the 7 homes	

Reference	Barriers	Facilitators	Active facilitation
SQW Ltd[52]	**Evidence:** not reported **Context:** challenges included ensuring that care home staff had time for training and attending events, and communicating with care homes where staff lacked IT literacy. E-learning was less valued than expected (staff preferred face-to-face training). Some staff were unfamiliar with the link nurse role, suggesting resources may have been too thinly spread	**Evidence:** intervention components (e.g. health and well being rounds) based on evidence of what works elsewhere **Context:** some intervention elements already existed in some form, including the Joint Intelligence Group, the Care Home Forums, the link and Supportive Care Home Team nurses, and the provision of educational resources. Initial groundwork that laid the foundations for subsequent developments was done by a small group of senior staff, with personal interest and a high level of commitment to improving the quality of care for Sutton's care home residents	Sutton Homes of Care Vanguard had a steering group on which a wide range of NHS, social care and voluntary sector organisations were represented. Programme staff included a programme director and project manager, with funding for communications, administrative support and a GP clinical lead. NHS England awarded £250,000 later in the year (2016/17) to facilitate the spread of the Vanguard

DLC, dementia learning community; IT, information technology.

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Appendix 3 Additional tables for Chapter 3 (international evidence)

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TABLE 39 TIDiER-Lite for US integrated working studies

Reference	By whom	What	Where	To what intensity	How often
Brickman *et al.*[75]	MDT of physician specialists (emergency care, wound care, vascular, infectious disease, cardiology, physiatry, psychiatry, etc.), and APPs (e.g. nurse practitioners, physician assistants); trained nursing home staff	Protocols for managing common problems within the care home where appropriate; training of care home nursing staff; access to an ED physician and APP for advice; MDT evaluations of residents' health; nursing coordinator to supervise the MDT and initial acute care management	Care home	Access to advice 24 hours/day	Resident evaluation weekly and on acute care visits
Grabowski *et al.*[73]	Telemedicine call centre staffed by a medical secretary and three providers: a registered nurse, a nurse practitioner, and a physician. Calls were triaged by the medical secretary to the appropriate provider	Intervention homes had a cart with equipment for two- way videoconferencing and a high-resolution camera for use in wound care. When a nursing home resident had an off-hours medical problem, a staff member brought the cart into the resident's room and contacted the telemedicine service	Nursing home	Telemedicine service operated evenings (5–11 p.m.) and weekends (10 a.m. to 7 p.m.)	Not applicable
Hofmeyer *et al.*[74]	Advanced practice providers and registered nurses based at central hub, plus director of electronic long-term care and service line manager	Two-way video and peripherals allowing real-time consultation between care home staff and residents and on-call specialists. Specialist equipment included a two-way stethoscope and high-definition camera	Rural long-term care homes in USA (mainly South Dakota)	Service available 24/7	As required; facilities involved in this pilot study had an average of 23 electronic long-term care consultations per site per year
Stadler *et al.*[76]	Physicians, nurse practitioner, physician's assistant, social worker, nurse	Reducing avoidable facility transfers comprises following elements: (1) longitudinal care and after-hours calls managed by small team of providers; (2) ACP became standard practice in SNFs; (3) increased engagement of provider during acute care events; (4) case review of hospital transfers	Participating SNFs	Small team providers managed all care, with at least 1 of team on site every business day, and after-hours calls. ACP became standard practice for SNFs. Nursing staff received education session on engaging provider early. Case review of most recent of most recent hospital transfers	Nursing staff received one education 1 on engaging provider early. Case review took place monthly for 1 hour and discussed approximately 15–20 cases

APP, advanced practice provider; SNF, skilled nursing facility.

TABLE 40 TIDieR-Lite for international training/workforce development studies

Reference	By whom	How often	To what intensity	Where	What
Resnick *et al.*[87]	Research nurse facilitator; champion from staff in assisted living facilities; stakeholder team	Monthly visits from research nurse facilitator for 12 months; weekly emails	Research nurse facilitator visited each facility monthly for 2 hours. Weekly tidbits (function focused care webpage, 2014) were sent via e-mail to all stakeholder team members to provide new updates relevant to physical activity, innovative approaches to increase function and physical activity among residents, and opportunities to participate in contests either within the setting or between settings (e.g. best approach to engage residents in physical activity during Valentine's day)	Assisted living facilities	Step I: environment and policy assessments; step II: education; step III: establishing resident function focused care service plans; step IV: mentoring and motivating
Romoren *et al.*[86]	2 skilled nurses trained all health workers in nursing homes	Once, after completing the training programme the nursing homes then had competencies to provide intravenous treatment locally	1 day	Nursing homes	Educational programme included theory and practical training in intravenous treatment of dehydration and infection

TIDieR-Lite, Template for Intervention Description and Replication.

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TABLE 41 Applicability data for international training/workforce development studies

Reference	Elements of intervention/ initiative	Features of workforce	Features of services	Systems leadership	Financial and commissioning processes	Features of organisations	Patients and populations
Resnick *et al.*[87]	Evidence of treatment fidelity based on delivery with a mean of 11.00 (SD 2.13) stakeholder meetings completed, education of 965 staff provided across all settings with a mean of 88% correct on the knowledge test, completion of policy and environment assessments in all settings, and mentoring and motivation activities were provided based on interventionist documentation (e.g. observations and positive feedback and verbal encouragement provided, contests provided)	Despite the many benefits associated with implementation of function-focused care, assisted living staff express concerns that engaging residents in function and physical activity will increase the risk of falling and subsequent transfers to the hospital setting	There may have been differences in regulatory issues or policies within settings that influenced transfers, such as caring for patients on hospice. Despite the high rate of falls in these settings, only about 50% of assisted living settings report having a plan for how falls are evaluated and/or prevented	FFC-AL-EIT used a four-step approach to implementation and included having a research nurse facilitator work with a champion identified by the setting and a stakeholder team (includes administrative and clinical staff that could affect or be affected by the intervention being implemented)	Patients on hospice. These could be considered in future work. At the time of this study, Maryland and Massachusetts were noted to have some Medicaid coverage for assisted living for eligible residents although Pennsylvania did not. Some Pennsylvania settings, however, allowed residents to pay for their stay in assisted living based on their full social security income (Eldercare Financial Assistance Locator, 2020). These differences may have influenced findings	Assisted living facilities similar in UK	Study was limited due to inclusion of a relatively homogenous sample of white residents from only 3 states and 85 settings

Reference	Elements of intervention/ initiative	Features of workforce	Features of services	Systems leadership	Financial and commissioning processes	Features of organisations	Patients and populations
Romoren *et al.*[86]	Over 90% of the health personnel (nurses and nursing assistants) in the 30 nursing homes received the intervention. Feedback during the training, follow-up meetings and evaluations. was positive. Among advantages described, patients were treated in surroundings and by personnel familiar to them, by personnel knowing them well; and the general phrase: 'That hospitalization was avoided'. Among disadvantages described were practical difficulties with placing and keeping the PVC and confrontation with ethical dilemmas with end-of-life treatment. As a solution to the former, the ambulance service offered to assist in the practical problems with the PVC when necessary. All nursing homes were actively planning to continue providing intravenous treatment in the future	Mean man-years for nurses in the nursing homes was 14.1 (range 3.5–40.2), mean man-years for nursing assistants were 26.2 (range 5–105)	The local hospital and the Teaching nursing home in Vestfold County, Norway, decided to conduct and evaluate an intervention to increase the competence in administrating intravenous fluids and antibiotics in all nursing homes in the county.	In each of the nursing homes as well as in each hospital department, 1 or several nurses served as primary contact for the study team. These were responsible for including and registering information about the patients receiving intravenous treatment in standardised data collection forms. The nursing homes were followed closely by the study team, both regarding the local intravenous treatment and the patient inclusion and data collection. The primary contacts were contacted for a follow-up by telephone on a regular basis. In addition, the study team was available for support to the nursing homes and on e-mail and telephone on a daily basis. The nursing homes received a follow-up visit some months after the intervention, a few were visited several times	Not reported	30 participating nursing homes had 12–124 beds (median 41), in total 1379 beds. They had one to eight departments, and either one type of beds or a combination of beds: for rehabilitation, short-term and long-term care, palliative care and special departments for patients with dementia	Study nursing homes were the vast majority of public and private nursing homes in 1 county, and probably without relevant differences from Norwegian nursing homes in general.

FFC-AL-EIT, Function Focused Care for Assisted Living Using the Evidence Integration Triangle; PVC, peripheral venous catheter.

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Appendix 4 Risk of bias tables

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TABLE 42 Risk of bias results for RCTs

	Question[a]												
Reference	1	2	3	4	5	6	7	8	9	10	11	12	13
Boyd *et al.*[41]	Unclear; method of randomisation not reported	Unclear	Unclear; residents similar for age but other characteristics not reported	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes; authors discuss design limitations of the study
Connolly *et al.*[41]	Yes	Unclear	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Downs *et al.*[87]	Yes	Yes	Yes	No	No	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes; cluster RCT justified
Forbat *et al.*[126]	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes; cluster RCT justified
Frankenthal *et al.*[98]	Yes	No	Yes	No	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grabowski *et al.*[73]	Unclear; states 'we randomly assigned...'. but no information on how the process	Unclear; no information but would all get intervention eventually so less relevant?	Unclear; as a result, the two groups were relatively equal in terms of their overall five-star ratings. Compared with the control facilities, the treatment	Not applicable	Not applicable	Unclear	Yes	Yes	Yes	Yes	Unclear; nursing home billing data used to record hospitalisations did not provide time of resident's transfer to hospital, nor did billing data include ED visits, which might also be	Yes	Yes

Reference	Question[a]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
			facilities were larger but they had fewer admissions per bed. Staffing levels of nurses and nurse aides in the two groups were relatively similar								influenced by use of telemedicine. Unfortunately, billing data also did not allow us to distinguish between hospitalisations for short-stay residents and those for long-stay residents		
Gravenstein *et al.*[92]	Yes	Yes	Yes	Unclear	No; open label vaccines supplied	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes; cluster randomisation and use of Medicare data justified
Haines *et al.*[59]	Yes; random number	Yes	Unclear; limited resident data	No	No	No	Unclear	Unclear; lack of resident data	Yes; intention-to-treat	Yes	Yes	Yes	Yes; step-wedge cluster design and analysis justified
Honinx *et al.*[137]	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Unclear
Junius-Walker *et al.*[99]	Yes	Yes	Yes	No	No	No	Yes	Yes; small difference in loss to follow-up between groups	Yes; intention to treat analysis	Yes	Yes	Yes	Yes; cluster design justified
Kane *et al.*[27]	Unclear; no details of randomisation reported	Unclear	Yes, applies to nursing home residents	Unclear	No	No	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes; analysis accounted for cluster randomisation

continued

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TABLE 42 Risk of bias results for RCTs (*continued*)

	Question[a]												
Reference	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Lamppu *et al.*[138]	Yes	Yes	Yes (see *Table 1*)	Unclear; defines residents as participants	No	Yes; nurses undertaking assessments were blinded	Yes	Yes	Unclear; 16 residents died before intervention complete and were excluded from the analysis	Yes	Yes	Yes	Yes; authors justified cluster randomisation and matching
Mackey *et al.*[140]	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Martin *et al.*[117]	Yes	No	Yes	No	No	No	Unclear	Yes	Yes	Yes	Yes	Yes	Yes
McConeghy *et al.*[93]	Yes; independent statistician	Yes; likely as done independently	Yes; except more African Americans in the trivalent influenza vaccine group	Unclear	Unclear	Not applicable; used Medicare routine data	Yes	Yes	Yes; intention to treat analysis	Yes	Yes	Yes	Yes; authors justified cluster design, etc.
Moyo *et al.*[118]	Yes	No	Yes	No	No	No	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes
Overbeek *et al.*[121]	Yes	No	Yes	No	No	Unclear	No; education level	Yes	Yes	Yes	Yes	Yes	Yes
Resnick *et al.*[87]	Yes	Unclear	Yes	No	No	Yes	Yes	Yes; full flow diagram	Yes; 'intent-to-treat philosophy'	Yes	Yes	Yes	Yes; cluster design justified

Reference	Question[a]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Romoren *et al.*[86]	Yes; randomisation at nursing home level. Randomisation was stratified based on nursing home size and followed 2 computer-based lists, 1 with the 7 large and 1 with the 21 small homes. To get a balanced	Unclear; randomization list was open to the intervention team, and the 2 nurses who ran the training program cooperated so that each of them included every second nursing home consecutively according to the list	Unclear; patients in the control and intervention groups were similar in most characteristics except a higher proportion of women in the control group; a higher proportion of patients with	Unclear; nursing home staff knew if in intervention groups as had training. Don't think residents would be aware if nursing home in intervention or control	No	Unclear; nurses assessing patient outcome in hospital could be blind to whether nursing home in intervention or control. Nurses assessing patient outcomes in nursing	Yes	Unclear; not all patients treated locally were included in study and data collection forms were incomplete for a number of patients. We have no reason to believe that patients not included in the study	Yes	Yes	Yes	Yes	Unclear; original power calculation was for a standard RCT, allowance for the number of steps and allowance for any repeated measures on individuals was not included in this sample size estimate

continued

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TABLE 42 Risk of bias results for RCTs (*continued*)

Reference	Question[a]												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	randomisation, we randomised 3 small homes then 1 large home consecutively		cancer in the intervention group and a higher proportion of combined pneumonia and urinary tract infection in the control group			homes would know if their home was in interven-tion or control group		differed from patients included or that the main results could have been altered, but it may have led to an underes-timate of the need for intra-venous treatment among nursing home patients					
Sampson *et al.*[89]	Yes; indepen-dent, computer generated	Yes	Yes (see *Table 2*)	Unclear; unclear for residents	No	No; 'not feasible for those collecting data'	Yes	Yes; analysis included loss to follow-up	Yes	Yes	Yes	Yes; pilot trial so mainly descrip-tive	Yes; protocol/ methods published

Reference	Question[a]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Siddiqi *et al.*[83]	Yes; independent computer-generated list	Yes, as above	Unclear; 'There were differences between allocation arms at baseline, with the Stop Delirium! group having a higher proportion of residents who were male, in nursing (as opposed to residential) care, lacking capacity to consent and with a dementia diagnosis'	No	No	No	Yes	Yes	Unclear	Yes	Yes	Yes	Yes; full protocol available
Sluggett *et al.*[100]	Unclear; no details reported	Unclear	Unclear: 'Residents randomised to the intervention were more likely to be male, have shorter duration of stay in the RACF, and live in a regional area'	No	No	No; trial was 'non-blinded'	Yes	Yes	Yes; 'constrained longitudinal data analysis'	Yes	Yes	Yes	Yes; cluster RCT of individual intervention

continued

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TABLE 42 Risk of bias results for RCTs (*continued*)

Reference	Question[a]												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Tappen *et al.*[139]	Yes; computer-generated random numbers	Yes, as question 1	Yes (see *Table 2*)	No	No	Unclear	Yes	Yes; similar numbers lost to follow-up	Yes	Yes	Yes	Yes	Yes
Temkin-Greener *et al.*[134]	Unclear; not reported	Unclear	Yes	No	No	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes	Yes

a Questions
1 Was true randomisation used for assignment of participants to treatment groups?
2 Was allocation to treatment groups concealed?
3 Were treatment groups similar at the baseline?
4 Were participants blind to treatment assignment?
5 Were those delivering treatment blind to treatment assignment?
6 Were outcomes assessors blind to treatment assignment?
7 Were treatment groups treated identically other than the intervention of interest?
8 Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?
9 Were participants analysed in the groups to which they were randomised?
10 Were outcomes measured in the same way for treatment groups?
11 Were outcomes measured in a reliable way?
12 Was appropriate statistical analysis used?
13 Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) accounted for in the conduct and analysis of the trial?

TABLE 43 Risk of bias results for quasi-experimental studies

	Question[a]								
Reference	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Brickman *et al.*[75]	Yes	Yes; no individual data collected but homes owned by same company and historically similar	Yes; homes owned by same company and historically similar	Yes	No; post intervention only reported	Not applicable; no individual data collected	Yes	Yes	Yes
Brine *et al.*[46]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conti *et al.*[47]	Yes	Unclear; statistical methods used in the evaluation mean that the control group was selected to be as similar to the Sutton residents in the study as possible on a range of demographic, socioeconomic, health and hospital use characteristics. Some of the differences at care home level were not expected to be substantially reduced through matching, since Sutton features a preponderance of small, independent care homes in a largely urban setting relative to the rest of England. These differences included the size, age category and rural classification of the care homes. We were also unable	Unclear; notwithstanding similarities, it is possible that unmeasured differences may have existed between the Sutton residents in the study and the matched comparison group, for example in the availability of informal care support or local authority funding. It is also possible that there were greater similarities than anticipated in the care provided by some of the care homes included in the control group and those supported by the Sutton Homes of Care vanguard. For example, there may have been enhanced care initiatives being implemented in the comparison care homes. This would have made it harder to discern an effect of theSutton homes of Care vanguard compared with the control	Yes	Yes	Yes	Yes	Yes	Yes

continued

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TABLE 43 Risk of bias results for quasi-experimental studies (*continued*)

	Question[a]								
Reference	1	2	3	4	5	6	7	8	9
		to measure differences relating to the quality of care delivered in care homes or other measures of the care home market, due to lack of data available to the improvement analytics unit. As such, these could not be addressed by the risk adjustment. We did however attempt to minimise the risk of introducing a significant bias by selecting care home residents from multiple areas							
Craswell *et al.*[60]	Yes	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Dai *et al.*[62]	Yes	Not applicable	Not applicable	No; ITS analysis	Yes	Not applicable	Not applicable	Yes	Yes
Fan *et al.*[63]	Yes	Unclear; only includes data for intervention site	Yes	Yes	Yes	Not applicable	Yes	Yes	Yes
Hullick *et al.*[68]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Hullick *et al.*[69]	Yes	Yes	Yes	Yes	No; only pre and post overall	Unclear	Yes	Yes; administrative data	Yes
Hullick *et al.*[70]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Reference	Question[a]								
	1	2	3	4	5	6	7	8	9
Lloyd *et al.*[49]	Yes	Yes; matched comparison group on care home characteristics and resident characteristics. However, some small differences remained even after matching, and the regression models adjusted for those	Yes	Yes; matched comparison group on care home characteristics and resident characteristics	Unclear	Yes	Yes	Yes	Yes
Marsden *et al.*[103]	Yes	Yes	Unclear	No	Yes	Yes	Yes	Yes	Yes
Mor *et al.*[95]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pedersen *et al.*[77]	Yes	Yes	Yes	Yes	No	Yes; drop-out similar between groups	Yes	Yes	Yes; electronic medical records
Pedersen *et al.*[78]	Yes	Unclear	Yes	Yes	Not applicable	Yes	Yes	Yes	Yes
Sherlaw-Johnson *et al.*[51]	Yes	Unclear; higher rate of dementia in comparator group	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vestesson *et al.*[53]	Yes	Yes	Yes	Yes; matched control group We ensured that the matched control group was as similar as possible to the vanguard residents in the study on observed characteristics (eg demographic mix, co-morbidities and past hospital activity). Vanguard and control residents may, however, have still differed in unobservable ways (for instance in degree of family support)	No	Yes	Yes	Yes	Yes

continued

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TABLE 43 Risk of bias results for quasi-experimental studies (*continued*)

Reference	Question[a]								
	1	2	3	4	5	6	7	8	9
				Furthermore, we did not identify as many care home residents as expected and we are unable to determine whether the missing residents (vanguard and non-vanguard) were different to the residents included the study. This could have affected the results					
Weatherall *et al.*[81]	Yes	Yes; (see *Table 1*)	Yes	Yes	Yes; national routine data used	Not applicable; use of routinely collected data	Yes	Yes	Yes
Zheng *et al.*[135]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

a Questions
1 Is it clear in the study what is the 'cause' and what is the 'effect'?
2 Were the participants included in any comparisons similar?
3 Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?
4 Was there a control group?
5 Were there multiple measurements of the outcome both pre and post the intervention/exposure?
6 Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analysed?
7 Were the outcomes of participants included in any comparisons measured in the same way?
8 Were outcomes measured in a reliable way?
9 Was appropriate statistical analysis used?

TABLE 44 Risk of bias results for cohort/cross-sectional studies

Reference	Question[a]									
	1	2	3	4	5	6	7	8	9	10
Adekpedjou *et al.*[110]	Yes	Yes	No; < 50% of long-term care home residents included	Yes	No	Not applicable	Yes; do not resuscitate or DNH order	Yes	NA; used administrative data	Yes
Carter *et al.*[44]	Yes	Yes	Yes	Yes	No	Not applicable	Not applicable	Yes	No	No
Gorisek *et al.*[96]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Unclear	No
Harrison *et al.*[130]	Yes, completed by DC	Yes	No; appears < 50% of NHs surveyed had complete data	Yes, within groups, e.g. advanced dementia	No	Yes; degree of integration	Yes	Yes	Not applicable; routine administrative data used	Yes
Hendriks *et al.*[113]	Yes	Yes	Unclear	Yes	No	Not applicable	Not applicable	Yes	No; data from residents' physicians	Unclear
Hickman *et al.*[114]	Yes, completed by DC	Yes	Yes; < 1% opted out of participating	Yes	No	Yes; different levels of ACP	Yes	Yes	No; assessment by study nurses	Yes
Kobewka *et al.*[79]	Yes	Yes	Not applicable; study used routine data	Yes; Ontario care home residents	No	Not applicable	Yes	Yes	No	Yes
Levy *et al.*[141]	Yes	Yes	Not applicable; routine data used	Yes	No	Not applicable	Not applicable	Yes	Not applicable; routine administrative data used	Yes; matched groups used
Miller *et al.*[131]	Yes; added by DC	Yes	Yes; nursing home-level data used	Yes	No	Yes; volume of consultations in different nursing homes	Yes	Yes	Not applicable; administrative data used	Yes
Miller *et al.*[132]	Yes	Yes	Yes; administrative data used	Yes	No	No	Not applicable	Yes	Not applicable	Yes
Nymberg *et al.*[97]	Yes	Yes	Yes	Yes	No	No	No	Yes	Unclear	No

continued

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TABLE 44 Risk of bias results for cohort/cross-sectional studies (*continued*)

	Question[a]									
Reference	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Niznik *et al.*[91]	Yes	Yes	Yes; routine data used	Yes	No	No	Yes	Yes	Not applicable; administrative data used	Yes
Pop-Vicas *et al.*[94]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes

DC, Duncan Chambers.
a Questions
1 Was the research question clearly stated?
2 Was the study population clearly specified and defined?
3 Was the participation rate at least 50%?
4 Were all the subjects selected or recruited from the same or similar populations?
5 Was a sample size justification provided?
6 Did the study examine exposure levels?
7 Were exposure measures clearly defined?
8 Were outcome measures clearly defined?
9 Were confounders adjusted for?

TABLE 45 Risk of bias results for mixed-methods and qualitative studies

	Questions[a]											
	Screening		Qualitative					Mixed methods				
Reference	S1	S2	1.1	1.2	1.3	1.4	1.5	5.1	5.2	5.3	5.4	5.5
Alcorn *et al.*[108]	–	–	–	–	–	–	–	Yes	Yes	Yes	Yes; e.g. discussion of how care home staff hoped residents may 'bounce back' after hospital treatment but most died after a short stay	Yes; appears well conducted and reported
Amador *et al.*[106]	–	–	–	–	–	–	–	Yes	Yes	Yes	Unclear; limited overlap between qualitative and quantitative analyses	Unclear; limited details of qualitative methods
Amadoru *et al.*[64]	Yes	Yes	Yes; checked by DC	Yes	Yes	Yes	Yes	–	–	–	–	–
Cohen *et al.*[111]	Yes	Yes	Yes	Yes	Yes; supported by quotes	Yes	Yes	–	–	–	–	–
Dwyer *et al.*[61]	Yes	Yes	Yes; question is about how to reduce admissions though high-quality care	Yes; interviews with service providers and users	Yes; data analysis theory-based and rigorous	Yes; substantial quotes included	Yes	–	–	–	–	–

continued

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TABLE 45 Risk of bias results for mixed-methods and qualitative studies (*continued*)

	Questions[a]											
	Screening		Qualitative					Mixed methods				
Reference	S1	S2	1.1	1.2	1.3	1.4	1.5	5.1	5.2	5.3	5.4	5.5
Harrad-Hyde *et al.*[109]	Yes	Yes	Yes; completed by DC	Yes	Yes	Yes; relevant quotations included	Yes	–	–	–	–	–
Ingber *et al.*[26]	Yes	Yes	–	–	–	–	–	Yes; complex intervention being implemented in real-world settings	Yes; paper provides data on both effectiveness and the complexities of implementation	Yes; qualitative data help to explain quantitative results overall and at the state level	Unclear; no obvious inconsistencies but qualitative results reported in less detail	Unclear; qualitative methods not reported in detail
Koerner *et al.*[127]	Yes	Yes	Yes; interviews with staff in homes using needs rounds	Yes	Yes; implementation science frameworks and thematic analysis used	Yes; relevant quotations included	Yes	–	–	–	–	–
Mitchell *et al.*[128]	Yes	Yes	–	–	–	–	–	Yes; palliative care has both quantitative and qualitative benefits	Yes	Yes	Yes; e.g. discussion of why some residents were not referred	Yes
Mullaney *et al.*[119]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes

	Questions[a]											
	Screening		Qualitative					Mixed methods				
Reference	S1	S2	1.1	1.2	1.3	1.4	1.5	5.1	5.2	5.3	5.4	5.5
Murphy-Jones *et al.*[102]	Yes	Yes	Yes	Yes	Yes	Yes	Unclear; trustworthiness of study was influenced by the primary author holding the position of an 'insider', being an experienced prehospital clinician, employed as a paramedic in the same trust as participants and having specialist education in the subject area. This enabled participants to be relaxed and converse as colleagues using everyday language but impacted on confirmability. Researcher's clinical knowledge may have led to misinterpretations of responses and data may have been missed by not exploring concepts. To counter this, participants were asked to explain colloquial terms and confirm the researcher's interpretations. To reduce bias, the researcher adopted a reflexive approach, recording field notes and maintaining a research diary	–	–	–	–	–
O'Neill *et al.*[65]	Yes	Yes	Yes	Yes; focus groups	Yes; thematic analysis	Yes; quotes included	Yes	–	–	–	–	–

continued

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TABLE 45 Risk of bias results for mixed-methods and qualitative studies (*continued*)

	Questions[a]											
	Screening		Qualitative					Mixed methods				
Reference	S1	S2	1.1	1.2	1.3	1.4	1.5	5.1	5.2	5.3	5.4	5.5
Sheaff *et al.*[84]	Yes	Yes	–	–	–	–	–	Yes; implementation and impact components	Yes	Yes	Yes; see Discussion section in main text	Unclear; limited qualitative methods/data
SQW Ltd[52]	Yes	Yes	–	–	–	–	–	Yes	Yes	Yes	Unclear	Yes

DC, Duncan Chambers
a Questions
Screening
S1 Are there clear research questions?
S2 Do the collected data allow to address the research questions?
Qualitative
1.1 Is the qualitative approach appropriate to answer the research question?
1.2 Are the qualitative data collection methods adequate to address the research question?
1.3 Are the findings adequately derived from the data?
1.4 Is the interpretation of results sufficiently substantiated by data?
1.5 Is there coherence between qualitative data sources, collection, analysis and interpretation?
Mixed methods
5.1 Is there an adequate rationale for using a mixed methods design to address the research question?
5.2 Are the different components of the study effectively integrated to answer the research question?
5.3 Are the outputs of the integration of qualitative and quantitative components adequately interpreted?
5.4 Are divergences and inconsistencies between quantitative and qualitative results adequately addressed?
5.5 Do the different components of the study adhere to the quality criteria of each tradition of the methods involved?

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