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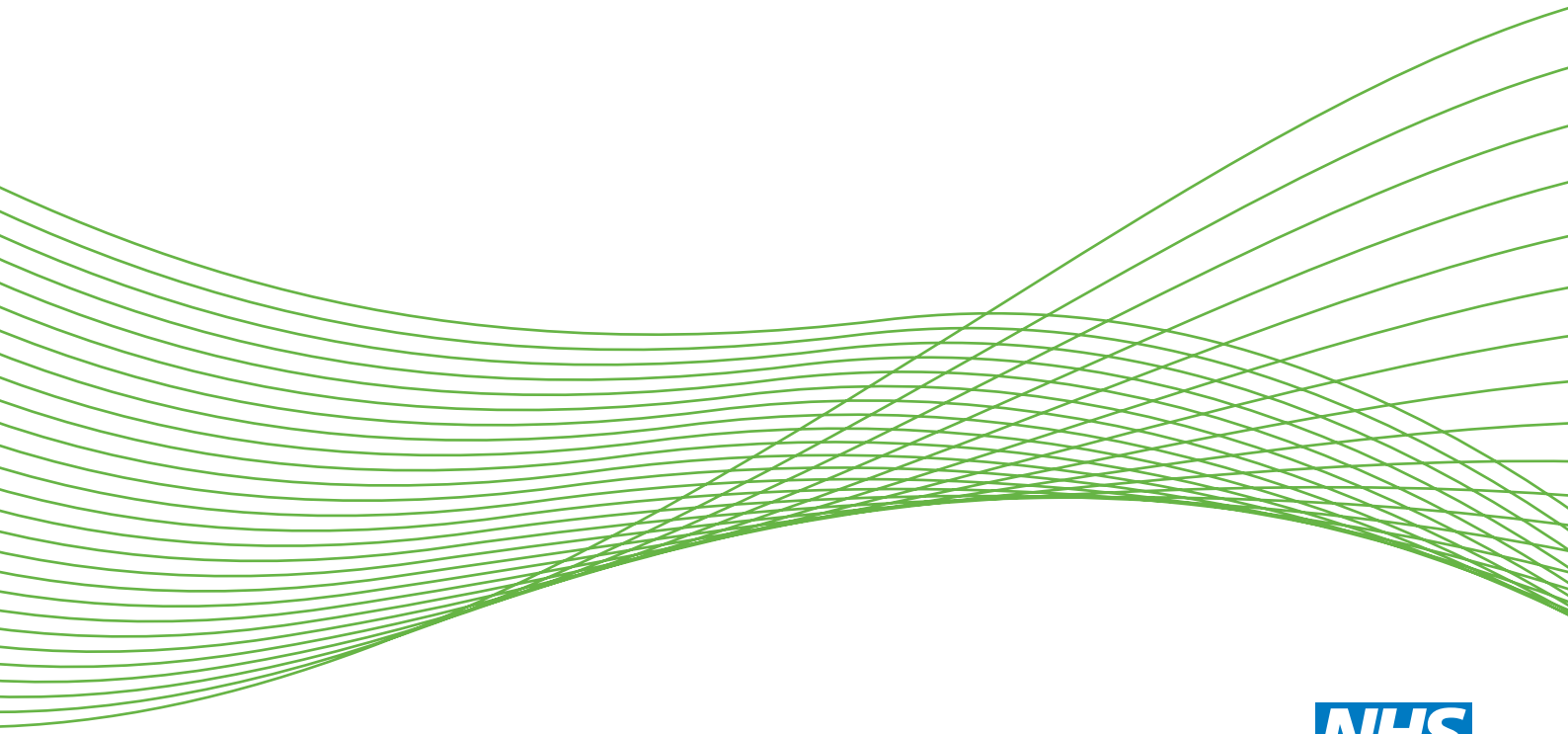

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Innovation to enhance health in care homes and evaluation of tools for measuring outcomes of care: rapid evidence synthesis

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Abstract

Innovation to enhance health in care homes and evaluation of tools for measuring outcomes of care: rapid evidence synthesis

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Background: Flexible, integrated models of service delivery are being developed to meet the changing demands of an ageing population. To underpin the spread of innovative models of care across the NHS, summaries of the current research evidence are needed. This report focuses exclusively on care homes and reviews work in four specific areas, identified as key enablers for the NHS England vanguard programme.

Aim: To conduct a rapid synthesis of evidence relating to enhancing health in care homes across four key areas: technology, communication and engagement, workforce and evaluation.

Objectives: (1) To map the published literature on the uses, benefits and challenges of technology in care homes; flexible and innovative uses of the nursing and support workforce to benefit resident care; communication and engagement between care homes, communities and health-related organisations; and approaches to the evaluation of new models of care in care homes. (2) To conduct rapid, systematic syntheses of evidence to answer the following questions. Which technologies have a positive impact on resident health and well-being? How should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences? Which measurement tools have been validated for use in UK care homes? What is the evidence that staffing levels (i.e. ratio of registered nurses and support staff to residents or different levels of support staff) influence resident outcomes?

Data sources: Searches of MEDLINE, CINAHL, Science Citation Index, Cochrane Database of Systematic Reviews, DARE (Database of Abstracts of Reviews of Effects) and Index to Theses. Grey literature was sought via Google™ (Mountain View, CA, USA) and websites relevant to each individual search.

Design: Mapping review and rapid, systematic evidence syntheses.

Setting: Care homes with and without nursing in high-income countries.

Review methods: Published literature was mapped to a bespoke framework, and four linked rapid critical reviews of the available evidence were undertaken using systematic methods. Data were not suitable for meta-analysis, and are presented in narrative syntheses.

Results: Seven hundred and sixty-one studies were mapped across the four topic areas, and 65 studies were included in systematic rapid reviews. This work identified a paucity of large, high-quality research studies, particularly from the UK. The key findings include the following. (1) Technology: some of the most promising interventions appear to be games that promote physical activity and enhance mental health and well-being. (2) Communication and engagement: structured communication tools have been shown to enhance communication with health services and resident outcomes in US studies. No robust evidence was identified on care home engagement with communities. (3) Evaluation: 6 of the 65 measurement tools identified had been validated for use in UK care homes, two of which provide general assessments of care. The methodological quality of all six tools was assessed as poor. (4) Workforce: joint working within and beyond the care home and initiatives that focus on staff taking on new but specific care tasks appear to be associated with enhanced outcomes. Evidence for staff taking on traditional nursing tasks without qualification is limited, but promising.

Limitations: This review was restricted to English-language publications after the year 2000. The rapid methodology has facilitated a broad review in a short time period, but the possibility of omissions and errors cannot be excluded.

Conclusions: This review provides limited evidential support for some of the innovations in the NHS vanguard programme, and identifies key issues and gaps for future research and evaluation.

Future work: Future work should provide high-quality evidence, in particular experimental studies, economic evaluations and research sensitive to the UK context.

Study registration: This study is registered as PROSPERO CRD42016052933, CRD42016052933, CRD42016052937 and CRD42016052938.

Funding: The National Institute for Health Research Health Services and Delivery Research programme.

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Report Supplementary Material 1 Mapping tables

Supplementary material can be found on the NIHR Journals Library report project page (www.journalslibrary.nihr.ac.uk/programmes/hsdr/157705/#/documentation).

Supplementary material has been provided by the authors to support the report and any files provided at submission will have been seen by peer reviewers, but not extensively reviewed. Any supplementary material provided at a later stage in the process may not have been peer reviewed.

Glossary

Medicaid A social insurance programme in the USA that covers institutional nursing services on a means-tested basis.

Medicare A federally funded programme of health care in the USA for people aged > 65 years.

OSCAR Online Survey, Certification and Reporting (United States database containing survey information on state inspections of nursing homes).

PsycINFO Psychological Abstracts database.

Telehealth The provision of health care remotely by means of telecommunications technology.

Telemedicine The remote diagnosis and treatment of patients by means of telecommunications technology.

List of abbreviations

ADL	activities of daily living
APN	advanced practice nurse
ASCOT	Adult Social Care Outcomes Toolkit
ASSIA	Applied Social Sciences Index and Abstracts
CARE	Combined Assessment of Residential Environments
CENTRAL	Cochrane Central Register of Controlled Trials
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CNA	certified nursing assistant
DARE	Database of Abstracts of Reviews of Effects
DCM	dementia care mapping
GDS-12R	Geriatric Depression Scale – Residential
INTERACT	Interventions to Reduce Acute Care Transfers
IT	information technology
LPN	licensed practical nurse
LVN	licensed vocational nurse
MDCS	minimum direct care staffing
MDS	minimum data set
MeSH	medical subject heading
MMRI-R	Minimum Dataset Mortality Risk Index – Revised
NA	nursing assistant
NHS EED	NHS Economic Evaluation Database
NIHR	National Institute for Health Research
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RACF	residential aged care facility
RCT	randomised controlled trial
RN	registered nurse
ROBINS-I	Risk of Bias In Non-Randomised Studies of Interventions
SBAR	situation, background, assessment and recommendation

Plain English summary

Health and social care services are facing new and complex demands from a population that is getting older. NHS England selected six places in England (called vanguard sites) to find new ways of working to meet the needs of patients who live in care homes. This report pulls together research evidence on four topics that are important to health in care homes: the use of technology, communication and engagement between care homes and external bodies, workforce, and how any changes in care can be assessed. In each of these four areas, we describe the research evidence that is available without looking at it in detail, and then we present a review that answers a specific question, chosen by people working in the vanguard sites.

In this 12-month project, we mapped information from 761 studies, and looked at 65 studies in depth. Much of the research was from the USA, and a high proportion was of medium or low quality. Some of the key findings were as follows. Research on digital technology in care homes suggests that games that encourage activity may be helpful for physical and mental health. When we looked at how communication could be improved between care homes and the NHS, tools that provide a guide to the necessary information showed some promise. We found 65 measurement tools that had been used in care homes since the year 2000. Only six had been tested for use in UK care homes, and none scored well when we assessed quality. There are many studies on the care home workforce, but we found no strong evidence of a link between staffing levels or roles and resident health and well-being.

This report provides some support for changes that are already under way in the care home vanguard sites, and points to many gaps in research where future work is needed.

Scientific summary

Background

Flexible, integrated models of service delivery are being developed to meet the changing demands of an ageing population. To underpin the spread of innovative models of care across the NHS, summaries of the current research evidence were commissioned.

Objectives

The aim of this work was to conduct a rapid synthesis of evidence relating to enhancing health in care homes across four key areas: technology, communication and engagement, workforce and evaluation.

The objectives were to map the published literature on:

- the uses, benefits and challenges of technology in care homes
- flexible and innovative uses of the nursing and support workforce to benefit resident care
- communication and engagement between care homes, communities and health-related organisations
- approaches to evaluation of new models of care in care homes.

To conduct rapid, systematic syntheses of evidence to answer the following questions:

- Which technologies have a positive impact on resident health and well-being?
- How should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences?
- Which measurement tools have been validated for use in UK care homes?
- What is the evidence that staffing levels (i.e. ratio of registered nurses and support staff to residents or different levels of support staff) influence resident outcomes?

Setting

Care homes with and without nursing in high-income countries.

Review methods

For each of the four themes, the evidence synthesis comprised two stages: (1) a broad mapping review of published material within the theme and (2) a systematic review that addressed a specific question. The methods were tailored to each specific theme.

Literature searches

Two information scientists developed the search strategies. They combined relevant search terms with indexed keywords [such as medical subject headings (MeSH)] and text terms that appeared in the titles and/or abstracts of database records. The searches were applied to selected, specific databases for each topic, in addition to a common set of databases that included MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Science Citation Index, Cochrane Database of Systematic Reviews,

Database of Abstracts of Reviews of Effects (DARE) and the Index to Theses. Searches were restricted to studies published in English between 2000 and 2016 in high-income countries. Grey literature and unpublished studies were sought via Google™ (Mountain View, CA, USA) and websites of organisations relevant to each search. References and abstracts of journal articles and grey literature were downloaded into an EndNote X7 (Thomson Reuters, CA, USA) library and deduplication was undertaken. Two researchers screened titles and abstracts for initial inclusion. The criteria used across all four mapping reviews were inclusive. By allowing any study design or outcome, the review team were able to fully scope the available evidence base. Full papers were retrieved for all studies that met the broad criteria and were of potential relevance to the mapping review. All papers retrieved were further scrutinised to obtain a final set of papers for inclusion in the mapping review.

Mapping review: broad inclusion criteria

Technology

Any study concerning the use of novel digital technology to enhance health and well-being in care homes, encompassing novel technologies as well as established technologies that are new to the care home setting, which reported staff, resident or service outcomes and/or barriers and facilitators.

Communication and engagement

The focus of eligible studies was communication or engagement between more than one care home, or between care homes and communities or health-related organisations. Studies also needed to report one of the following outcomes:

- a measure of communication or engagement external to the care home (i.e. studies of communication between patients and/or staff only within a care home were not included)
- resident outcomes (e.g. quality of care, health and safety, clinical outcomes)
- staff outcomes (e.g. well-being, safety, satisfaction).

Evaluation

Studies including tools for measuring quality of care or aspects of patient health or quality of life, validated in a UK care home, which reported any of the following outcomes: (1) resident outcomes – health status, improvement or maintenance of functional ability, activities of daily living (ADL), falls, mortality, quality of life or well-being measures, and (2) methods of care quality assessment.

Workforce

Studies that report on new staff roles (e.g. a NHS 'in-reach' role in a care home or enhanced role for support workers in the home) or report on staffing levels in care homes. Studies were also required to report one or more of the following outcomes:

- resident outcomes – health status, improvement or maintenance of functional ability, ADL, falls, mortality, quality of life or well-being measures
- staff outcomes – well-being, satisfaction or recruitment and retention
- service use outcomes – on the use of external NHS and social care, or other, services and care home organisation or profits/commercial success
- impacts on relationships or integration between care homes and partner organisations.

Mapping review: data extraction

Information was extracted from each study into a Microsoft Excel® (Microsoft Corporation, Redmond, WA, USA) spreadsheet. These data were modified for each topic, but included citation, location (country) of study, study design, target population, name and brief details of the intervention. Mapping data extraction

was conducted by one reviewer and checked by a second reviewer. Mapping findings were tabulated in tables and reported narratively. These results were presented to the vanguard group and used to help formulate the potential review questions for each theme.

Systematic evidence syntheses

The systematic evidence syntheses were conducted according to the principles outlined in the Centre for Reviews and Dissemination's guidance (Centre for Reviews and Dissemination. *Systematic Reviews: CRD's Guidance for Undertaking Reviews in Health Care*. York: University of York; 2009) on the conduct of systematic reviews and reported following the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher D, Liberati A, Tetzlaff J, Altman DG, Prisma G. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLOS Med* 2009;**6**:e1000097). The protocols were written in accordance with the new PRISMA-P initiative and registered on PROSPERO, the international database of prospectively registered systematic reviews in health and social care.

Inclusion and exclusion criteria

After being mapped, papers were screened once more (independently by two reviewers) to identify those that met the criteria for inclusion for each systematic review. For three of the themes (communication and engagement, evaluation and workforce), additional focused searches were conducted to ensure that the material included in the review was comprehensive. Detailed inclusion criteria were developed for each systematic review.

Data extraction and quality assessment

For all reviews, data extraction was conducted by one researcher and checked by a second researcher for accuracy, with any discrepancies resolved by discussion or by consultation with a third researcher when necessary. A standardised data extraction form for each review was developed, piloted on an initial sample of papers and refined as necessary. Data extracted included study citation, country of origin, design, sample size, sample characteristics, description of the intervention and control comparator conditions, outcomes and outcome measures used, and findings. All data extraction was undertaken in Microsoft Excel. Quality assessment was undertaken alongside the data extraction. The quality of randomised controlled trials was assessed using the Cochrane Risk of Bias tool. All non-randomised controlled trials (observational studies) were assessed using the ROBINS-I (Risk of Bias In Non-Randomised Studies – of Interventions) tool.

Data synthesis

Data from the individual studies were tabulated and discussed in a narrative overview. Owing to the nature of the available evidence, a quantitative analysis of the results, including a meta-analysis, was not appropriate. There was extensive heterogeneity in study design, settings and outcome measures across the included studies.

Findings

In total, 761 studies were mapped, and 65 were included in the four systematic evidence syntheses. Overall, this work identified a paucity of large, high-quality research studies, particularly from the UK.

Digital technology

Digital technology has multiple potential applications in care homes, and researchers have investigated a range of interventions using experimental study designs. However, a majority of studies are pilot or feasibility trials, of insufficient size to detect clinically significant outcomes. Cost, ease of use and staff demands are frequently identified as both barriers to and facilitators of the implementation and use of technology. There is limited evidence that games that promote activity, and robotic interventions, may

have some benefits for residents' mental well-being. However, these interventions are more likely to have been evaluated, and it is not clear that they are superior to non-technological solutions. Digital records, monitoring technologies and telehealth may also have positive impacts, but the evidence base does not allow firm conclusions to be drawn.

Communication and engagement

The evidence base for communication interventions was weak. However, the use of standardised data collection forms appears to promote the transfer of vital information for residents who are referred to hospital. The studies reviewed provided no data on the impact of transfer forms on patient outcomes. Tools to structure communication, such as the Situation, Background, Assessment, Recommendation (SBAR) approach, have been evaluated outside the UK and appear to have the potential to enhance clinical outcomes for care home residents. Complex interventions to improve communication may also improve resident clinical outcomes and reduce hospital transfers, but the evidence is limited. There was, as anticipated, a paucity of research into how care homes engage with their local communities.

Evaluation

There are many measurement tools that have been used in care homes and described in the English-language literature. Only six of the recently used tools had undergone any validation in a UK setting. This does not mean that other tools are not useful, but if they are introduced into routine use, some work will be needed to explore their measurement properties and to ensure that they are appropriate for this context. The two general measures of care outcomes that had undergone some validation for use in UK care homes have different origins. We found no data that enabled us to recommend one over the other. None of the included tools scored highly in our assessment of methodological quality.

Workforce

The literature relevant to care home staffing is extensive, but much of it has limited relevance to the UK context. Initiatives in flexible deployment of staff or new roles were difficult to identify in the published literature. However, interventions that promote joint working within and beyond the care home, multidisciplinary teams, primary nursing and a focus on specific care tasks all appear to have merit. There is no strong evidence of a relationship between the number of staff, staff-to-resident ratios, staff skill mix or nursing care models and any resident outcomes. There is limited evidence to suggest that the number of staff without nursing qualifications may influence residents' quality of life.

Recommendations for research

Technology

1. There is a general need for appropriately powered experimental studies in this area, and to address the paucity of economic evaluations.
2. Greater focus on interventions with practical applications to health care, such as the use of digital records and telehealth interventions, is needed. Their use and benefits could be addressed with mixed-methods and quasi-experimental designs.
3. The burden of new interventions on care home staff is another important topic for future research. In addition, the impact of technology on families appears to have been neglected in this research area, and this should be rectified in future studies.
4. Joint working between care homes, researchers and the manufacturers of new technologies may be helpful to generate robust evidence of effectiveness from multiple sites.
5. Resident and family participation is essential in future research on the need for, and the design and implementation of, technological interventions.

Communication and engagement

1. Formal evaluation in a UK setting of the use of transfer forms and tools such as SBAR would be valuable either before or as they are introduced across the NHS.
2. If the complex, multifaceted interventions that have been used in US settings are introduced into the UK, they require multimethod, long-term evaluation to produce evidence that would support wider implementation.
3. Investigation is needed into the most effective and appropriate ways for care homes to engage with local communities, and the long-term impact on residents and the public perception of care homes. This is an area that would benefit from ethnographic and other qualitative approaches.

Evaluation

1. Care home commissioners and providers would benefit from an easy to administer, robust measure of care outcomes. The two general measures of care outcomes that we discussed, the Combined Assessment of Residential Environments profiles and the Adult Social Care Outcomes Toolkit, have had some validation for UK use. However, our assessment of methodological quality suggests that publication of further validation work would be helpful to promote their use.
2. The burden on residents, staff and care homes, the training needed and the costs involved in administering and analysing data from outcome measures all merit closer scrutiny before the measures are implemented across the NHS.
3. There are many measurement tools being developed elsewhere, and our mapping review provides some evaluative work to select candidate tools for testing in the UK.

Workforce

1. The evidence base on the care home workforce needs to be supplemented with robust, large-scale research that is specific to the UK. Future work could usefully consider the experiences and perceptions of staff and residents, and the qualities and values that would promote high-quality care.
2. Further measurement or analysis of the number of staff and a search for associations with resident outcomes cannot be justified. An examination of the impact of staffing practices on staff outcomes, particularly health, may be informative.

Study registration

This study is registered as PROSPERO CRD42016052933, CRD42016052933, CRD42016052937 and CRD42016052938.

Funding

Funding for this study was provided by the Health Services and Delivery Research programme of the National Institute for Health Research.

Chapter 1 Background

NHS England's 'vanguard programme' has been leading on innovating and integrating services to meet the changing needs of local populations. Four categories of vanguard site were defined: integrated primary and acute care systems, multispecialty community providers, urgent and emergency care systems, and care for older people living in care homes. This evidence synthesis aims to provide empirical underpinning for the innovation that is already under way in the six vanguard care home sites. It will also contribute to the evolution and refinement of new care models as they are developed, evaluated and disseminated across the NHS and social care.

The mixed economy in the care home sector poses unique challenges to the integration of services. The funding of care homes, resident care and in-reach services is a mix of public and private. The majority of care homes are commercial bodies that must work across organisational and disciplinary boundaries, and liaise with state-funded health and social care services, independent professionals, social enterprises and charities.[1] Residents of care homes have increasingly complex health-care needs. Levels of multimorbidity, frailty and disability are rising as the care home population ages.[2] Across the care home sector, recruiting and retaining the nursing and support workforce and high staff turnover are ongoing challenges. Technology offers many potential benefits to care and communication, but the availability and uptake of this are variable. Over recent years, a consensus has emerged that services for care home residents need to improve in a range of ways. These include better access to co-ordinated and multidisciplinary care, partnership working,[3] enhanced dignity and privacy, and staffing levels matched to the needs of residents.[3,4] The vanguard programme is part of the policy response to these identified needs. It aims to develop and evaluate new models of care, with a renewed emphasis on prevention, active rehabilitation and health promotion in care homes. This is expected to enhance well-being while also reducing resource use.[5]

This report presents the findings from a rapid synthesis of the evidence on enhancing health in care homes through the organisation, delivery and quality of services to care home residents. The six vanguard care home sites are, and have been, developing locally appropriate services that have potential for national replicability, adaption and spread. To maximise the benefit to the wider NHS from the investment in this programme, it is important that innovation is followed by dissemination, and underpinned, when possible, by existing evidence. A review now is timely to ensure that any changes that are spread across the NHS are grounded in evidence-based good practice. Gaps in our knowledge also need to be identified for ongoing evaluation and research. Vanguard sites are being encouraged to learn from international experience. Our review will provide an objective, critical synthesis of relevant findings from other countries that aims to help vanguard sites and others to consider novel ways of working and radical change to enhance care.

Our work is focused around four inter-related issues: technology, communication and engagement, workforce and evaluation. These are key enablers of care home vanguard success, as identified in early guidance for vanguard sites.[6] They are also expected to be enduring issues with relevance to other settings. By considering some of the issues pertinent to developing and evaluating new models of care in and with the care home sector, this work aims to inform the ongoing work of the vanguard programme to meet the challenges of commissioning and delivering care across a range of providers.

The term 'care home' is used in this report to describe residential care for older adults in facilities with registered nurses (RNs) on site (nursing homes) and those without (residential care). Under this umbrella term, we have considered research on similar settings in high-income countries.

Chapter 2 Aims and objectives

The aim of this review was to identify and synthesise evidence underpinning new models of care to enhance health in care homes. The focus was in four key areas: technology, communication and engagement, workforce and evaluation.

Objectives

Our objectives were to:

- identify the potential uses, benefits and challenges of technology in care homes and for enhancing communication between care homes and partner organisations (what is the impact of technology, who benefits and how?)
- identify flexible uses of the nursing and support workforce, and innovative ways of working and retaining staff to benefit resident care
- identify and critically describe the key characteristics and benefits of effective communication and engagement between care homes, communities and other health-related organisations, including barriers to and facilitators of the initiation and maintenance of successful relationships
- summarise existing evidence on approaches to the evaluation of new models of care in care homes, including an assessment of the quality of care received by residents.

Specification of questions for rapid systematic reviews

We worked with the vanguard sites to ensure that we specified questions for review that were relevant to commissioners, providers and front-line staff. After completing the mapping reviews, we identified a range of potential questions for each of the four themes (technology, communication and engagement, workforce and evaluation) that could be answered by a focused evidence synthesis. An interactive workshop with representatives of the vanguard sites and NHS England was held to prioritise single questions for each theme. The potential questions are shown in *Appendix 1*. The selected questions are as follows:

- Technology – which technologies have a positive impact on resident health and well-being?
- Communication and engagement – how should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences?
- Evaluation – which measurement tools have been validated for use in UK care homes?
- Workforce – what is the evidence that staffing levels (i.e. ratio of RNs and support staff to residents or different levels of support staff) influence resident outcomes?

Chapter 3 Methods: overview

For each of the four themes, the evidence synthesis comprised two stages: (1) a broad mapping review of published material within the theme and (2) a systematic review that addressed a specific question. The general methods for each are described in this chapter, including details of the how the methods were tailored to each specific theme.

Literature searches

Two information scientists developed the search strategies. They combined relevant search terms with indexed keywords [such as medical subject headings (MeSH)] and text terms that appeared in the titles and/or abstracts of database records. The searches were applied to selected, specific databases for each topic, in addition to a common set of databases that included MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Science Citation Index, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE) and the Index to Theses. Searches were restricted to studies published in English between 2000 and 2016 in high-income countries (see *Appendix 2*). Grey literature and unpublished studies were sought via Google™ (Mountain View, CA. USA) and websites of organisations relevant to each search.

Technology searches also included PsycINFO, the Association of Computing Machinery's Digital Library and IEEE *Xplore*® Digital Library, alongside the following grey literature resources: ProQuest Dissertations & Theses, NHS Evidence, Health Management Information Consortium, The King's Fund, Nuffield Trust, Health Foundation, Social Care Institute for Excellence, National Institute for Health and Care Excellence, and Archiv.org.

Communication and engagement searches included PsycINFO, Cochrane Central Register of Controlled Trials (CENTRAL), Health Technology Assessment, NHS Economic Evaluation Database (NHS EED) and Applied Social Sciences Index and Abstracts (ASSIA). Grey literature searches were not undertaken.

Workforce searches included Arts and Humanities Citation Index and ASSIA. In addition, grey literature sources included Google, GreyLit.org, Theses Canada, Open Grey, ProQuest Dissertations & Theses, Care Quality Commission, Age UK, Alzheimer's Society, Nuffield Trust, Carers UK, Abbeyfield, The King's Fund, National Institute for Health Research School for Social Care, Personal Social Services Research Unit, Royal College of Nursing, Vanguards and the Joseph Rowntree Foundation.

Evaluation searches included Cochrane Database of Methods Studies, CENTRAL, Health Technology Assessment, NHS EED and PsycINFO. Grey literature sources included Google, Joseph Rowntree Foundation, Kellogg, The King's Fund, Nuffield Trust, ProQuest, RAND Corporation, Robert Wood Johnson Foundation and Social Care Online.

References and abstracts of journal articles and grey literature were downloaded into an EndNote X7 (Thomson Reuters, CA, USA) library and deduplication was undertaken. Two researchers screened titles and abstracts for initial inclusion. Initial screening was undertaken in EndNote or Rayyan (Mourad Ouzzani, Hossam Hammady, Zbys Fedorowicz, and Ahmed Elmagarmid. Rayyan – a web and mobile app for systematic reviews. *Systematic Reviews* 2016;**5**:210); the latter is a web application for title and abstract screening for systematic reviews.[7] The criteria used across all four mapping reviews were inclusive. By allowing any study design or outcome, the review team were able to fully scope the available evidence base. Full papers were retrieved for all studies that met the broad criteria and were of potential relevance to the mapping review. All papers retrieved were further scrutinised to obtain a final set of papers for inclusion in the mapping review.

Mapping review: broad inclusion criteria

Technology

Any study concerning the use of novel digital technology to enhance health and well-being in care homes, encompassing novel technologies as well as established technologies that are new to the care home setting, which reported staff, resident or service outcomes and/or barriers and facilitators.

Communication and engagement

The focus of eligible studies was communication or engagement between more than one care home, or between care homes and communities or health-related organisations. Studies also needed to report one of the following outcomes:

- a measure of communication or engagement external to the care home (i.e. studies of communication between patients and/or staff only within a care home were not included)
- resident outcomes (e.g. quality of care, health and safety, clinical outcomes)
- staff outcomes (e.g. well-being, safety, satisfaction).

Workforce

Studies that report on new staff roles (e.g. a NHS 'in-reach' role in a care home or an enhanced role for support workers in the home) or report on staffing levels in care homes. Studies were also required to report one or more of the following outcomes:

- resident outcomes – health status, improvement or maintenance of functional ability, activities of daily living (ADL), falls, mortality, quality of life or well-being measures
- staff outcomes – well-being, satisfaction or recruitment and retention
- service use outcomes – on use of external NHS and social care, or other, services and care home organisation or profits/commercial success
- impacts on relationships or integration between care homes and partner organisations.

Evaluation

Studies including tools for measuring quality of care, or aspects of patient health or quality of life, validated in a UK care home, that reported any of the following outcomes: (1) resident outcomes (health status, improvement or maintenance of functional ability, ADL, falls, mortality, quality of life or well-being measures) and (2) methods of care quality assessment.

Mapping review: data extraction

Information was extracted from each study into a Microsoft Excel® (Microsoft Corporation, Redmond, WA, USA) spreadsheet. The data included citation, location (country) of study, study design, target population, name and brief details of the intervention. Mapping data extraction was conducted by one reviewer and checked by a second reviewer.

Data extraction: technology mapping

Data were also extracted on the presence of an assessment of the costs of, barriers to, and facilitators of, the implementation and acceptability of the technologies. For each of the mapped studies, the interventions were listed, and descriptive categories were developed from this list: digital records, telehealth, surveillance and monitoring, robots, communication (excluding telemedicine or telehealth interventions), education and gaming. An eighth category (technologies) was used for the heterogeneous mix of studies that did not fall into any of the preceding seven categories.

Data extraction: communication and engagement mapping

Data were also extracted on target population (whether in the care home or communication partner) and setting of communication partner (e.g. another care home or a hospital emergency department), and outcomes were separated according to whether they related to communication or engagement, care home residents, staff or organisation.

Data extraction: workforce mapping

Outcomes were classified as relating to staff, residents or services.

Data extraction: evaluation mapping

Additional data extracted included sample size, sample characteristics, description of the intervention and control comparator conditions, outcomes and outcome measures used, and results.

Mapping review: synthesis

Mapping findings were tabulated in tables and narratively. These results were presented to the vanguard group and used to help formulate potential review questions for each theme. A range of potential questions for each of the four themes (technology, communication and engagement, workforce and evaluation) were derived that could be answered with a focused evidence synthesis. An interactive workshop with representatives of the vanguard sites and NHS England was held to prioritise single questions for each theme.

Systematic review questions

1. Technology: which technologies have a positive impact on resident health and well-being?
2. Communication and engagement: how should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences?
3. Evaluation: which measurement tools have been validated for use in UK care homes?
4. Workforce: what is the evidence that staffing levels (i.e. ratio of RNs and support staff to residents or different levels of support staff) influence resident outcomes?

The systematic reviews were conducted according to the principles outlined in Centre for Reviews and Dissemination's guidance on the conduct of systematic reviews[8] and reported following the guidance of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[9] The protocols were written in accordance with the new PRISMA-P initiative[10] and registered on PROSPERO, the international database of prospectively registered systematic reviews in health and social care (www.crd.york.ac.uk/prospero/).

Inclusion and exclusion criteria

After being mapped, papers were screened once more (independently by two reviewers) to identify those that met the criteria for inclusion for each systematic review. For three of the themes (communication and engagement, evaluation and workforce), additional focused searches were conducted to ensure that the material included in the review was comprehensive.

The inclusion criteria for each systematic review are now outlined.

Technology review

Types of participants
Studies had to be focused on care homes, nursing homes or residential aged care facilities.

Intervention
The intervention of interest was equipment or methods that incorporate digital technology (any electrical device that can store, generate and transfer data) to enhance health and well-being in care homes, encompassing novel technologies as well as established technologies that are new to the care home setting.

Outcomes
The relevant outcome was care home residents' health, functional ability or well-being.

Study design
Relevant study designs included randomised controlled trials (RCTs) (including parallel-group trials, cluster randomised trials and crossover trials) and non-randomised controlled studies.

Communication and engagement review

Types of participants
Studies had to be focused on care homes, nursing homes or residential aged care facilities; the communication partner could be a hospital, another health-related organisation or a community health partner.

Intervention
The intervention of interest was some form of tool that improved communication or an explicit statement that that the study was focusing on communication between care homes and other health-related organisations. Studies were excluded if the focus of communication was not relevant to the UK (e.g. US Medicaid or Medicare processes).

Outcomes
Communication or engagement outcomes, for example staff views on communication, resident outcomes (health/well-being, safety and quality of care) and/or staff outcomes (well-being, safety and satisfaction).

Study design
Randomised controlled trials, cluster RCTs, quasi-experimental studies, interrupted time series and pre- and post-intervention studies.

Workforce review

Types of participants
The populations of interest were staff and residents from a care home setting. The term 'staff' included people paid a salary or wage (not volunteers) within any of the following categories: (1) people employed directly by care homes, (2) staff employed by the NHS, excluding pharmacist interventions, (3) staff of local authority social services and (4) staff of private providers. Relevant staff employed by care homes included (1) registered or licensed nurses; (2) personnel providing personal care and support with ADL and instrumental ADL who are not registered or licensed nurses – job titles may include care assistant, nursing assistant (NA), auxiliary and social care worker; (3) care home managers; and (4) personnel who provide and/or direct activities in the home.

Intervention
The intervention of interest was staffing levels, which was defined as the ratio of RNs and support staff to residents or different levels of support staff, and the role mix of staff within nursing homes.

Outcomes
Relevant resident outcomes were one or more of the following: health status, quality of life or well-being measures, improvement or maintenance of functional ability (e.g. ADL), adverse events (e.g. falls), health service utilisation and mortality. Relevant staff outcomes were measures of health, well-being, satisfaction or recruitment/retention/turnover.

Study design
Relevant study designs were systematic reviews, RCTs, non-randomised trials, primary and secondary cohort/panel studies and cross-sectional studies.

Evaluation review

Types of participants
The population of interest was residents, families, carers or staff from a care home setting.

Intervention
The intervention of interest included approaches to the evaluation of new models of care in care homes, and approaches to the assessment of the quality of care received by care home residents.

Outcomes
Relevant outcomes were (1) resident outcomes (health status, improvement or maintenance of functional ability, ADL, falls, mortality, quality of life or well-being measures) and (2) methods of care quality assessment.

Study design
All comparative studies were considered eligible.

Data extraction and quality assessment

For all reviews, data extraction was conducted by one researcher and checked by a second researcher for accuracy, with any discrepancies resolved by discussion or consultation with a third researcher when necessary. A standardised data extraction form for each review was developed, piloted on an initial sample of papers and refined as necessary. Data extracted included study citation, country of origin, design, sample size, sample characteristics, description of the intervention and control comparator conditions, outcomes and outcome measures used, and findings. All data extraction was undertaken in Microsoft Excel.

Quality assessment was undertaken alongside the data extraction. The quality of RCTs was assessed using the Cochrane Risk of Bias tool, which focuses on the domains shown to have an impact on the trial results in particular (selection, performance and detection biases and attrition).[11] All and non-RCTs (observational studies) were assessed using the ROBINS-I (Risk of Bias In Non-Randomised Studies – of Interventions) tool, which also focuses on the bias domains likely to have an impact on results (selection, measurement, performance, attrition, detection and outcome).[12] Both tools focus on the internal validity of a study. Discrepancies between reviewers' ratings were resolved through discussion. For some interventions considered, the blinding of participants would have been impractical and the blinding of assessors would have been challenging. For this reason, ratings of the measurement of outcome data were considered to be less important. Most of the studies were given a low quality score in this domain. To summarise the ratings from the ROBINS-I, each domain was judged to exhibit low, moderate, serious or critical risk of bias. Low risk of bias indicates that the study is comparable with a well-performed randomised trial in the domain being evaluated. Moderate risk of bias indicates that the study is sound for a non-randomised study but not comparable with a rigorous randomised trial. Serious risk of bias indicates the presence of important problems, and critical risk of bias indicates that the study is too problematic to provide any useful evidence on the effects of intervention. If insufficient information is provided to determine the risk of bias of a certain domain, the domain is marked as having no information.

Data synthesis

Data from the individual studies were tabulated and discussed in a narrative overview. Owing to the nature of the available evidence, a quantitative analysis of the results, including a meta-analysis, was not appropriate. There was extensive heterogeneity in study design, settings and outcome measures across the included studies.

Chapter 4 Mapping and rapid evidence syntheses

In the following sections, the findings are presented from four mapping reviews and four rapid, systematic evidence syntheses. The mapping reviews are broad-ranging and intended to provide a flexible and interactive resource. In this report, the data are tabulated for information. For dissemination purposes, they will be made available in a colourful, diagrammatic and interactive format.

Section 1: digital technology interventions and care home residents' health, well-being and functional status

Background

Digital technology is expected to play an increasingly important role in enhancing the health, well-being and safety of care home residents. The list of potential applications of technology in this setting is long, and includes remote monitoring, communication between care homes and external agencies and families, medicines optimisation, assistive technologies and the promotion of physical and social activity.[13] Recent developments have focused in particular on the introduction of platforms that link electronic health and care data records,[14,15] tools for remote consultation and diagnosis, sensor-based technologies that monitor movement and physical activity[16,17] and social robots that act as companions or serve to support ADL.[18]

Research in this field has accumulated rapidly over the last 10 years, but a clear message on the most acceptable, effective and cost-effective choices for care home residents, providers and commissioners has yet to emerge. Previous evidence syntheses have examined the effectiveness of individual technologies (e.g. robotic pets, sensors and telehealth), specific outcomes (e.g. wandering, falls)[19–22] and the implementation of complex infrastructure information technology (IT) systems. Telemedicine in long-term care has been used to enable a range of medical specialists to provide advice in care homes.[21,23] Existing reviews of the evidence suggest that this is a feasible approach, but this work is dominated by qualitative and descriptive studies of service utilisation and staff satisfaction. Similarly, a review of the use of gaming technologies in long-term care settings points to positive effects on physical and social activity and a potential role in rehabilitation, but the six included studies were mainly descriptive or small.[24] Wearable or environmental sensors have multiple potential uses in residential care: they detect movement by pressure, position and infrared light, and can alert staff that a resident has risen from a chair or got out of bed and may be at risk of falling. A recent systematic review of the effectiveness of sensors in geriatric institutions described a high rate of false alarms and inconsistent findings, and only 1 of the 12 included studies was conducted in a care home.[20] Robots in older adult care have also attracted a great deal of attention from researchers and practitioners. They can be divided into two groups: rehabilitative robots that are designed to support physical assistive technology and are not interactive (e.g. smart wheelchairs and artificial limbs) and assistive robots that either support ADL or have a companion function. Research generally reports positive findings for the impact of robots on older people's well-being. Kachouie's review of social assistive robots[25] also suggested that these may have potential to reduce nurses' workload. However, this work identified limitations common to many existing studies, including a failure to consider cultural and linguistic sensitivities or to elicit participants' expectations or perceptions, a gender bias among research participants (the majority are older women), little work with residents' families, and methodological concerns about study design, conduct and reporting.[25]

Previous research has provided useful insights, but important gaps remain in our understanding of the value, impact and best use of digital technology in care homes. Care home organisations are interested in the potential of technology to enhance quality of life, boost social interaction and enhance resident safety. Policy-makers and commissioners may also wish to advocate for the use of technology to increase efficiency and reduce demands on health services. All are faced with a disparate body of evidence from a wide range of sources, some of which is relevant to long-term care. Previous reviews of the evidence have synthesised research from across different care settings and have included qualitative, non-experimental

and small-scale studies that provide useful information on the acceptability of and satisfaction with technological interventions, but are an uncertain basis for resource allocation decisions. Care homes and their residents are unique in many ways, and it cannot be assumed that an intervention that is suitable for the community can be readily transferred to a care home. To our knowledge, no review has focused exclusively on technological interventions in care homes.

The aim of this work was to (1) map the existing evidence on the use and outcomes of digital technology interventions in care homes, describe the body of work, and identify gaps in our understanding and areas where evidence is strong; and (2) conduct a focused systematic review on the impact of digital technology interventions on the health, well-being and functional status of care home residents.

Methods

See *Chapter 3* for details of methods.

Findings of mapping review

Which technologies have a positive impact on resident health and well-being?

Number and characteristics of studies

After deduplication, 6240 studies were identified for title and abstract screening, and 338 were identified for full-text screening. In total, 281 articles were included in the mapping review, listed in *Table 1*. Basic data on all of the studies in this mapping review are presented in *Report Supplementary Material 1, Table 1*.

TABLE 1 Technology mapping review: included studies

First author	Year of publication	Review
Abdelrahman[26]	2015	Technology
Age UK[27]	2013	Technology
Age UK[28]	2010	Technology
Age UK[29]	2012	Technology
Alexander[30]	2009	Technology
Alexander[31]	2015	Technology
Alexander[32]	2016	Technology
Aloulou[33]	2013	Technology
Alzheimer's Society[34]	2011	Technology
Alzheimer's Society[35]	2015	Technology
Anonymous[36]	2009	Technology
Anonymous[37]	2011	Technology
Anonymous[38]	2010	Technology
Anonymous[39]	2008	Technology
Anonymous[40]	2009	Technology
Anonymous[41]	2013	Technology
Babalola[42]	2014	Technology
Bäck[43]	2013	Technology
Bäck[44]	2012	Technology

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Baker[45]	2015	Technology
Bakerjian[46]	2009	Technology
Banks[47]	2008	Technology
Banks[48]	2013	Technology
Barbour[49]	2016	Technology
Baril[50]	2014	Technology
Baril[51]	2014	Technology
Barrett[52]	2009	Technology
Bartle[53]	2017	Technology
Beeckman[54]	2013	Technology
Beedholm[55]	2016	Technology
Bemelmans[19]	2012	Technology
Bemelmans[56]	2015	Technology
Bemelmans[57]	2016	Technology
Bennett[58]	2015	Technology
Bennett[59]	2016	Technology
Bereznicki[60]	2014	Technology
Bezboruah[61]	2014	Technology
Biglan[62]	2011	Technology
Biglan[63]	2009	Technology
Blair Irvine[64]	2012	Technology
Bobillier Chaumon[65]	2014	Technology
Bollen[66]	2005	Technology
Bond[67]	2000	Technology
Bowen[68]	2013	Technology
Brandt[69]	2011	Technology
Brankline[70]	2009	Technology
Bratan[71]	2004	Technology
Braun[72]	2014	Technology
Broadbent[73]	2016	Technology
Broder[74]	2015	Technology
Brown[75]	2000	Technology
Bruun-Pedersen[76]	2015	Technology
Burdea[77]	2015	Technology
Burns[78]	2007	Technology
Bygholm[79]	2014	Technology
Campbell[80]	2011	Technology

continued

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Campbell[81]	2017	Technology
Castle[82]	2009	Technology
Centre for Workforce Intelligence[83]	2013	Technology
Chae[84]	2001	Technology
Chan[85]	2000	Technology
Chan[86]	2001	Technology
Chang[87]	2013	Technology
Chang[88]	2014	Technology
Chang[89]	2015	Technology
Chen[90]	2012	Technology
Cherry[91]	2011	Technology
Chesler[92]	2015	Technology
Clark[93]	2009	Technology
Cobb[94]	2007	Technology
Courtney[95]	2006	Technology
Centre for Policy on Ageing[96]	2014	Technology
Curyto[97]	2002	Technology
Daly[98]	2005	Technology
Damant[99]	2015	Technology
De Luca[100]	2016	Technology
De Luca[101]	2016	Technology
de Veer[102]	2011	Technology
Degenholtz[103]	2008	Technology
Degenholtz[104]	2010	Technology
Degenholtz[105]	2011	Technology
Degenholtz[106]	2016	Technology
Demiris[107]	2008	Technology
Demiris[108]	2013	Technology
Dewsbury[109]	2012	Technology
Dorsten[110]	2009	Technology
Doshi-Velez[111]	2012	Technology
Driessen[112]	2016	Technology
Eccles[113]	2012	Technology
Edirippulige[23]	2013	Technology
Elliott[114]	2016	Technology
Eyers[115]	2013	Technology
Field[116]	2008	Technology
Filipova[117]	2015	Technology

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Fossum[118]	2011	Technology
Fossum[119]	2012	Technology
Fournier[120]	2004	Technology
Freedman[121]	2005	Technology
Fu[122]	2015	Technology
Gaver[123]	2011	Technology
Gerling[124]	2012	Technology
Gerling[125]	2015	Technology
Ghorbel[126]	2013	Technology
Gietzelt[127]	2014	Technology
Grabowski[128]	2014	Technology
Grant[129]	2014	Technology
Guilfoyle[130]	2003	Technology
Guilfoyle[131]	2002	Technology
Hamada[132]	2008	Technology
Handler[133]	2013	Technology
Hardy[134]	2016	Technology
Harrington[135]	2003	Technology
Hensel[136]	2006	Technology
Hensel[137]	2007	Technology
Hensel[138]	2009	Technology
Hex[139]	2015	Technology
Hitt[140]	2016	Technology
Hobday[141]	2010	Technology
Hoey[142]	2010	Technology
Hofmeyer[143]	2016	Technology
Hori[144]	2004	Technology
Hori[145]	2006	Technology
Hoti[146]	2012	Technology
Hsu[147]	2011	Technology
Hui[148]	2001	Technology
Hui[149]	2002	Technology
Hung[150]	2007	Technology
Hustey[151]	2009	Technology
Hustey[152]	2010	Technology
Hustey[153]	2012	Technology
Iio[154]	2014	Technology

continued

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Irvine[155]	2012	Technology
Irvine[156]	2012	Technology
Jiang[157]	2014	Technology
Johansson-Pajala[158]	2016	Technology
Johnston[159]	2001	Technology
Jøranson[160]	2015	Technology
Jøranson[161]	2015	Technology
Jøranson[162]	2016	Technology
Jung[163]	2009	Technology
Kachouie[25]	2014	Technology
Kanstrup[164]	2015	Technology
Kapadia[165]	2015	Technology
Keogh[166]	2014	Technology
Khosla[167]	2012	Technology
Khosla[168]	2013	Technology
Kidd[169]	2006	Technology
Kidd[21]	2010	Technology
Knapp[170]	2015	Technology
Kong[171]	2012	Technology
Kosse[20]	2013	Technology
Lai[172]	2015	Technology
Lattanzio[173]	2014	Technology
Lawrence[174]	2010	Technology
Lesnoff-Caravaglia[175]	2005	Technology
Libin[176]	2004	Technology
Lin[177]	2014	Technology
Little[178]	2016	Technology
Loh[179]	2009	Technology
Loveday[16]	2016	Technology
Low[180]	2013	Technology
Lyketsos[181]	2001	Technology
MacDonald[182]	2005	Technology
Maiden[183]	2013	Technology
Mansdorf[184]	2009	Technology
Mariño[185]	2016	Technology
Marston[24]	2013	Technology
Martin-Khan[186]	2012	Technology
McDonald[187]	2012	Technology

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
McGibbon[188]	2013	Technology
McNeil[189]	2013	Technology
Meador[190]	2009	Technology
Meißner[191]	2014	Technology
Michel-Verkerke[192]	2012	Technology
Mickus[193]	2002	Technology
Millington[194]	2015	Technology
Miskelly[195]	2004	Technology
Mitzner[196]	2014	Technology
Morley[197]	2012	Technology
Morley[198]	2016	Technology
Morrissey[199]	2015	Technology
Moyle[200]	2013	Technology
Moyle[201]	2013	Technology
Moyle[202]	2015	Technology
Moyle[203]	2017	Technology
Munyisia[204]	2012	Technology
Munyisia[205]	2011	Technology
Munyisia[206]	2013	Technology
Murphy[207]	2005	Technology
My Home Life[208]	2012	Technology
Naganuma[209]	2015	Technology
Nagayama[210]	2016	Technology
Nakai[211]	2000	Technology
Namazi[212]	2003	Technology
Niemeijer[213]	2011	Technology
Niemeijer[214]	2014	Technology
Niemeijer[215]	2015	Technology
Novek[216]	2000	Technology
Oliver[217]	2006	Technology
Oliver[218]	2010	Technology
Pallawala[219]	2001	Technology
Park[220]	2012	Technology
Pillemer[221]	2009	Technology
Pillemer[222]	2012	Technology
Potts[223]	2011	Technology
Qadri[224]	2009	Technology

continued

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Qian[225]	2015	Technology
Rabinowitz[226]	2010	Technology
Rantz[227]	2010	Technology
Rantz[228]	2013	Technology
Rantz[229]	2015	Technology
Rantz[230]	2017	Technology
Ratliff[231]	2005	Technology
Remington[232]	2015	Technology
Richardson[233]	2014	Technology
Robinson[22]	2006	Technology
Robinson[234]	2007	Technology
Robinson[235]	2013	Technology
Robinson[236]	2013	Technology
Robinson[237]	2015	Technology
Robinson[238]	2016	Technology
Rochon[239]	2006	Technology
Rosen[240]	2002	Technology
Rosen[241]	2003	Technology
Rudston[242]	2013	Technology
Russell[243]	2015	Technology
Šabanović[244]	2013	Technology
Sabelli[245]	2011	Technology
Sanctuary Care[246]	2016	Technology
Sävenstedt[247]	2003	Technology
Sävenstedt[248]	2004	Technology
Schneider[249]	2016	Technology
Shibata[250]	2004	Technology
Sicurella[251]	2016	Technology
Silverman[252]	2006	Technology
Smith[253]	2014	Technology
South East Health Technologies Alliance[254]	2016	Technology
Specht[255]	2001	Technology
Spiro[256]	2005	Technology
Stephens[257]	2015	Technology
Sugihara[258]	2015	Technology
Sung[259]	2015	Technology
Tabar[260]	2015	Technology
Tak[261]	2007	Technology

TABLE 1 Technology mapping review: included studies (*continued*)

First author	Year of publication	Review
Tak[262]	2008	Technology
Tak[263]	2012	Technology
Tak[264]	2013	Technology
Tang[265]	2001	Technology
Thorpe-Jamison[266]	2013	Technology
Tinder Foundation[267]	2016	Technology
Tiwari[268]	2011	Technology
Toh[269]	2015	Technology
Toh[270]	2015	Technology
Torres-Padrosa[271]	2011	Technology
Trinkle[272]	2003	Technology
Tseng[273]	2013	Technology
Van der Ploeg[274]	2016	Technology
Vandenberg[275]	2015	Technology
Vogelsmeier[276]	2007	Technology
Vowden[277]	2013	Technology
Wagner[278]	2004	Technology
Wagner[279]	2001	Technology
Wakefield[280]	2004	Technology
Walker[281]	2006	Technology
Walker[282]	2008	Technology
Wang[283]	2011	Technology
Webster[284]	2014	Technology
Weiner[285]	2002	Technology
Weiner[286]	2004	Technology
Welsh[287]	2010	Technology
Wigg[288]	2010	Technology
Yu[289]	2006	Technology
Yu[290]	2007	Technology
Yu[291]	2013	Technology
Zelickson[292]	2003	Technology
Zhang[293]	2012	Technology
Zhang[294]	2016	Technology
Zhuang[295]	2013	Technology
Zwijsen[296]	2010	Technology
Zwijsen[297]	2012	Technology

Countries

The USA was the setting for around two-fifths of the work (114 studies).[26,30–32,36,42,46–49,64,67–70,74,75,77,82,87–89,91,93–95,97,98,103–108,110–112,117,120,121,128,129,133,134,136–138,140,141,143,151–153,155,156,159,172,175,176,178,181,184,189,190,192,196–198,212,217,218,221,222,224,226–233,239–241,243,244,250,252,255,257,260–264,266,272,276,278–282,285,286] A further 94 (33%) studies were from high-income countries outside the USA and Europe.[19,23–25,33,37–41,50–52,61,62,66,73,78,81,84–86,90,92,101,114,116,122,125,130–132,142,144–150,154,157,164–168,171,174,177,179,180,182,185–187,201–205,209–211,216,219,220,225,235–238,245,249,251,253,256,258,259,265,268–270,273–275,283,289–291,293,295] A minority of studies were conducted in Europe ($n = 78$, 28%), half of these in the UK.[16,20–22,27–29,34,35,43–45,53–60,63,65,71,72,76,79,80,83,96,99,100,102,109,113,115,118,119,123,124,126,127,134,139,158,160–162,164,170,173,183,188,191,192,194,195,199,200,206–208,213–215,223,234,242,246–248,254,267,271,277,284,296,297] Most of the work was recent, with a rapid increase in the annual publication rate post 2009: approximately three-quarters of the articles were published after that date.

All of the 38 UK studies were published after 2010. They comprised 14 reviews or reports relating to technology and care homes,[21,22,27–29,35,83,96,99,170,208,234,254,267] three case studies,[80,134,246] three qualitative studies,[115,124,194] two observational studies,[16,139] one pilot RCT,[277] one protocol,[45] 12 descriptive studies[58,59,71,109,113,123,188,195,207,223,242,284] and two opinion pieces.[34,53] Telehealth and surveillance technologies were both the subject of six articles,[16,71,113,115,195,234] and single articles were identified on gaming,[125] robots,[80] digital records[134] and communication technologies.[246] The remaining 21 studies comprised a mix of topics, including general overviews of technology in long-term care, digital exclusion and assistive technologies.

Methodologies

A range of research methods had been employed, but most studies fell into the lower categories of the established hierarchies of evidence.[298] The biggest single group of studies ($n = 78$, 28%) comprised those that were descriptive or non-experimental, including case studies and small feasibility studies.[36,38,40,42,44,48,50–52,58–61,63,68,71,74–77,79,80,88–90,93–95,97,98,109,111,113,114,120,123,126,134,137,142,144,145,150,167,169,173,174,178,180,182,183,185,188,190,193,195–197,200,207,209,211,218–220,223,226,228,242,243,246,249,250,255,258,265,267,271,284,285,288,290,294] A further 16 (6%) were opinion pieces[34,46,53,189,198,217,232,239,251,256,260,278,279,286,287,292] and a small number were of narrative, non-systematic overviews of the current state of research. Qualitative methods have been extensively used to explore various aspects of technology in care homes; these were the main focus of 59 (21%) studies.[30,31,33,55,57,65,66,69,78,103,107,108,110,115,118,119,121,124,129,130,136–138,140,146,158,159,164,168,171,176,179,192,194,199,212–216,224,225,233,237,241,245,247,248,257,268,270,273,275,276,283,291,293,296,297]

Table 2 shows the breakdown of research methods by intervention topic. Qualitative and descriptive studies form the largest groups for all topics. However, for robots, gaming and education, more than one-third of the studies are experimental or quasi-experimental.

Qualitative research can provide invaluable insights into resident and staff experiences and perceptions of new uses of technology. Fifty-nine of the included articles described studies that used qualitative methods to investigate interventions in all categories.[30,31,33,55,57,65,66,69,78,103,107,108,110,115,118,119,121,124,129,130,136–138,140,146,158,159,164,168,171,176,179,192,194,199,212–216,224,225,233,237,241,245,247,248,257,268,270,273,275,276,283,291,293,296,297] Twelve explored technologies related to digital records, nine related to telehealth and surveillance technologies, seven related to robots, two related to communication technologies and two related to gaming. The remaining 18 studies covered a mix of topics.

One in 10 articles ($n = 29$, 10%) reported on observational (case control and cohort) studies, and just under one in five ($n = 53$, 19%) was an experimental or a quasi-experimental design, including before-and-after studies. Many of these were pilot studies and did not appear to be powered to detect significant differences between any intervention and control groups. Eleven systematic reviews of previous evidence were identified. Only two of these followed established guidance for producing systematic reviews.[19,22]

Interventions or topics

The mapped studies described technologies directed at care processes, resident and staff experiences and outcomes of care. More than half of all articles ($n = 145$, 51%) related to the use of technologies that were likely to directly influence experiences and processes of care (communication, telehealth, digital health records, surveillance and monitoring). Thirty-nine articles (14%) related to the use of robots that may have companion

TABLE 2 Technology mapping review: study designs and topics

Study design	Topic, *n* (%)								Total, *n*
	Digital records	Telehealth	Communications	Robots	Surveillance	Gaming	Education	Technologies	
Systematic review	2 (5)	2 (3)	0	2 (5)	2 (6)	1 (7)	0	2 (3)	11
Experimental and quasi-experimental	5 (12)	11 (18)	3 (27)	12 (31)	2 (6)	5 (36)	8 (57)	9 (16)	55
Observational	3 (7)	11 (18)	0	5 (13)	4 (13)	2 (14)	1 (7)	3 (20)	29
Cross-sectional	7 (16)	2 (3)	2 (18)	1 (3)	1 (3)	0	0	3 (20)	16
Qualitative	12 (28)	9 (15)	5 (45)	7 (18)	9 (42)	2 (14)	2 (14)	13 (19)	59
Descriptive	10 (23)	19 (32)	1 (9)	11 (28)	13 (33)	4 (28)	2 (14)	23 (52)	83
Overview and reports	0	0	0	0	0	0	0	11 (16)	11
Other	4 (9)	6 (10)	0	1 (3)	0	0	1 (7)	6 (25)	18
Total	43 (100)	60 (100)	11 (100)	39 (100)	31 (100)	14 (100)	14 (100)	70 (100)	282

or rehabilitative functions.[19,25,39,43,47,48,55–57,73,80,87–89,132,160–162,167–169,176,196,200–203,209,220,235–238,244,245,250,251,259,268] The use of technology for education or training with staff or residents' families (e.g. online training in dementia care or injury prevention) was the subject of 14 (5%) articles.[45,64,134,141,155,156,171,182,184,240,241,243,281,282]

Studies were concerned with the impact of technology on residents ($n = 106$, 38%), staff ($n = 78$, 28%) or a mix of residents and staff ($n = 95$, 34%). Only a small minority were concerned exclusively with residents' families ($n = 3$, 1%).

When outcomes were measured or discussed, these related to residents in 107 (38%) articles and to staff in 70 (25%) articles. Thirty-three (12%) articles considered the impact of technology on the use of other services, and 30 (11%) presented or discussed costs or any form of economic assessment.

Barriers to, and facilitators of, technology use in care homes

Barriers to, and facilitators of, technology use were considered in just under half ($n = 123$, 43%) of the articles. One hundred and thirteen of these described interventions in telehealth, digital records or communication, topics of particular importance and current relevance to health care in care homes. The barriers and facilitators listed in these articles were examined more closely and grouped into 10 categories. *Table 3* shows the number of articles mentioning barriers or facilitators, by category. Many of the identified barriers were also potential facilitators of the uptake and use of technology. The most frequently occurring issues were ease of use, staff attitudes and structural concerns. Cost and ease of use were most often discussed as barriers, whereas staff attitudes and work demands were more likely to be facilitators.

Table 3 shows the number of articles on communication technologies, digital records and telehealth that discuss barriers to, and facilitators of, the implementation or use of technology.

TABLE 3 Technology mapping review: barriers and facilitators

Factor	Articles, *n* (%)		
	Communication technologies ($N = 11$)	Digital records ($N = 43$)	Telehealth ($N = 60$)
Cost			
Barrier	2 (18)	3 (7)	10 (17)
Facilitator	1 (9)	2 (5)	3 (5)
Structural issues			
Barrier	4 (36)	10 (23)	11 (18)
Facilitator	0	0	0
Ease of use			
Barrier	4 (36)	8 (19)	4 (7)
Facilitator	1 (9)	10 (23)	4 (7)
Staff attitudes/motivation			
Barrier	3 (27)	8 (19)	4 (7)
Facilitator	2 (18)	12 (28)	8 (13)
Integration with existing systems			
Barrier	3 (27)	2 (5)	2 (3)
Facilitator	0	0	0
Access to training			
Barrier	4 (36)	2 (5)	3 (5)
Facilitator	1 (9)	4 (10)	2 (3)

TABLE 3 Technology mapping review: barriers and facilitators (*continued*)

Factor	Articles, *n* (%)		
	Communication technologies (*N* = 11)	Digital records (*N* = 43)	Telehealth (*N* = 60)
Reliability of technology			
Barrier	1 (9)	3 (7)	5 (8)
Facilitator	0	1 (2)	0
Legal/regulatory issues			
Barrier	1 (9)	1 (2)	1 (2)
Facilitator	0	1 (2)	0
Incentives			
Barrier	0	1 (2)	0
Facilitator	0	1 (2)	1 (2)
Work demands			
Barrier	0	5 (12)	6 (10)
Facilitator	1 (9)	11 (26)	4 (7)

Findings of systematic evidence synthesis

Twenty-three studies met the inclusion criteria for the systematic review. The PRISMA diagram for this study is shown in *Figure 1*. Ten studies were conducted in the USA,[47,169,176,210,222,227,230,299–301] two in Australia,[203,274] two in New Zealand[166,236] and one in each of Belgium,[54] Canada,[147] Italy,[101] Japan,[250] Singapore,[163] Norway,[160] Taiwan,[177] the Netherlands[56] and the UK.[277] Thirteen randomised studies were included (six individually randomised parallel group trials, two individually randomised crossover trials and five cluster randomised trials),[47,54,101,147,160,177,203,210,230,236,274,277,299] as were 11 non-randomised studies of interventions.[56,161,163,166,168,169,176,222,227,250,300,301] Details of the studies included in this systematic review are shown in *Tables 4–7*.

Study quality

Thirteen of the included studies were RCTs; the remaining 11 were non-randomised, observational studies. Full details of the validity assessment are presented in *Appendix 3*, *Table 18*. The quality of reporting was variable between studies and across criteria. Of the 13 RCTs, nine were considered overall at a high risk of bias, whereas the other four were rated overall as having some concern of bias. Risk of bias across the domains for each RCT was variable, but in general RCTs were either rated as being at high risk of bias because of the measurement of outcomes or flagged as having some concerns because of deviations from intended interventions. Although the lack of blinding of participants and/or assessors may be justifiable given the nature of the interventions, the deviations from the intended interventions support the overall risk-of-bias assessment of high or some concern. None of the RCTs was rating as being at a low overall risk of bias.

Of the 11 non-randomised studies, 10 were considered to be at serious or critical risk of bias, with one considered to be at moderate risk. The majority ($n = 10$) were considered as having serious or critical risk of bias owing to confounding and measurement outcomes. Confounding relates to when one or more prognostic factor that predicts the outcome also influences or predicts who receives the intervention. Although the lack of blinding may be justifiable given the nature of the interventions, because of issues with confounding all 10 studies remained at serious or critical risk of bias.

The quality of the studies for each of the individual interventions is summarised alongside the results. With only one non-randomised study rated as being at moderate risk of bias and four RCTs rated as having some concern of bias, the overall evidence base to support the effectiveness of individual technologies is weak.

Quality assessments are shown in *Appendix 3*, *Tables 18* and *19*.

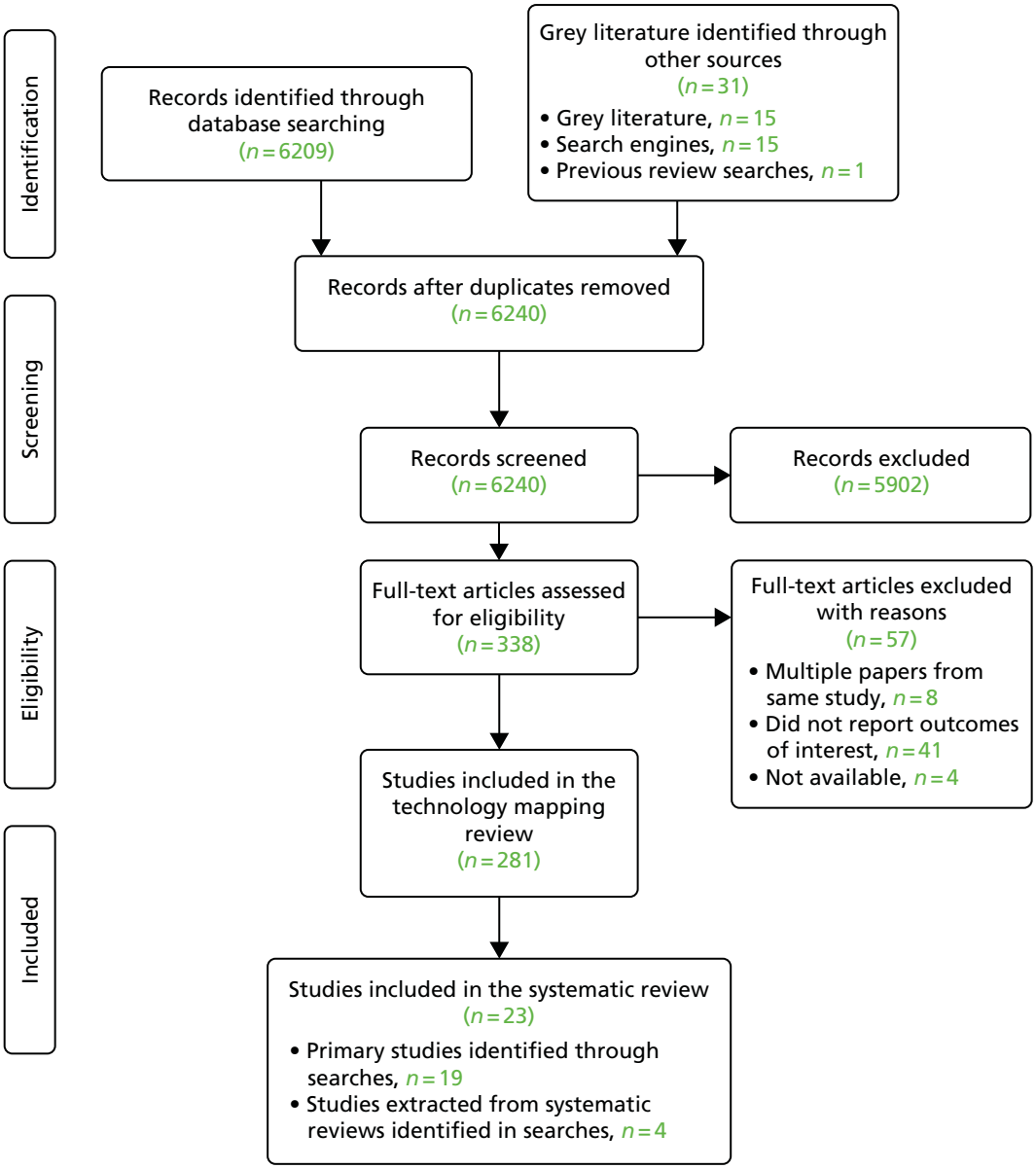

FIGURE 1 Technology PRISMA flow diagram.

Results of evidence synthesis

The findings from the 24 studies investigating associations between digital technology interventions and care home residents' health, functional ability and well-being are synthesised in the following section, grouped by outcome.

Studies investigating the effects of interventions on physical health, physical activity and functional status

Six studies assessing the effects of interventions on physical health, physical activity and functional status were included. They were conducted in Singapore, Taiwan, New Zealand, Belgium, Canada and the USA.[54,147,163,177,210,302] The Belgian study involved 144 participants; the sample size of the other five studies ranged from 34 to 45 residents.[54] Two were quasi-experimental studies, two were randomised studies (one with parallel groups and one crossover) and two were cluster randomised studies. All except one were rated as being at high or critical risk of bias.

TABLE 4 Technology systematic review: included studies investigating the effects of digital technology interventions on physical health, physical activity and functional status

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Beeckman, 2013, Belgium[54]	Cluster RCT	11 wards in four nursing homes (464 residents and 118 professionals)	Mean resident age 84.5 years, 76% female, (intervention group); mean age 84.9 years, 82.8% female (control group)	1. Clinical decision support system for pressure ulcer prevention (interactive education, reminders, monitoring feedback and leadership) implemented over 16 weeks 2. Control: ulcer prevention protocol presented to all staff in a 30-minute group lecture	Prevalence of pressure ulcers, prevention measures, knowledge and attitudes among staff	High	Residents in the intervention group were significantly more likely to receive adequate pressure ulcer prevention, but there were no differences in pressure ulcer prevalence between the groups. Professionals' knowledge was unchanged
Hsu *et al.*, 2011, Canada[147]	Crossover RCT	34 residents	Mean age 80 years; 71% female (whole sample); participants were cognitively intact, with upper extremity dysfunction	1. Standard exercise plus Nintendo® (Windsor, UK) Wii bowling video game 20 minutes per session, twice weekly 2. Control group: standard exercise Intervention was delivered for 4 weeks, and then groups were reassessed and crossed over	Scores on the following measures: a numeric rating scale of pain intensity, Physical Activity Enjoyment Scale and a six-item measure of functional capacity	High	Enjoyment of activity was significantly greater in the intervention group ($p = 0.014$); for all other outcomes similar improvements were shown in both groups
Jung *et al.*, 2009, Singapore[163]	Quasi-experimental study	45 residents	Age range 56–92 years (whole sample) (gender balance not stated)	1. Nintendo Wii sports and cooking games programme delivered over a 6-week period for 1.5 hours per session, three times per week 2. Control: traditional games	Scores on the UCLA Loneliness and Rosenberg Self-Esteem scales; Bradburn Affect Balance Scale; Physical Activity Questionnaire for Elderly Japanese	Critical	Intervention group participants scored significantly higher on affect ($p < 0.05$), self-esteem and physical activity and significantly lower on loneliness ($p < 0.01$) than those in the control group

continued

TABLE 4 Technology systematic review: included studies investigating the effects of digital technology interventions on physical health, physical activity and functional status (*continued*)

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Keogh *et al.*, 2014, New Zealand[302]	Quasi-experimental study	34 residents	Mean age 83 years; 88% female	1. Nintendo Wii sports games provided for 8 weeks 2. Control: normal ADL	Functional ability (bicep curl and Four Square Step Test), physical activity (Rapid Assessment of Physical Activity) and quality of life World Health Organization Quality of Life Questionnaire – Brief Australian version)	Critical	Significantly greater increases in functional ability, physical activity and quality of life in the intervention group ($p < 0.05$)
Lin *et al.*, 2014, Taiwan[177]	Randomised study, parallel groups	24 residents	Residents in long-term care facilities with chronic stroke. Mean age 74.6 years, 16.6% female (intervention group); mean age 75.6 years, 41.6% female (control group)	1. Balance training using a bidirectional and multiuser telerehabilitation (remote teleconferencing) system 2. Control: conventional therapy Both conditions were provided for three sessions per week for 4 weeks	Balance and satisfaction, measured using scores from the Berg Balance Scale and Barthel Index. Technology satisfaction was based on the technology acceptance model	Some concerns	Significant effect on Berg Balance Scale scores, total and self-care score of Barthel Index and basic daily activity were observed in both groups ($p < 0.05$). No significant changes in mobility were observed ($p = 0.088$), and measures of perceived usefulness and satisfaction were similar in both groups
Nagayama, 2016, USA[210]	Pilot cluster RCT	12 facilities (44 residents)	Mean age 82.1 years; 85.2% female (whole sample)	1. Occupational therapy based on occupation-based goal setting 2. Control: impairment-based approach focused on restoring capacities without goal-setting tools; both delivered for 20 minutes twice weekly for 4 months	Health status, measured using the Short Form questionnaire-36 items (SF-36) and the Short Form Questionnaire-6 Dimensions (SF-6D) utility score; quality-adjusted life-years; scores on the Barthel Index of Daily functioning and total care cost	High	The intervention group had a significantly greater improvement in Barthel scores ($p = 0.027$). No other outcome was significantly different between groups. The incremental cost-effectiveness ratio, calculated using the change in BI score, was US$63.10

ABAB, an experimental design where the baseline period (A) is followed by an intervention (B). To confirm that the intervention resulted in a change, the intervention is then withdrawn (A) and reinstated (B); UCLA, University of California, Los Angeles, CA, USA.

TABLE 5 Technology systematic review: studies investigating the effects of digital technology interventions on mental health

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Bemelmans *et al.*, 2015, the Netherlands[56]	Quasi-experimental time series study (ABAB) within-subject comparison	91 residents	Female 80.3%; residents with dementia and (1) undesirable psychological/ psychosocial unrest or mood, and (2) care providers experienced difficulties in providing ADL-related care	1. Therapeutic application: a protocol was followed using PARO robotic seal to provide comfort to distressed residents 2. Care support application: the same protocol was followed using PARO at the start of a care activity 3. Control: non-intervention time periods when normal care was provided	IPPA scores	Serious	IPPA scores and mood improved significantly following the therapeutic PARO intervention ($p < 0.01$). No effects were seen with the care support application
De Luca *et al.*, 2016, Italy[101]	Randomised study	59 residents	Mean age 79 years; 67.8% female	1. Telemonitoring with a multimodal approach (including monitoring of vital signs and neurological/psychological counselling once per week) 2. Control: standard in-home nursing care	Measures of neurobehavioral symptoms and quality of life; blood pressure and heart rate; admissions to health-care services	High	Significant reductions in Geriatric Depression Scale ($p < 0.01$), Brief Psychiatric Rating Scale ($p < 0.05$) scores, mean blood pressure, heart rate and admission to health-care services ($p < 0.05$) and improved quality of life ($p < 0.05$) between groups favouring the intervention

continued

TABLE 5 Technology systematic review: studies investigating the effects of digital technology interventions on mental health (*continued*)

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Jøranson *et al.*, 2015, Norway[160]	Cluster RCT	10 care homes; 60 residents	Age range 62–95 years; 67% women; diagnosed with dementia or cognitive impairment (MMSE score of < 25/30)	1. Group sessions with PARO for 30 minutes twice per week for 12 weeks 2. Control: received treatment as usual	Regular medication prescribed, assessed using the Anatomical Therapeutic Chemical Classification System; scores on the Brief Agitation Rating Scale and Norwegian versions of the Cornell Scale for Symptoms of Depression in Dementia and MMSE	High	The intervention group experienced significant reductions in agitation and depression at 3 months. Symptoms increased in the control group
Libin and Cohen-Mansfield, 2004, USA[176]	Quasi-experimental	Nine nursing home residents	Mean age 90 years, all female; residents with dementia	1. NeCoRo® [(interactive robotic cat) Kyoto, Japan]: one 10-minute session 2. Control: one 10-minute session with non-interactive plush cat toy	Agitated behaviour, measured using the Mapping Instrument (ABMI); affect, measured using Lawton's Modified Behaviour Stream; residents' engagement with the stimuli, assessed using various measures but not validated tools	Serious	The intervention group experienced significant increases in pleasure ($p = 0.007$) and interest ($p = 0.028$). Non-significant effects in relation to anger, anxiety and engagement were reported in both groups

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Moyle *et al.*, 2017, Australia[203]	Parallel, three-group cluster RCT	28 long-term care facilities (415 residents)	Mean age 84 years, 73% female (main intervention group); mean age 86 years, 81% female (second intervention group); mean age 85 years, 72% female (control group), documented diagnosis of dementia	1. PARO robot provided 2. Plush toy provided 3. Control: no intervention	Changes in participants' levels of engagement, mood states, and agitation, using the video coding protocol – incorporating observed emotion Scheme, and the CMAI-SF. Measurements were taken at baseline and at 1, 5, 10 and 15 weeks	Some concerns	Participants in the PARO group were more engaged verbally (3.61 points) and visually (13.06 points) than participants with the plush toy. Both PARO (3.09 points) and the plush toy (3.58 points) had significantly greater reductions in neutral affect than usual care. PARO was more effective than usual care in improving pleasure (1.12 points) and agitation (3.33 points). When measured using the CMAI-SF, there was no difference between the groups
Robinson *et al.*, 2013, New Zealand[236]	RCT with parallel groups	40 residents in a residential care facility	Age range 55–100 years, 67.5% female	1. Twice-weekly sessions with PARO companion robot for 12 weeks 2. Control: normal activities with resident dog present	Loneliness (UCLA loneliness scale), depression (Geriatric Depression Scale), and quality of life (Quality of Life for Alzheimer's Disease scale)	High	Compared with the control group, residents who interacted with the robot had significant decreases in loneliness during the study period. Residents talked to and touched the robot significantly more than the real resident dog ($p < 0.05$). There were no other significant differences in change scores from baseline to follow-up between groups

continued

TABLE 5 Technology systematic review: studies investigating the effects of digital technology interventions on mental health (*continued*)

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Shibata *et al.*, 2004, Japan[250]	Quasi-experimental	23 residents/ attendees at health service facility that provides nursing home stays, rehabilitation and day care	Mean age 84.6 years, 66.6% female (intervention group); mean age 85.5 years, 81.8% female (control group)	1. PARO robot provided 2. Control: PARO robot provided with a less active motion generation programme; both conditions were delivered for about 1 hour per session, 4 days per week for 3 weeks	Participant mood, assessed using a face scale, Profile of Mood States and comments from the nursing staff	Moderate	Average face scale scores improved by an average of 2 points for the intervention group and by 0.7 in the control group; decreases in Profile of Mood States 'depression-dejection' ratings were by an average of 14 points in the intervention group and 7 points in the control group
Van der Ploeg *et al.*, 2016, Australia[274]	Pilot randomised, crossover, repeated measures study	Nine residents from five nursing homes in Melbourne	Mean age 86.7 years (range 83–93 years); 66% female	1. Internet video calls (Skype™, Microsoft Corporation, Redmond, WA, USA) to reduce agitation in residents with dementia 2. Control standard landline telephone calls. Four 20-minute calls were booked over 2 weeks and then the groups were switched	Changes in Cohen-Mansfield Agitation scores	High	Skype conversations lasted longer than telephone calls (12 vs. 10.3 minutes). Mean agitation counts fell by 24.1 points during Skype calls and 12.9 points during landline calls. These differences were not statistically significant

ABMI, Agitated Behaviors Mapping Instrument; CMAI-SF, Cohen-Mansfield Agitation Inventory-Short Form; IPPA, Inventory of Positive Psychological Attitudes; MMSE, Mini Mental State Examination.

TABLE 6 Technology systematic review: studies investigating the effects of digital technology interventions on social relationships

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Banks *et al.*, 2008, USA[47]	Cluster RCT	38 residents in three long-term care facilities	Age and gender profile of the sample not stated	1. AIBO (Sony AIBO) (robotic dog) intervention (weekly 30-minute visit for 8 weeks) 2. Living-dog intervention (weekly 30-minute visit for 8 weeks) 3. Control group (no intervention)	Resident loneliness (UCLA scale) and attachment to pets (MLAPS)	Some concerns	Residents receiving a dog intervention (robotic or living) were significantly less lonely than those in the control group ($p < 0.05$), regardless of their attachment to pet score. There were no differences between the robotic or living dog group in reducing loneliness
Jung *et al.*, 2009, Singapore[163]	Quasi-experimental study	45 residents	Age range 56–92 years (whole sample) (gender balance not stated)	1. Wii sports and cooking games programme delivered over a 6-week period for 1.5 hours per session, three times per week 2. Control: traditional games	Scores on the UCLA Loneliness and Rosenberg Self-Esteem scales; Bradburn Affect Balance Scale; Physical Activity Questionnaire for Elderly Japanese	Critical	Intervention group participants scored significantly higher on affect ($p < 0.05$), self-esteem and physical activity and significantly lower on loneliness ($p < 0.01$) than the control group
Kidd *et al.*, 2006, USA[169]	Quasi-experimental	23 residents	No data on age and gender of the participants	1. Group session with PARO (interactive robotic seal) turned on 2. Control: group session with PARO (interactive robotic seal) turned off; sessions took place approximately fortnightly over an 8-month period	Questions relating to social interaction and play with the robot designed specifically for this study	Critical	Participant responses to questions indicated higher levels of social interaction and play in the intervention condition

continued

TABLE 6 Technology systematic review: studies investigating the effects of digital technology interventions on social relationships (*continued*)

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Robinson *et al.*, 2013, New Zealand[236]	RCT with parallel groups	40 residents in a residential care facility	Age range 55–100 years; 67.5% female	1. Twice-weekly sessions with PARO companion robot for 12 weeks 2. Control: normal activities with resident dog present	Loneliness (UCLA Loneliness Scale), depression (Geriatric Depression Scale), and Quality of Life (Quality of Life for Alzheimer's Disease scale)	High	Compared with the control group, residents who interacted with the robot had significant decreases in loneliness over the study period. Residents talked to and touched the robot significantly more than the real dog ($p < 0.05$). There were no other significant differences in change scores from baseline to follow-up between the groups
Vowden and Vowden, 2013, UK[277]	Cluster RCT (pilot study)	16 nursing homes (39 patients)	Mean age 79.47 years, 58.8% female (intervention); mean age 82.67 years, 55.6% female (control)	1. Patients received standard care supported by a remote nurse consultant with patient information and images uploaded via a smartphone 2. Control: standard care; the study ran for a 6-month period	Cost savings and usefulness of the system, assessed using opinions and quotations provided by experts and care home staff	High	No statistical analysis because of small sample size; the study authors reported that the case studies included in their article illustrate the potential benefits of the system

MLAPS, Modified Lexington Attachment to Pets Scale; MMSE, Mini Mental State Examination.

TABLE 7 Technology systematic review: complex IT systems and various resident outcomes

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Holmes *et al.*, 2007, USA[300]	Quasi-experimental design	Two units; 118 residents	Average age on both units was 87 years (±7.5 years); 78 residents (38 on the intervention unit and 40 on the comparison unit)	1. Vigil [Vigil Health Solutions, Inc. (2007). Vigil integrated care management system. URL: www.vigil.com/products] (a bed-exit sensor, and bedroom and bathroom exit monitors) was implemented for residents of a special care unit maintained by a large nursing home for people with dementia 2. A special care unit matched for unit-wide case mix and cognition was used as a comparison unit in which the service was not implemented	Reduction of falls, accidents and injuries for residents; decrease in staff time spent on direct care and staff burden	Critical	No significant reduction in falls and injuries, but there was a significant improvement in affective disorder in the intervention group, relative to the comparison group

continued

TABLE 7 Technology systematic review: complex IT systems and various resident outcomes (*continued*)

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Kelly *et al.*, 2002, USA[301]	Crossover design	47 patients	66% ($n = 31$) were female; no data on age	1. A crossover design was used to compare the fall rate of patients wearing the NOC watch device (NOC Watch Inc., Crystal Bay, NV, USA) with the fall rate of those not wearing it	Fall rate per 100 patient-days	Critical	Significant reduction in fall rate of 91% ($p = 0.02$). Patients had 11 falls in the pre period (4.0 falls per 100 days), 1 fall in the during period (0.3 falls per 100 days) and 17 falls in the post period (3.4 falls per 100 days)
Lapane *et al.*, 2011, USA[299]	Cluster RCT (to determine the extent to which the use of a clinical informatics tool for monitoring plans reduces adverse outcomes)	25 homes comprising 3480 residents	50% aged ≥ 85 years, 33% aged 75–84 years, 18% aged 65–74 years; 73% female (intervention recipients)	1. Geriatric Risk Assessment MedGuide reports and automated monitoring plans for falls and delirium within 24 hours of admission 2. Control: usual care	Incidence of delirium, falls, hospitalisations and mortality	High	Significant difference in the rate of potential delirium onset between groups (adjusted hazard ratio 0.42, 95% confidence interval 0.35 to 0.52) favouring the intervention. No other significant effects were observed
Pillemer *et al.*, 2012, USA[222]	Quasi-experimental study to investigate the impact of introducing a HIT system on resident outcomes	761 residents	Mean age, 79.6 years, female 68.17% (intervention group); mean age 79.2 years, 63.55% female (control group)	1. Implementation of a HIT system, where patient records were converted to electronic format 2. Control: non-electronic patient records; residents followed for 9 months following implementation of the intervention	Resident satisfaction with care; average number of falls; ADL (Performance Activities of Daily Living scale); mood (Feeling Tone Questionnaire); Observed behaviour frequency of behavioural states based on rater observations	Critical	No statistically significant impact of the introduction of HIT system on residents for any outcomes, except a negative effect on behavioural symptoms

Authors, year of publication, location	Design	Sample size (care home residents)	Sample characteristics	Interventions and comparators	Outcomes and measures	Overall risk of bias rating	Results
Rantz *et al.*, 2010, USA[227]	Quasi-experimental study to investigate the contribution of bedside EMRs and on-site clinical consultation by gerontological expert nurses on cost, staffing and quality of care in nursing homes	18 facilities; 8166 residents	No data were provided on age or gender. Facilities were split into four groups, all willing to implement bedside EMR systems	1. Group 1 implemented bedside EMR, with nurse consultation; group 2 implemented bedside EMR only; group 3 implemented nurse consultation only; group 4 implemented neither	Cost reports (total costs per resident and nursing staff), staffing and retention, various quality indicators and measures for resident outcomes including ADL, motion, behavioural/ depressive symptoms, pressure sores, urinary tract infection, delirium, physically restrained	Serious	Total costs increased in the intervention groups that implemented technology. Staffing and retention remained constant. Improvement trends were detected in resident outcomes for ADLs, range of motion, and pressure sores in intervention groups
Rantz *et al.*, 2017, USA[230]	Prospective, randomised controlled study to assess the effectiveness and cost-effectiveness of using data from an environmentally embedded sensor system for early recognition of illness	171 residents in 13 assisted living communities	Mean age 83.6 years, 74.4% female (intervention group); mean age 86 years, 72.9% female (control group)	1. Environmental sensor system to measure overall activity, respiration, pulse, restlessness during sleep, and gait. Health alerts using the sensors are sent to nurses via e-mail 2. Control: usual care	SF-12, GDS, MMSE, activities/instrumental ADL and IADL, gait speed and profile (GAITRite), hand grip, falls, emergency room visits, hospitalisations, nursing home stays, physician visits	Some concerns	Functional decline was significantly more rapid in the comparison group, suggesting that alerts from sensor data promote early detection and intervention. No differences were identified in SF-12, GDS, MMSE, ADL or IADL scales, or grip strength measures between groups. There were no difference in health-care costs between groups

EMR, electronic medical record; GDS, Geriatric Depression Scale; HIT, Healthcare Information Technology; MMSE, Mini Mental State Examination; SF-12, Short Form questionnaire 12-items.

Research teams from three countries have evaluated the potential of Nintendo® (Windsor, UK) Wii technology to enhance physical functioning, in addition to reporting on outcomes such as health and quality of life. Playing specific Wii games appeared to have a greater impact on physical and psychological health than playing traditional board games when implemented over a 6-week period with 45 residents of a Singapore care home.[163] This quasi-experimental study was successful in its aim to increase physical activity; participants also reported increases in positive affect and self-esteem, and lower levels of loneliness, than those in the control group, suggesting that the intervention has the potential to have a broad impact on well-being.[163] A quasi-experimental mixed-methods study[166] from New Zealand evaluated the impact of an 8-week programme of Nintendo Wii sports games. Significantly greater increases in functional ability, self-reported physical activity levels and quality of life were reported among the 13 members of an intervention group than among 13 residents who continued with their normal ADL. However, the Wii was less successful when used with residents in Canada who had existing impairments. A Nintendo Wii bowling game was added to standard care for 34 residents with upper limb dysfunction from two long-term care facilities. Wii bowling participants reported greater enjoyment of physical activity than residents receiving standard care, but changes in functional status, pain intensity and the extent to which pain disturbed the resident were similar in both groups after the intervention.[147]

Other studies of digital technology interventions failed to demonstrate any improvement in functional status over and above usual care. In a pilot trial in Taiwan,[177] the effectiveness of balance training via a telerehabilitation system was compared with conventional therapy for 24 care home residents with chronic stroke. During a 4-week period, balance and functional status improved, but there were no significant differences between the intervention and control groups. Mobility, including 50-yard walking and going up and down stairs, was unaffected. Another pilot cluster RCT,[210] this time from the USA, evaluated an iPad (Apple Inc., Cupertino, CA, USA) application [the Aid for Decision-making in Occupation Choice (ADOC)]. This application was developed for use with occupational therapists, and displayed images of daily activities that could be selected by the clients in an attempt to promote shared decision-making and occupation-based goal-setting. The ADOC was found to be acceptable to therapists and clients, and able to maintain or improve ADL, compared with an impairment-based approach. The authors report that it also appeared to be a cost-effective intervention. No significant differences in health status or quality of life were detected between the intervention and control groups.

This combination of studies does not present strong evidence for a positive impact of technological interventions on the physical health and functional status of care home residents. However, the Nintendo Wii appears to be a promising intervention for increasing physical activity and enhancing mood and social functioning.

Studies investigating the effectiveness of interventions for improving mental health and well-being

Ten studies described digital interventions aimed at influencing mental health and well-being in care home residents.[56,101,132,160,163,169,176,236,250,274] A majority measured symptoms of depression and dementia. They also report on agitation, a set of behaviours associated with emotional distress that impair social functioning and ADL. Examples of agitation include excessive motor activity, such as pacing and/or verbal and physical aggression. Agitation is common in dementia and cognitive impairment, but it is important to note that it can have other causes.[303]

Mood and agitation

The influence of robotic animals on mood and agitation among care home residents has been investigated in studies from five countries: the Netherlands,[56] Norway,[160] New Zealand,[236] Japan[250] and the USA.[176] In all but one of these studies,[176] the intervention was with PARO, a robotic seal (www.PAROrobots.com). A sixth study, from Korea, discussed the need to explain and promote the PARO intervention with care home staff, but it presented no data on outcomes and is not included in this review.[132]

PARO is the most commonly available robotic pet developed for use by people living with dementia. PARO is built to resemble a baby seal, and moves its head and legs and makes sounds when interacting with people. PARO contains sensors that detect touch, light, sound, temperature and position. This allows the PARO device to respond when it is being held or stroked, and move in the direction of sounds. PARO can be programmed to respond in a certain way to stimuli, and remember the users' previous actions and behaviour patterns.

Two studies rated as being at high/serious risk of bias described the positive impact of PARO on mood and agitation. The short-term effects of intervening with PARO robotic seal were assessed in a quasi-experimental time series study (with within subject comparisons) in the Netherlands.

The effects of PARO on the psychological well-being and psychosocial functioning of residents with dementia were measured, along with its ability to facilitate daily care activities. Ninety-one residents completed this study. The authors described a strong positive effect of PARO on mood and on an individual goal attainment scale (Inventory of Positive Psychological Attitudes) when used in a therapeutic intervention. The potential of PARO to support delivery of care by enhancing resident co-operation was unproven.[56] PARO has also been used successfully in Norway in group interventions to tackle symptoms of agitation and depression among care home residents with dementia or cognitive impairment. A cluster RCT[160] involving 60 residents described significant improvements in the intervention group, 3 months after the end of a 12-week intervention. Medication usage was unchanged. In a smaller study in Japan,[250] PARO also appeared to have a positive impact on mood when deployed with 11 older people living in a long-stay facility. Twelve people in a second facility were given a less interactive version of PARO as a placebo, but the results between the groups were similar, which implies that PARO's ability to move and interact may not be an essential component of the intervention.

Only one published study,[236] a RCT from New Zealand rated as being at moderate risk of bias, failed to detect any positive effects on quality of life for PARO. The intervention was compared with a real dog who lived with residents in a care home. No differences were detected between the groups in quality of life or depression.[236] This study is discussed further in *Social relationships (loneliness and isolation): the influence of robotic animals*.

A robotic cat was the subject of a pilot study in the USA.[176] It had many similarities to PARO: inbuilt sensors and basic artificial intelligence allowed a range of sounds (purring, meowing and hissing) and non-verbal (stretching, wagging tail, lying down) responses to stimuli. Researchers compared the impacts of the robotic and toy cats on mood and engagement with the stimulus (attention, attitude and intensity measured on a five-point scale) of nine people living with dementia in one nursing home. The residents gained pleasure from interacting with the robotic cat, but both cats held participants' interest and appeared to reduce agitation.

In summary, robot interventions reported in published literature appear likely to have a positive effect on resident mood, agitation and interaction, but it is not clear that they offer greater benefits than real pet animals, other than in ease of access and availability. Evaluations of the costs and benefits of robotic interventions, and comparisons with existing practice, would all be helpful.

Other interventions to influence mood and reduce agitation

The impacts of telemonitoring were investigated in a study of 59 residents of a single Italian care home, allocated randomly into two groups in sequential order of recruitment. The intervention included transfer of patient data by text, monitoring of clinical signs (heart rate and blood pressure) and specialist neurological/psychological counselling. Quality of life had improved for all participants at 6 months. The intervention group also experienced reductions in depression scores and mean blood pressure. However, some caution is needed in extrapolating from this study, as it had a number of methodological limitations, including small sample size, baseline differences between the groups and method of allocation.[101]

The impact on agitation of video calls with relatives was compared with that of standard telephone calls for people with dementia. Nine residents in five Australian care homes took part in a pilot randomised crossover study. Reductions in agitation during the calls was greater for video calls, suggesting that this might be worthy of further scrutiny in a larger study.[274]

Social relationships (loneliness and isolation): the influence of robotic animals

Nintendo Wii and PARO have both been shown to have some influence on loneliness among care home residents. The study in Singapore care homes comparing the Nintendo Wii with traditional board games reported lower levels of loneliness in the intervention group.[163] In New Zealand, PARO was deployed in a RCT involving 40 older people in one retirement home facility (17 were in the rest home area and 13 were in the hospital area). Twice-weekly sessions with PARO were more effective than interactions with a real dog in reducing loneliness. The authors observed that residents spoke to and touched PARO more often than residents in the control group interacted with the real dog.[236] PARO has also been reported to support social interaction in a small study in two US nursing homes. The researchers worked with 23 residents, visiting every 2 weeks over 4 months. Although they reported positive outcomes, they also noted that some residents were reluctant to interact with PARO because they perceived a seal to be a wild, aquatic animal. In particular, some residents were concerned that it may be stranded on land.[169]

In summary, interventions that bring people together and prompt them to interact with a digital intervention, such as a robotic pet, or other residents appear to have a positive effect on loneliness and social isolation. However, there is no evidence of the superiority of technological interventions over non-digital alternatives on these outcomes.

Complex information technology systems and a range of resident outcomes

This section considers the remaining studies that did not fit into the preceding section. They describe the impact of complex interventions on multiple resident outcomes.

Seven articles were identified that evaluated the impact of complex IT systems or telemonitoring on resident outcomes. In most of these, technology is a vehicle for delivering complex care, and it is difficult to isolate the contribution of the technology. This is particularly pertinent to studies in telehealth, when the expert advice delivered into the care home is likely to be the active ingredient.

Impact of information technology systems in care homes on mood, functional status and mortality

A non-randomised study from the USA examined the effects on nursing home residents of introducing a broad-ranging IT system.[222] Patient records were converted from paper to electronic. The IT system enabled scheduling, mobile capture of assessments and treatments, online entry of notes, and real-time reporting of sentinel events, quality indicators and quality measures. Mobile electronic devices for certified nursing assistants (CNAs) and nurses allowed them to access to resident records at the bedside or anywhere within the facility. Desktop personal computers were configured on every nursing station and within every department for clinical management. Physicians were also able to access records and approve prescriptions remotely. Residents reported being satisfied with the changes. No statistically significant changes were detected in mood, functional status or mortality, but there was an increase in the observation of disruptive behaviours. The researchers hypothesised that the IT system would have an impact on resident outcomes via quality of care and anticipated that greater use of IT might be associated with adverse outcomes by promoting less personalised care and reducing time spent with residents. When outcomes were measured 9 months after implementation, this did not appear to be the case.[222]

Clinical decision support systems and pressure ulcer incidence

In a large randomised study,[54] researchers in Belgium evaluated the use of an electronic clinical decision support system (computer program) to increase adherence to guidelines in care homes. Individually tailored pressure ulcer prevention protocols were developed for care home residents and compared with paper- and classroom-based introduction of the guidelines. The intervention was associated with a

significantly greater reduction in grade I–IV pressure ulcers than that in the control group (intermediate outcome). However, this was a multifaceted intervention, including education, reminders, monitoring and the introduction of new nurse roles. The role of digital technology is difficult to disentangle, and it is not clear that it was an essential component of this intervention.[54]

In a similar study in the USA,[299] bespoke software was used with pharmacists and nurses to identify care home residents at risk of falls and delirium, and to implement monitoring plans and medication reviews. The aim was to reduce adverse events associated with medication use. This intervention was evaluated in a RCT in 25 care homes served by two long-term care pharmacies. Plans were triggered for 461 (14%) out of the 3480 residents in the intervention homes. Newly admitted residents who received the intervention had lower rates of delirium, hospitalisation and mortality than residents in usual care. Among longer-stay residents, there were no significant differences between the intervention and control groups.[299]

Impact of telemonitoring on clinical outcomes, including mood

The impacts of telemonitoring were investigated in a study of 59 residents of a single Italian care home,[101] allocated randomly into two groups in order of recruitment. The intervention comprised transferring patient data by text, video and audio, regularly monitoring vital clinical signs (heart rate and blood pressure), and intermittent specialist neurological and psychological teleconsulting. Quality of life had improved for all participants at 6 months. The intervention group also experienced non-significant reductions in depression scores and mean blood pressure. However, it is difficult to draw firm conclusions, as this study had a number of methodological limitations, including small sample size, baseline differences between the groups and method of allocation.[101] A pilot cluster RCT in a northern English city investigated the impact of remote expert advice on wound care for staff in nursing homes. Patient information and images were uploaded and transferred via smartphone for the 17 patients in the intervention group, whereas the nine control patients received usual care. The authors concluded, from an analysis of patient pathways, that the intervention had potential benefits for patients and staff.[277]

Technology for surveillance is in use in care homes in the USA and Europe. This may be why few evaluative studies were identified that were published after the year 2000. Holmes and colleagues[300] assessed the impact of bed, bedroom and bathroom exit monitors in a quasi-experimental study with 118 residents. They did not report any reduction in falls or injuries, but they did note improvement in mood for residents subject to the intervention. The mechanism for this is unclear.

Discussion

Summary of findings

There are multiple applications for technology in care homes. Much of the research effort has been directed at telehealth, digital records, social robots, surveillance or monitoring, gaming, education and communication. We identified 22 topic overviews or systematic reviews published since the year 2000 in high-income countries. We also identified a paucity of research that met the quality standards for robust evidence used in health-related research.[304] Descriptive and qualitative studies form the main body of work. They are essential to inform the implementation of technologies, with insights into, for example, acceptability and barriers to utilisation. In some areas – notably robots and telehealth – there are several experimental and quasi-experimental studies that aim to evaluate effectiveness.

Digital technology has the potential to enhance the health and well-being of care home residents. The most promising interventions appear to be those that promote physical activity or enhance mental health and well-being. Robotic pets and games that stimulate group activity are the most common interventions that have been subject to experimental evaluation. Other interventions that may have greater practical application to care – for example monitoring and digital records– are less likely to have been studied in this way. There is a paucity of comparative studies within the body of empirical evidence in this review. This means that it is impossible to conclude that the digital interventions are of greater benefit to residents'

health and well-being than less costly alternatives. There is an urgent need for properly conducted experimental research in this field.

The introduction of technologies into care homes raises a range of moral and ethical concerns, a discussion of which was outside the remit of this rapid evidence synthesis. However, it is important to acknowledge that issues of consent, dignity, privacy and care that prioritises the best interests of the resident should be central considerations when technological innovations are being considered in this setting.

Strengths and limitations

We applied systematic methods to synthesise existing evidence on technology to enhance the health and well-being of care home residents. A focus on resident outcomes enabled us to draw conclusions from a disparate body of work on diverse technologies. Our searches were designed to be comprehensive and identify work beyond traditional academic outputs, which we expected to be less relevant to this subject. There are two potential areas of weakness in our work. Hierarchies of research design that are used to judge the quality of health-related research place a high value on randomised controlled studies that are able to prove causation. Until recent years, the number of RCTs conducted with care home residents has been small. This may be because of the ethical, methodological and practical challenges of working in care homes. Participants are aged and living with multiple conditions, including cognitive and physical frailty. They may stay in a home for a relatively short time, and experience rapid deterioration in their health. Long-term care is also a setting that has not always attracted significant research funding, and RCTs may be costly. However, it is also possible that new technologies do not lend themselves to evaluation in a RCT. Interventions are often complex, with multiple effects and outcomes for a range of participants (staff, residents, families). Systems need updating and tweaking as the technology is implemented, which may result in the intervention being modified after the study has started. A qualitative evaluation of the process of implementation often yields the most useful information in the early stages of implementation, and when the technology is established, motivation to evaluate its impact in a RCT may be low. Whatever the underlying reasons, the paucity of experimental research will make it difficult for any review to draw conclusions that are based on traditional concepts of strong evidence. We have taken this into account in our narrative. It is also important to acknowledge that the USA and East Asia are the two main geographical foci of development in technology for care homes. Without translation from languages other than English, it is possible that we have omitted some relevant work.

Gaps in research knowledge

UK-relevant research

This review points to an overall paucity of research on technology and UK care homes, and a notable lack of experimental and observational studies. Only one pilot RCT from the UK was identified in our mapping review. Telehealth and technology for surveillance and monitoring have attracted some attention from UK researchers. Other applications of technology, including digital records and companion or rehabilitative robots, have yet to be formally evaluated and results published from UK settings.

Robust experimental studies

In recent years, an increasing number of RCTs have been conducted in care homes. In this review, a minority were powered to be able to detect statistically significant differences between groups. Such studies have generated useful findings on the acceptability and feasibility of novel interventions, but cannot provide evidence of a firm link between an intervention and observed outcome. There are many practical applications of technology. Experimental research to date has focused on robotics and games, to the detriment of other interventions.

Economic evaluation

Our work identified few studies that considered costs and no formal economic evaluations of introducing novel technologies into long-term care. Training staff to operate and maintain any technologies that are

introduced is also important and should be considered as an ongoing cost.
This is an omission, as cost is likely to be a particularly important consideration in a sector characterised by financial insecurity and narrow profit margins.

Impact on all stakeholders

Caring for older adults requires time, and staff workload is a key issue for care homes. Any technology that places demands on staff would need to offset this with significant benefits to residents, staff or the organisation. Our review identified a large number of studies that considered barriers to and facilitators of the use and implementation of technology. However, few considered the consequences for staff and organisations.

Implications for the UK care home sector

Digital technology pervades all aspects of care services, and there is no reason to expect care homes to be immune from new developments. But without formal, independent assessment of the positive and negative consequences of new technologies or new use of existing technology, it will be impossible to make rational choices about the allocation of future resources. The care home sector requires support to evaluate new interventions, and service commissioners have an important contribution to make with expertise and funds. The technology industry could also play a key role. With shared protocols for implementation of new interventions and collection of information on outcomes, it may be possible to pool data from multiple locations and generate a more robust evaluation. The robot PARO provides an example of where such an approach could have been beneficial. It has been the subject of many small studies that provide a poor basis for decision-making. If these studies had been more homogeneous in approach, data on PARO could have been available from a significant number of care home residents.

Evaluating new technologies requires resources, time and commitment across the long-term care economy. Funding studies of sufficient size and duration in this setting will require considerable resources, and funders may have been reluctant to support the evaluation of commercially marketed interventions. Consideration should be given to joint working and sponsorship of independent research. Credible evidence for impact of a new intervention if of benefit to all concerned, including manufacturing companies, commissioners and residents.

Section 2: communication and engagement

Background

In England, most care homes sit outside the NHS and statutory services, but work alongside a wide range of public and private service providers. This is a unique context and poses particular challenges to communication between professional carers working for different organisations. Good communication is essential to the successful integration of services, and is particularly important when care is delivered by many different providers. Collaboration with health and social care professionals is believed to benefit care quality and promote person-centred care for care home residents.[305,306] In addition, good communication between care homes, hospices and acute services is known to improve quality and resource use.[307,308] Care homes have long seen the benefits of collaboration with their local communities to enhance residents' quality of life and break down some of the misconceptions and stigma surrounding care homes. Initiatives such as community tea parties, adopt-a-resident and communal gardening initiatives are perceived to be of benefit to quality of life and boost a home's commercial success.[309,310]

Communication and engagement are cross-cutting issues, relevant to a care homes' relationships with health services, social care, commercial companies and community groups. To date, no review has brought together current understanding of which approaches to communication and engagement are most likely to enhance resident health and well-being. This work intends to fill this gap, and be of value to decision-makers in care homes and commissioning organisations with limited time and resources.

In this review, communication was defined as the transfer or sharing of information by speaking, writing or other media. Engagement was understood to refer to meaningful contact or connection and/or involvement (or the feeling of being connected or involved).

Methods

See *Chapter 3* for details of methods.

Findings of mapping review

Number and characteristics of studies

After deduplication, 3607 references were available for title and abstract screening (see *Figure 2*). Of these, the full texts of 250 references were retrieved for further assessment of eligibility, and the details of 94 studies were mapped (*Table 8* and *Report Supplementary Material 1, Table 2*). Of those that were not reviews, 61 (64%) took place in the USA, 11 (12%) took place in the UK, five took place in the rest of Europe, six (9%) took place in Australia, four took place in Canada and one took place in each of New Zealand, Singapore and Sweden. There were 16 (17%) experimental studies: seven RCTs, two quasi-experimental studies, five pre–post and two interrupted time series studies. There were also five (5%) relevant published protocols: three for RCTs and two for quasi-experimental studies. Nine (9%) studies reported surveys, two (2%) reported retrospective reviews of data, 13 (14%) reported qualitative research (interviews or focus groups) and five (5%) described case studies. Eighteen (19%) studies utilised mixed methods, including a mix of surveys, qualitative, action research and process evaluations. Fifteen (16%) studies provided descriptions of interventions or methods of communication and three were discussion papers. Finally, eight (8%) systematic reviews were found.

Features of communication under investigation in the studies

Interpersonal communication within care homes was the focus of 18 (19%) studies. These discussed existing systems or proposed new methods for improving staff communication. Some described the use of formalised meetings or networks. Others focused more on one-to-one communication between staff members, and discussed barriers to successful communication or suggested strategies to improve it.
A number of articles related to educational interventions to help staff focus on and improve communication.

One-quarter of studies ($n = 22$, 24%) had an explicit focus on the process of transferring patients between care home and hospital or communication between care home and hospital staff. The documentation used during this process was a topic of interest, and studies were concerned with the introduction of an improved and/or standardised form, or a different way of transferring the information (e.g. electronic transfer). Some articles looked more broadly at how information is communicated between staff members in the care home and hospital. Two studies examined communication between different care homes, and three investigated features of communication with multiple stakeholders (e.g. staff, hospital, academics and community representatives).

Named quality improvement tools were the focus of 27 (29%) of the studies. The most common ($n = 8$, 8%) was INTERACT (Interventions to Reduce Acute Care Transfers), which was originally conceived and tested in the USA as a tool to reduce hospitalisations from care homes.[372,383] It was improved through two rounds of expert consultation and focus groups and evolved into INTERACT 3.[373] This is a quality improvement programme that focuses on managing acute changes in the condition of residents in care homes, with the aim of reducing admissions to hospital. The focus of INTERACT 3 is the management of an acute change in condition, and it incorporates several fundamental strategies. First, it explicitly uses principles of quality improvement: it demands a designated champion and strong leadership support, provides the means to measure, track and benchmark defined outcomes, and generates root-cause analyses of hospitalisations. Staff receive feedback and guidance about translating these outcomes into improvements in the process of care and educational interventions. INTERACT 3 aims to promote early identification and evaluation of changes in a resident's condition, using specific tools, STOP and WATCH and the Situation, Background, Assessment and Recommendation (SBAR) tool. Appropriate management in the care home should then prevent some residents from becoming so unwell that they require hospital transfer. INTERACT 3 also

TABLE 8 Communication and engagement mapping review: included studies

First author	Year of publication	Review
Agar[311]	2015	Communication and engagement
Alexander[312]	2014	Communication and engagement
Alexander[31]	2015	Communication and engagement
Amador[313]	2016	Communication and engagement
AMDA[314]	2011	Communication and engagement
Anderson[315]	2010	Communication and engagement
Anonymous[316]	2011	Communication and engagement
Anonymous[317]	2013	Communication and engagement
Anonymous[318]	2014	Communication and engagement
Anonymous[319]	2015	Communication and engagement
Anrys[320]	2016	Communication and engagement
Arendts[321]	2014	Communication and engagement
Arling[322]	2014	Communication and engagement
Badger[323]	2012	Communication and engagement
Banda[324]	2015	Communication and engagement
Baur[325]	2010	Communication and engagement
Beck[305]	2014	Communication and engagement
Bensadon[326]	2014	Communication and engagement
Bokhour[327]	2006	Communication and engagement
Boockvar[328]	2007	Communication and engagement
Anonymous[329]	2016	Communication and engagement
Cadogan[330]	1999	Communication and engagement
Cassidy[331]	2005	Communication and engagement
Catic[332]	2014	Communication and engagement
Colon-Emeric[333]	2013	Communication and engagement
Conway[334]	2015	Communication and engagement
Cortes[335]	2004	Communication and engagement
Cowley[336]	2012	Communication and engagement
Crotty[337]	2004	Communication and engagement
Crotty[338]	2004	Communication and engagement
Cwinn[339]	2009	Communication and engagement
Dalawari[340]	2011	Communication and engagement
Davis[341]	2005	Communication and engagement
Davies[342]	2011	Communication and engagement
Dearing[343]	2017	Communication and engagement
Ellis[344]	2006	Communication and engagement
Field[345]	2011	Communication and engagement

continued

TABLE 8 Communication and engagement mapping review: included studies (*continued*)

First author	Year of publication	Review
Fisch[346]	2014	Communication and engagement
Furman[347]	2006	Communication and engagement
Ghorbel[126]	2013	Communication and engagement
Gillespie[348]	2010	Communication and engagement
Gillespie[349]	2010	Communication and engagement
Gilmore-Bykovskyi[350]	2013	Communication and engagement
Goodman[351]	2005	Communication and engagement
Goodman[352]	2009	Communication and engagement
Goodman[353]	2013	Communication and engagement
Griffiths[354]	2014	Communication and engagement
Hasson[355]	2008	Communication and engagement
Hearn[356]	2015	Communication and engagement
Heckman[357]	2016	Communication and engagement
Hewison[358]	2009	Communication and engagement
Hustey[359]	2010	Communication and engagement
Hustey[152]	2010	Communication and engagement
Hustey[153]	2012	Communication and engagement
Huynh[360]	2013	Communication and engagement
Jarboe[361]	2015	Communication and engagement
Jones[362]	2010	Communication and engagement
King[363]	2013	Communication and engagement
Kirsebom[364]	2013	Communication and engagement
Krol[365]	2017	Communication and engagement
LaMantia[366]	2010	Communication and engagement
Lea[367]	2016	Communication and engagement
Longo[368]	2002	Communication and engagement
Martz[369]	2011	Communication and engagement
McGilton[370]	2009	Communication and engagement
Ouslander[371]	2009	Communication and engagement
Ouslander[372]	2011	Communication and engagement
Ouslander[373]	2014	Communication and engagement
Ouslander[374]	2016	Communication and engagement
Reed[375]	2003	Communication and engagement
Renz[376]	2013	Communication and engagement
Renz[377]	2015	Communication and engagement
Renz[378]	2016	Communication and engagement
Richardson[233]	2014	Communication and engagement
Romøren[379]	2017	Communication and engagement

TABLE 8 Communication and engagement mapping review: included studies (*continued*)

First author	Year of publication	Review
Sankaran[380]	2010	Communication and engagement
Sutton[381]	2016	Communication and engagement
Tabar[382]	2013	Communication and engagement
Tena-Nelson[383]	2012	Communication and engagement
Terrell[384]	2005	Communication and engagement
Tjia[385]	2009	Communication and engagement
Toh[269]	2015	Communication and engagement
Tsakitzidis[386]	2016	Communication and engagement
van Dongen[387]	2016	Communication and engagement
Vogelsmeier[388]	2011	Communication and engagement
Weiner[389]	2001	Communication and engagement
White[390]	2015	Communication and engagement
Whitson[391]	2008	Communication and engagement
Wroth[392]	2011	Communication and engagement
Yang[393]	2009	Communication and engagement
Young[394]	2010	Communication and engagement
Zafirau[395]	2012	Communication and engagement

AMDA, American Medical Directors Association.

enables advance care planning and use of palliative or hospice care, when appropriate and chosen by the resident as an alternative to hospitalisation. Finally, it enables improved communication and documentation within the nursing home, between the nursing home staff and families, and between the nursing home and the hospital. INTERACT tools for improving communication with acute hospitals include a checklist of key transfer documents, lists of critical data to be communicated during transfer, examples of forms to document these data and a tool to assist with medication reconciliation at the time of transfer to the nursing home. The keys to the success of the programme are described as executive leadership support, a culture dedicated to quality improvement and engagement of staff by an INTERACT champion; choosing the right person for this last role is described as one of the most important decisions.[372]

Selected examples of other quality improvement projects follow.

The Empira Fall Prevention Program[322] is a quality improvement collaborative of older adult service providers in the USA. It includes nursing and other leaders from participating care homes. The aim is to get every employee involved in determining the root causes of a resident's fall. The programme provided guidance for 'first responders' – those who found a fallen resident – along with attending nurses. The concept of a 'fall huddle' was introduced: the charge nurse and all staff members who had been working in the area of the fall would gather as soon as the resident was stabilised. The aim was to enhance understanding of the circumstances that led to the fall by recreating the scenario (with the resident if possible) and generating a list of questions to answer.

Connections, Communication, and Problem solving (CONNECT)[333] is a multicomponent intervention designed in the USA to promote the systematic use of management practices. Staff are provided with training and tools to improve day-to-day interactions, encouraged to establish social networks for creative problem-solving, and work with mentors to help them to maintain the newly acquired behaviours.[333]

This approach aims to strengthen interdependencies among staff and address common barriers to interdisciplinary problem-solving, such as passing responsibility to people further up the hierarchy. CONNECT intends to be widely generalisable to care home settings, because it enhances the capacity of existing staff to learn and improve.

Essence of Care[353] is a benchmarking tool designed in the UK to improve the quality of resident or patient care. It helps practitioners to take a patient-focused and structured approach to sharing and comparing practice across health and social care settings. Nine 'fundamental aspects of care' are identified, each with its own set of benchmarks, including one that focuses on communication between patients and/or carers and health-care personnel. The toolkit contains an overall patient outcome for each of these aspects of care and a number of factors that need to be considered to improve the outcome. Each factor consists of a benchmark of best practice, indicators to monitor progress, guidance, and forms to document and chart activity.

Nurses Improving Care for Health system Elders (NICHE) provides geriatric education for all levels of staff in the acute and long-term care areas. It also promotes collaboration across the continuum through NICHE organisational strategies, clinical improvement models and other resources.[396] It was devised in the USA and is now also used in Canada, Bermuda and Australia.

Communication outcomes

Process measures were commonly reported in studies that evaluated communication tools. For example, an evaluation of the introduction of a transfer form would record the number of completed forms. In other studies, the number of meetings or interactions would be recorded. Authors have also described gaps in information that arose, and made comparisons with a defined gold standard. Most commonly, qualitative methods were used to understand perceptions of the levels or value of communication, or satisfaction with interactions.

Other outcomes

Around one-fifth of the articles ($n = 19$; 20%) reported clinical outcomes. Some studies were set up to look at communication with the idea of improving a particular clinical outcome; for example, two of the studies aimed to reduce fall rates in the care homes, and another aimed to improve bowel health. Other studies were targeted at improving the administration of medication or reducing medication errors. A small number reported quality-of-life outcomes.

Staff outcomes were a focus of interest in around 26 (28%) of studies. A majority reported on changes in staff satisfaction, knowledge or attitudes, or adherence to a communication tool. Few studies reported organisational-level outcomes; the most commonly reported were related to patient transfer or readmission to hospital.

UK studies

Twelve of the mapped studies (13%) were published from the UK, including one systematic review and one discussion paper. Eight (8%) used qualitative methods, two of these were action research projects and two were mixed methods. Seven (7%) were concerned with quality improvement tools or frameworks, including Essence of Care[353] and the Gold Standards Framework.[358] All the UK studies were focused on care home staff communication with external health professionals, either community based (e.g. district nurses) or hospital.

Summary

This mapping review has identified 94 articles on communication and engagement in care homes, three-quarters of which were published in 2010 or later. Two-thirds of the research originated from the USA, with only 12 studies from the UK. The three major topics of interest to researchers have been quality improvement tools or frameworks, resident transfer to and from hospital, and interpersonal communication

within care homes. Little published research was found on care homes' communication and engagement with their local communities. No comparative studies of quality improvement frameworks were identified.

Findings of systematic evidence synthesis

How should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences?

Communication and engagement methods: systematic evidence synthesis

This review followed the methods previously described (see *Methods*). The PRISMA flow diagram is shown in *Figure 2*.

Results of evidence synthesis

A total of 5967 references were identified in the online search. After screening the titles and abstracts, 95 references were identified as potentially suitable for inclusion and retrieved for full-text assessment. In total, 13 references (11 studies) were included in the final review (*Table 9*).

Included studies

Four references[326,333,345,397] reported randomised controlled studies evaluating the effectiveness of a communication tool, one[322] had a mixed-methods approach including a pre and post segment, seven

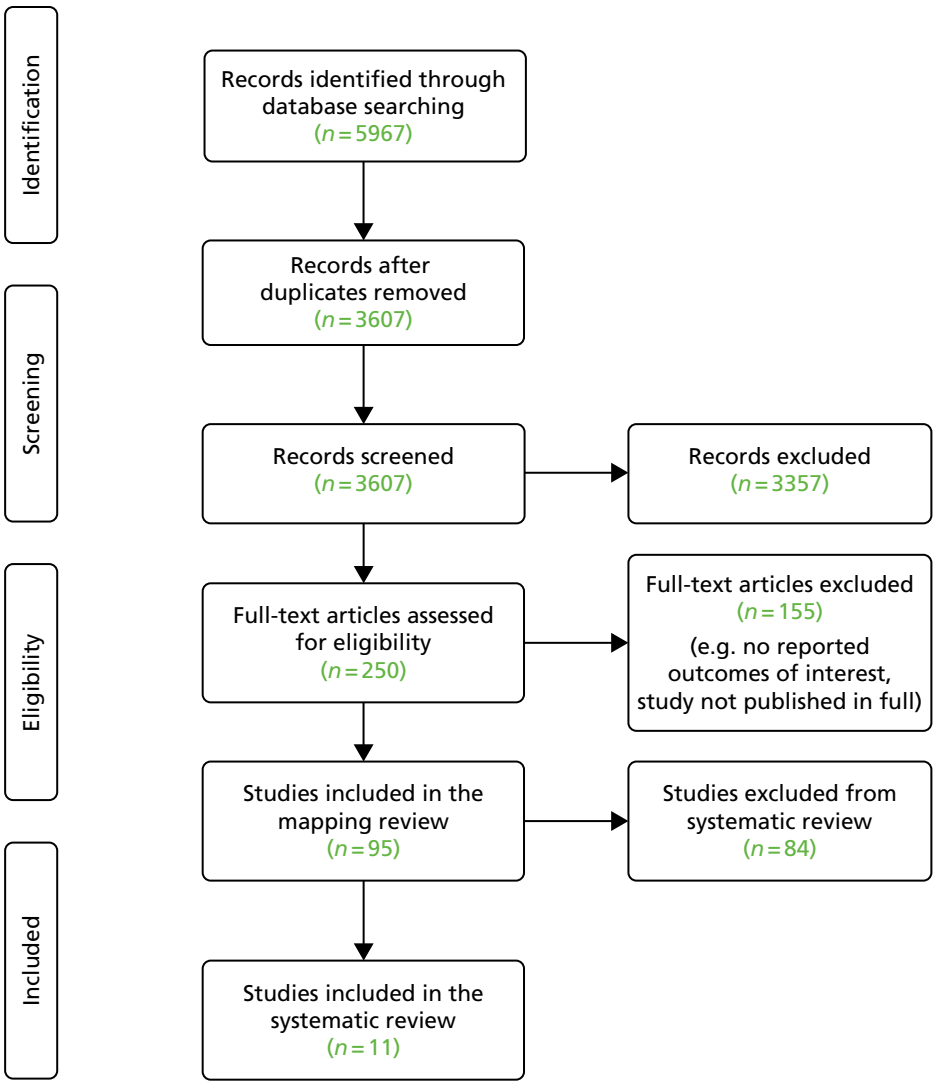

FIGURE 2 Communication and engagement PRISMA flow diagram.

TABLE 9 Communication and engagement systematic review: included studies

Authors, year of publication	Aims/purpose	Design	Participants	Settings	Type of intervention	Key findings
Arling *et al.*, 2014[322]	To explore the association between participation in a nursing home quality improvement collaborative and resident outcomes (changes in fall rates)	Mixed-methods approach (quantitative surveys and qualitative interviews) Interrupted time series design	RNs, $n = 12$; recreational therapist, $n = 3$; others including administrator, activity director and social worker, $n = 14$	Nursing facilities Empira project ($n = 15$) and other nursing facilities ($n = 357$)	Empira quality improvement falls reduction collaborative	Reductions in fall rates were highest in facilities where respondents experienced the highest levels of communication with collaborative members outside scheduled meetings, and where respondents perceived that the collaborative kept them informed and provided new ideas Clinicians felt that participation in a quality-improvement collaborative positively influenced their ability to share innovative ideas and expand the quality improvement programme within their nursing home
Bensadon *et al.*, 2014;[326] Musante, 2014[397]	Evaluation of INTERACT. This is a comprehensive quality improvement programme designed to promote prompt, local management of residents by promoting early identification, assessment and communication of changes in resident status	RCT	203 long-term care staff	72 nursing homes	INTERACT	Preliminary data suggest that implementing INTERACT can promote positive cultural change in long-term care and reduce preventable (re)hospitalisations. Aggregated interview data showed measurable improvement in six outcomes: communication (86%; 174/203), nursing assessment (83%; 168/203), documentation (73%; 149/203), quality improvement procedures (75%; 153/203), hospital relations (66%; 133/203) and reduced hospitalisation rates (58%; 118/203)

Authors, year of publication	Aims/purpose	Design	Participants	Settings	Type of intervention	Key findings
Colon-Emeric *et al.*, 2013[333]	To determine whether or not an intervention that improves nursing home staff connections, communication and problem-solving (CONNECT) would improve implementation of a falls reduction education programme (FALLS)	Cluster RCT	Staff in any role with resident contact ($n = 497$)	Four community nursing homes and four Veterans Affairs community living centres	CONNECT tool and FALLS intervention	CONNECT was associated with significant improvements in staff perceptions of communication quality, participation in decision-making, safety climate, caregiving quality and use of local interaction strategies in intervention community nursing homes (treatment-by-time effect $p = 0.01$) but not in Veteran Affairs nursing homes. Fall risk reduction documentation did not change significantly, and the direction of change in individual facilities did not relate to observed direction of change in fall rates. Fall rates did not change in control facilities (falls/bed per year: baseline, 2.61; after intervention, 2.64) but decreased by 12% in intervention facilities (falls/bed per year: baseline, 2.34; after intervention, 2.06); the effect of treatment on rate of change was 0.81 (95% CI 0.55 to 1.20)
Conway *et al.*, 2015[334]	To evaluate the impact of a nurse-led telephone support service to RACFs on a range of measures relating to the transfer of acutely unwell residents to the ED of a large tertiary referral hospital in New South Wales, Australia, over a 9-month period	Pre- and post- evaluative intervention design	50 staff from ED and 26 staff from RACFs participated	12 RACFs (4 intervention vs. 8 control)	A nurse-led telephone support service provided by an APN	Reduced presentations of older people to the ED from the four pilot RACFs occurred. High levels of satisfaction among staff in RACFs were reported

continued

TABLE 9 Communication and engagement systematic review: included studies (*continued*)

Authors, year of publication	Aims/purpose	Design	Participants	Settings	Type of intervention	Key findings
Cwinn *et al.*, 2009[339]	To measure the prevalence of information gaps that occurred when patients were transferred to an ED from a nursing home or seniors residence, and to assess effectiveness of a regionally standardised transfer form on reducing information gaps in the region	Retrospective study of care reporting database: standardised vs. institutional form	Transfer forms for consecutive patients aged ≥ 60 years who were transferred by ambulance from a nursing home or seniors residence within a 6-month period in 2004	Nursing homes or senior residence	Record review of transfer documents	A standardised transfer form was used in 42.7% of transfers. When the form was used, information gaps were present in 74.9% of transfers compared with 93.5% of the transfers when the form was not used ($p < 0.001$)
Dalawari *et al.*, 2011[340]	To assess the extent to which transfer forms facilitate communication between nursing home and ED staff based on proposed criteria	Retrospective review: pre and post quality improvement	Transfer documents for patients aged ≥ 65 years transferred by emergency medical services from nursing homes to St Louis University ED between January and June 2009	Nursing home including extended care facilities	Transfer forms	Information deemed valuable in caring for a patient in the ED has an increased chance of transmission when transfer forms are used. The transfer form group had available, on average, 71% of the essential items, compared with 28% for cases without a transfer form ($p < 0.001$). However, the availability of this information did not translate into observable differences in case resolution time ($p = 0.94$) and disposition status ($p = 0.12$)
Field *et al.*, 2011[345]	To improve the quality and safety of anticoagulation management in the nursing home	RCT	A representative of each nursing home Intervention homes, $n = 13$; control homes, $n = 13$	Nursing homes	SBAR tool	Facilitated telephone communication between nurses and physicians using the SBAR approach modestly improves the quality of warfarin management for nursing home residents. In intervention homes, residents' international normalised ratio values were in the therapeutic range a statistically significant 4.50% more often than in control homes (95% CI 0.31% to 8.69%)

Authors, year of publication	Aims/purpose	Design	Participants	Settings	Type of intervention	Key findings
Hustey and Palmer, 2010[152]	To determine whether or not the implementation of an internet-based communication system improves the amount of essential information conveyed between a SNF and the ED during patient care transitions	Before-and-after intervention	Transfer documents of patients transferred from a SNF to the ED over 16 months	A 55-bed subacute SNF	SNF–ED transfer form	The use of an internet-based system increased the amount of information communicated during SNF–ED care transitions and significantly reduced the number of pages in which this information was contained. There was more critical patient information (1.85 vs. 4.29 of nine elements; $p < 0.001$) contained within fewer pages of transfer documents (24.47 vs. 5.15; $p < 0.001$) after the intervention
Renz *et al.*, 2013;[376] Renz, 2015[377]	To evaluate the influence of SBAR protocol and training on nurse communication with medical providers, as perceived by nurses and physicians, using a pre–post questionnaire	Single-site repeated measures design (pre–post intervention)	40 nurses (21 RNs and 19 LPNs) and 7 physicians	137-bed skilled nursing home, part of a continuing care retirement community	INTERACT 2 SBAR communication tool	Implementation of the INTERACT 2 SBAR tool suggests improvement in nurse satisfaction with communication, although not statistically significant. Twenty-eight nurses (87.5%) found the tool useful, one nurse did not find it useful and three did not comment. Twenty-two nurses (69%) reported no limitations with the SBAR tool, although nine (28%) found the tool time-consuming

continued

TABLE 9 Communication and engagement systematic review: included studies (*continued*)

Authors, year of publication	Aims/purpose	Design	Participants	Settings	Type of intervention	Key findings
Tena-Nelson *et al.*, 2012[383]	To describe a replication of the INTERACT programme among member facilities of a New York City area nursing home provider association (INTERACT NY) and estimate its effect on hospital transfers	Pre- and post-intervention design	Nurse administrators, unit-based nurses, medical directors and attending physicians, nursing home administrators, CNAs, case managers and social workers	30 nursing homes	INTERACT NY	Overall, there was a non-significant 10.6% reduction in hospital admissions from 4.07 to 3.64 per 1000 resident-days from pre to post INTERACT NY ($p = 0.332$). Among nursing homes with high engagement, there was a non-significant 14.3% reduction in hospital admissions from 4.19 to 3.59 per 1000 resident-days ($p = 0.213$). Among nursing homes in the highest tertile of baseline (pre-INTERACT NY) hospital admission rates, there was a non-significant 27.2% reduction in hospital admissions from 7.32 to 5.33 per 1000 resident-days ($p = 0.102$)
Terrell *et al.*, 2005[384]	To improve communication between ECFs and the ED. This study tested the hypothesis that a one-page, standard ECF to ED transfer form with essential data elements would change the rate of successful documentation of ECF patient information	Pre- and post-intervention investigation	Transfer documents for patients transferred by ambulance from ECF to the ED	ECFs defined as either a skilled nursing care facility or an intermediate care facility	Transfer forms	Use of a one-page, standard ECF to ED transfer form increased the number of essential data provided to the ED. Post intervention, the proportion of transfers with successful documentation was 77.8% (56/72), an increase of 19.3% (95% CI 4.0% to 34.7%) during the pre-intervention period. In 31.9% (23/72) of post-intervention ED transfers, the transfer form was transported with the patient. Successful documentation was achieved in 22 (95.6%) of these 23 transfers

APN, advanced practice nurse; CI, confidence interval; ECF, extended care facility; ED, emergency department; LPN, licensed practical nurse; RACF, residential aged care facility; SCF, skilled nursing facility.

references[152,334,340,376,377,383,384] described pre- and post-intervention investigations on a single site and one[339] was a retrospective comparative study of patient transfer records.

Country

One study took place in Canada,[339] another took place in Australia[334] and the remainder took place in the USA.[152,322,326,333,340,345,376,383,384] All studies were conducted in nursing homes or residential aged care facilities.

Types of interventions

The included studies assessed a variety of interventions to improve the quality of communication between nursing homes and other health-care organisations. Four studies analysed the effect of standard communication tools, such as INTERACT,[326,383] SBAR[345] and a combined INTERACT II SBAR tool.[376] Two studies evaluated the effect of a quality improvement initiative to enhance clinical care outcomes for the residents, the Empira Quality Improvement falls reduction collaborative,[322] and CONNECT[333] in combination with a falls reduction education (FALLS) programme.[311] Four studies[152,339,340,384] evaluated the effectiveness of standardised transfer forms as a communication platform between nursing homes and hospital emergency departments. One study[334] used a pre–post design to evaluate the effect of a telephone-led support system by an aged care emergency advanced practice nurse for residential aged care facility (RACF) staff during transfer of residents to an emergency department. The outcome measures were heterogeneous, with studies reporting measures of staff communication with other organisations, effects of communication tools on the quality of communication and effects on resident outcomes such as bowel-related care, falls risk and quality and safety of anticoagulation management.

Participants

These interventions were targeted at providers and staff of the care or nursing homes (including administrators, directors of nursing, RNs and NAs) and other health service providers (including general practitioners, social workers, medical staff and pharmacy staff).

Excluded studies

Thirteen studies were excluded from this focused review: five[311,320,321,389,398] because they were protocols, six[269,337,338,353,361,390] because they did not explicitly state that they were focusing on communication outcomes in the study aims, one[323] because it evaluated the impact of a standard framework, and one[349] because it has not been published in full.

Risk of bias in included studies

Of the 11 included studies, 10 were rated as being at high to moderate risk of bias and one was rated as being at low risk. Full details of the validity assessment are presented in *Appendix 3, Table 20*. The quality of reporting was variable between studies and across the criteria. However, many of the RCTs suffered from high levels of bias because of data collection issues and bias in the measurement of outcomes. The lack of blinding was not considered to be critical for this assessment; however, the overall level of bias for three of RCTs remained moderate to high, with only one being considered as being at low risk of bias.

With only one RCT rated as being at low risk of bias, the overall evidence base to support the effectiveness of individual communication and engagement interventions is weak.

Effects of interventions

Staff reports of communication outcomes

Two RCTs and a mixed-methods study[322,326,333] from the USA investigated the impacts of complex quality improvement interventions in care homes. They report the views of staff on some measure of communication quality alongside resident outcomes. All three studies reported improvements in this domain after intervention, although the measured outcomes were different and none of the evidence was strong. One of the trials received a moderate quality rating[333] and the other two studies were rated as weak.[322,326]

A cluster randomised pilot trial[333] with 497 nursing home staff investigated whether or not an intervention to improve nursing home staff connections, communication and problem-solving could improve implementation of a falls reduction programme. The authors reported a significant improvement in staff perceptions of communication quality and safety culture over 6 months, measured using standard scales (openness mean score: baseline, 3.51; after intervention, 3.64; 3.7%, $p = 0.02$; safety culture: baseline, 4.45; after intervention, 4.69; 3.6%, $p = 0.004$). The second trial in this section assessed the implementation of a programme to promote early detection of deterioration in residents' condition (the INTERACT tool).[322,326] Involving over 200 care home staff in 72 nursing homes, this study also investigated the ability of the programme to facilitate cultural change in an organisation. Positive improvements in communication were reported. However, the brevity of reporting and complexity of the intervention make it difficult to interpret the significance of the changes.

The mixed-methods study included in this section looked at the impact that staff communication outside arranged group meetings had on residents' fall rates.[322] The 29 participants in the qualitative interviews highlighted the importance of sharing ideas with other colleagues, and the link between frequent communication and the staff feeling informed. In turn, they felt that this helped them to improve resident outcomes.

In summary, these three studies provide weak evidence that complex, quality improvement interventions may positively influence communication from the perspective of staff.

Clinical outcomes

Three studies[322,333,345] reported positive effects on a range of clinical outcomes from interventions to improve communication. Two were included in the previous section on staff outcomes, the mixed-methods study and the pilot RCT.[322,333]

Participating in a quality improvement programme was reported to be associated with a reduction in fall rates in care homes, in Arling's mixed-methods study.[322] Of particular importance were communication with other colleagues outside scheduled meetings, a perception that the collaborative kept staff informed and that it was effective in fostering new ideas. An intervention to improve nursing home staff connections, communication and problem-solving was tested on its ability to enhance the implementation of a falls reduction programme in a pilot cluster RCT.[333] Over a 6-month period, there was a 12% reduction in the falls rate in the intervention facilities pre and post intervention, but no statistically significant differences in control facilities. In this case, the communication intervention may have been successful in enhancing the implementation of the falls reduction programme.

Structured communication was the subject of a RCT in 26 US nursing homes.[345] This study evaluated the effect of introducing structured telephone communication between nurses and physicians about warfarin management for 453 residents. A template was used based on the SBAR approach, which focuses communication about patients under four headings: situation, background, assessment and recommendations. In the intervention homes, residents were significantly more likely to have optimal anticoagulation management, measured by an international normalised ratio value blood test within the target therapeutic range. There were no differences in the correct ordering of follow-up blood tests between intervention and control homes.

In summary, tools to structure communication, such as SBAR, have the potential to enhance clinical outcomes for care home residents. Complex interventions to improve communication may also improve resident clinical outcomes, but the evidence is limited.

Health service outcomes

Four studies[326,334,377,383] reported the impact of interventions on hospitalisation from care homes. Three articles[326,377,383] described outcomes from the Interventions to Reduce Acute Care Transfers programme in the USA, one of which implemented the SBAR tool.[377] Two of these studies were rated as moderate quality,[377,383] and one was rated as weak.[326]

The largest[326] of the three studies of INTERACT implementation reported reduced hospitalisation rates of 58% (118/203) post intervention across 72 nursing homes. The study set in 30 nursing homes[383] found no significant difference in the rate of hospital transfers, and a non-significant reduction in hospital admissions from 4.07 to 3.64 per 1000 resident-days, pre and post intervention. A single-site study[377] reported that the number of hospital transfers decreased after implementation of the SBAR tool; however, there were no differences in the number of avoidable transfers during intervention (1.75 transfers per month).

In the fourth study in this set,[334] a nurse-led telephone support service provided by an advance practice nurse was evaluated in a controlled pre and post intervention study in Australia. This study involved 50 staff from emergency departments and 26 from RACFs. In the 9 months after the implementation of the intervention, there were reductions in emergency department presentations (16%), admissions (19%) and total inpatient days (35%) from the 26 RACFs. The outcome of telephone calls to the service were examined for a 6-month period post intervention. Almost two-thirds (57/97, 60%) of the calls made to the telephone support service resulted in transfers being made to the emergency department, and half (29, 51%) of those residents transferred were admitted to hospital.

Overall, these studies reported small reductions in the rate of hospitalisation after intervention of complex interventions to enhance communication and reduce hospital transfers. Tools to structure communication between nursing homes and health services and telephone support services also appear to have potential to reduce transfers of care home residents to hospital. However, all of the evidence is graded as moderate or weak quality. It is also important to acknowledge that transfer to hospital is sometimes associated with the best outcome for the resident.

Transfer forms

Four studies evaluated the effectiveness of transfer forms to promote communication between nursing homes and hospital emergency departments.[152,339,340,384] Two studies, one from Canada[339] and one from the USA,[340] used a retrospective study design. The other two US studies were pre- and post-interventional studies.[152,340,384] All four studies were rated as being of moderate quality. The number of transfers reviewed in the studies ranged from 60[339] to 513.[152] All studies reported that the number of items of vital data transferred between nursing homes and hospitals increased following implementation of a transfer form. In Canada, a care-reporting database was used to evaluate the impact of standardised transfer forms on information provided to the hospital. Information gaps were observed in three-quarters (75%) of the transfers when the forms were used, compared with 94% when they were not used ($p < 0.001$).[339] A similar retrospective study of transfers between nursing homes and emergency departments in St Louis found that essential information was transferred in 71% of cases when a form was used, compared with 28% when a form was not used ($p < 0.0001$).[340] Documentation of transfers also increased by around 20% to 78% (56/72) after the introduction of a standard transfer form between extended care facilities and emergency departments.[384]

A study on a single site in the USA[152] evaluated the impact of an internet-based system on the information transferred with residents moving between skilled nursing facilities and emergency departments. The new system was used in 40% of care transitions and nine elements of patient information were assessed with a point being awarded for each element included in the transfer. Communication of vital information increased, whereas the total amount of information transferred reduced.[152]

In summary, the use of standardised data collection forms appears to promote the transfer of vital information with residents who are referred to hospital. The studies reviewed provided no data on the impact of transfer forms on patient outcomes.

Discussion

Summary of findings

Around two-thirds of the research on communication and engagement originated from the USA, with only 1 in 10 studies conducted in the UK. Communication about resident transfers to hospital was a major focus of attention. A number of ways of structuring communication have been evaluated, and this appears to offer potential benefits to care home residents and staff. Tools such as SBAR and structured transfer forms have enhanced communication and may have influenced resident outcomes in US studies. A number of the complex interventions aimed at reducing resident transfers to hospital have included a component directed at modifying communication between care home staff and health service personnel.

Strengths and weaknesses

There is extensive literature that may offer insights into communication in and with care homes, and our searches were designed to be comprehensive. However, to manage the volume of material identified, we focused our attention on studies that had an explicit aim or interest in influencing resident-related communication. We also omitted any research that was concerned with communication that was entirely internal to the care home. Nevertheless, we have included studies in our review that describe broad-ranging quality improvement programmes. Most of these programmes aimed to reduce the number of residents transferred to hospital, and modifying communication was one of the strategies employed to meet this aim. The data generated by these studies on staff perception of communication quality are valuable and can be used to judge the relevance of interventions in other settings. The findings that relate to the achievement of programmatic outcomes – notably reductions in hospital transfers – are less useful, as it is often not clear how enhanced communication has influenced outcomes.

The USA has produced a high proportion of the worldwide research into long-term care, and most of the larger studies. However, there are many differences in the organisation and practice of health and social services between the USA and the UK. Any generalisation of the findings of US research to the UK requires careful consideration of the context in which the study was conducted. Communication practices are likely to be very sensitive to cultural contexts, which emphasises the importance of locally appropriate research.

Gaps in research

Care homes in the UK are increasingly active in engaging with their local communities. Many homes host tea parties, bring-and-buy sales and dances. Some have hosted polling stations at election time. These activities are believed to encourage social interaction between residents and local communities, and aim to break down barriers and preconceptions about life in a care home. There is little research in this area to guide care homes and other organisations. This review identified a gap in our understanding of which activities offer the most benefit to residents, and which are acceptable and cost-effective. Future research could usefully further our understanding of the value of the care home as a community resource, and the role of volunteers in promoting engagement between communities and care homes. There is increasing interest in intergenerational initiatives with care home residents, and a need for well-designed evaluative research. A longitudinal perspective on the most effective ways of engaging with local populations and the long-term benefits to residents of greater community engagement would be particularly helpful.

Complex interventions to reduce the number of residents transferred to hospital have been implemented and evaluated in the USA. There is some evidence that these broad-ranging quality improvement programmes have a positive impact on communication and some resident outcomes. However, questions remain about the transferability of these interventions to the UK. The effectiveness and cost of different aspects of different component parts of the interventions may also vary. Research is needed to identify the active ingredients in broad-ranging and complex programmes. It is likely that some aspects of these programmatic interventions are likely to be more applicable to the UK context than others.

Structured communication between care homes and hospitals has been introduced via transfer forms to record information and tools to guide communication by care home staff. These approaches have been shown to enhance information transfer in studies from the USA. The impact on resident outcomes is unknown, but is assumed to be positive.

Telephone support lines for care homes, staffed by advanced nurse practitioners, appear to be effective in reducing transfers of residents to hospital in Australia. These models are in use in the UK but have not been evaluated.

Implications for the UK care home sector

Existing research offers little guidance for UK care homes on how best to promote engagement from local communities or specific groups. This is an area where the care home sector is active, and collaboration with researchers would help to develop the evidence base.

Structured communication tools are available to support care home staff to liaise with the NHS. Although they appear to be effective, they have not been the subject of formal evaluation in the UK, and there is no off-the-shelf solution available for the sector. Evaluation of such tools is essential to ensure that they are modified to be appropriate for the UK situation. Telephone support lines provided by the NHS for care homes are in place in the UK, but no evaluative evidence was found. Formal study of these interventions would be helpful to extend the evidence base.

Section 3: approaches to evaluation in care homes

Background

Evaluating novel interventions or ways of working is essential to ensuring that we understand and can quantify the impact on care home residents, staff and systems. This is particularly important when changes are being proposed to established practice, with implications for the quality and efficiency of care delivery. NHS England's care home vanguard programme aimed to identify interventions that could be rolled out across the NHS. Without effective evaluation, it will be impossible to identify effective interventions, or to understand which are the active ingredients of new models of care or the influential contextual factors for promoting enhanced care.

Evaluation in long-term care may be particularly challenging. Multiple organisations contribute to the care received, and there are few routine data on health-care experiences or health outcomes for residents. The USA has a national minimum data set on residents of Medicare- or Medicaid-certified care homes.[399,400] In England, there are no similar accessible, aggregated outcome data to monitor residents' health and care, and a high proportion of residents are removed from monitoring data produced by general practice for financial payments.[401] Residents are often excluded from a majority of population surveys.[402] This places an emphasis on data collection, which is both costly and a potential burden on busy care homes.

A number of reviews have been published on specific topics relevant to care home evaluation, but there is no overarching synthesis of the current evidence to guide commissioners towards an appropriate evaluation framework. Authors have looked at the ways in which care is organised and how these affect residents, including interdisciplinary interventions in care homes,[403] the impact of case management[404] or optimal organisation of homes for dementia care.[405] Much previous work investigated specific aspects of care, such as medication management and prescribing in care homes, with a particular focus on reducing polypharmacy and minimising the use of psychotropic drugs,[406–408] prevention of falls and exercise promotion/rehabilitation[409,410] or infection control and oral care.[411,412] Process and outcome measures in these areas have been taken as indicators of care quality in care homes, although it is noteworthy that more attention has been given to objective measures of physical status and functioning, rather than to quality of life or resident-identified priorities. The aim of this work is to produce a synthesis of the current evidence that will be useful to guide commissioners to an appropriate evaluation framework. The mapping

review will collate information on approaches to evaluation in care homes and tools used, whereas the systematic rapid evidence synthesis will identify tools validated for use in UK care homes.

Methods

The methods are described in a previous section of this report.

Findings of mapping review

This mapping review had two component parts. In the first, articles were sought that described general evaluations of care, to produce an overview of approaches to evaluation in this setting. In the second, measurement tools used to evaluate different aspects of care in this setting were identified.

TABLE 10 Evaluation mapping review: included studies

First author	Year of publication	Review
Axelsson[413]	2000	Evaluation
Bartoszek[414]	2016	Evaluation
Bettger[415]	2012	Evaluation
Bowers[416]	2008	Evaluation
Bravo[417]	2005	Evaluation
Brownie[418]	2013	Evaluation
Castle[419]	2005	Evaluation
Chenoweth[420]	2007	Evaluation
Chin[421]	2011	Evaluation
Chiu[422]	2005	Evaluation
Corradi[423]	2016	Evaluation
Corazzini[424]	2003	Evaluation
Crogan[425]	2006	Evaluation
Crogan[426]	2006	Evaluation
Cutler[427]	2006	Evaluation
Davis[428]	2016	Evaluation
Drouin[429]	2015	Evaluation
Edvardsson[430]	2008	Evaluation
Fisher[431]	2006	Evaluation
Flores[432]	2009	Evaluation
Forsyth[433]	2000	Evaluation
French[434]	2007	Evaluation
Froggatt[435]	2011	Evaluation
Graney[436]	2000	Evaluation
Halfens[437]	2013	Evaluation
Harrington[438]	2003	Evaluation
Jones [439]	2015	Evaluation

TABLE 10 Evaluation mapping review: included studies (*continued*)

First author	Year of publication	Review
Kapoor[440]	2008	Evaluation
Kehinde[441]	2011	Evaluation
Kovach[442]	2008	Evaluation
Lepore[443]	2012	Evaluation
Levenson[444]	2010	Evaluation
Merilahti[445]	2016	Evaluation
Mor[446]	2011	Evaluation
Mukamel[447]	2007	Evaluation
O'Reilly[448]	2007	Evaluation
Peak[449]	2002	Evaluation
Port[450]	2003	Evaluation
Reijula[451]	2009	Evaluation
Rosen[452]	2006	Evaluation
Ryan[453]	2004	Evaluation
Saivar[454]	2004	Evaluation
Sales[455]	2015	Evaluation
Sangl[456]	2005	Evaluation
Schnelle[457]	2004	Evaluation
Schnelle[458]	2005	Evaluation
Shier[459]	2014	Evaluation
Simmons[460]	2000	Evaluation
Stevenson[461]	2009	Evaluation
Swafford[462]	2009	Evaluation
Thompson[463]	2006	Evaluation
Tolson[464]	2013	Evaluation
Van Camp[465]	2005	Evaluation
Wagner[466]	2008	Evaluation
Wan[467]	2003	Evaluation
Werner[468]	2009	Evaluation
Winters[469]	2014	Evaluation
Woitha[470]	2015	Evaluation
Worden[471]	2006	Evaluation
Wu[472]	2009	Evaluation
Xholi[473]	2004	Evaluation
Yeager[474]	2014	Evaluation
Yeh[475]	2003	Evaluation
Zhang[476]	2009	Evaluation

Approaches to evaluation

Number and characteristics of studies

The database search returned 3799 records. After deduplication and application of the inclusion criteria, 266 articles were selected for screening based on their titles and abstracts by two independent reviewers. Disagreements were resolved through discussion. Of these, 64 articles were judged to have met the inclusion criteria and included in the mapping review (*Table 10*).

Countries

Excluding the five studies that were reviews,[414,418,429,462,463] 38 studies were carried out in the USA,[415,419,423–427,431–434,436,438,440–444,446,447,449,450,452–454,456–461,465–468,472,474,476] six in Australia,[420,421,428,430,439,448] three in multiple sites (one in 30 countries,[464] one in 25 European countries[470] and one in Australia, the Netherlands and Switzerland[437]), two each from Canada[417,455] and Finland[445,451] and one each from China,[422] the Netherlands,[469] Sweden[413] Taiwan[475] and the UK.[435] Three of the studies[416,471,473] did not mention the country where study took place in the title or the abstract.

Methodologies

Of the 64 studies included, eight were experimental studies: five non-randomised trials,[425,426,430,455,466] two RCTs[417,420] and one before-and-after study.[452] There were also 19 cross-sectional studies[415,416,419,422,427,431,437,440,445,447,451,454,457,461,464,467,469,470,472] and one study employed the Delphi methods process.[428] Three of the studies provided descriptions of the methods of evaluations[439,453,458] and two were discussion papers.[444,456] The rest of the studies used observational methods, including surveys, cohort studies, longitudinal, retrospective data analyses and a case study.

Clinical care outcomes

Most of the studies (80%, 51/64) described ways to improve the clinical care outcomes of residents in nursing or residential homes.[413,414,417,419–426,428–434,437,439–441,444,445,447–449,452–473,475,476] Thirty of these studies (60%) assessed approaches to measuring the well-being and quality of care of residents.[417,419–421,424,428,429,432,437,438,444,447–450,453–459,461,463,466–469,471,472,475] For example, one study[469] assessed measures for monitoring change in client-reported and professional indicators over a period of time, and another[451] assessed perceived well-being among elderly people. Six of the studies (12%) focused on measures to promote or maintain the mental health of residents, in particular cognitive ability, delirium status and dementia.[413,420,423,430,439,442] Some of the studies reported on measures to improve mobility ($n = 5$, 10%), nutrition ($n = 3$, 6%), pain ($n = 3$, 6%) and skin care ($n = 2$, 4%), and only one study assessed the measures to improve clinical assessment.

Influencing the culture of nursing homes

Four of the studies (6%) in the mapping assessed approaches to improving the culture of care home facilities. One[427] provided insights into the use of checklists to assess room, bathing, unit and facility environments, whereas another[416] assessed measures of improving provider performance. Another study[421] reported on the effects of observing and interviewing residents to identify elements of the built and social environments that may influence their well-being. The other study[474] was a systematic review that sought to examine and summarise ways in which using the resource dependency theory perspective has an impact on how to operationalise the market environment in health-care settings.

Palliative care

Three (5%) studies also reported on approaches to improve palliative care. One[435] examined the use of a framework that aimed to develop staff knowledge about palliative care by implementing informal, reflective debriefing sessions and using a model (the ÄldreVäst Sjuhärad) to make judgements about the quality of partnership working with older people. A systematic review[463] focused on describing the various methods of measuring the quality of end-of-life care, including measures of satisfaction and perception, quality of life/dying, and structures and processes of care. The reliability and feasibility of a set of quality indicators of palliative care across 25 European countries were presented in a study that argued for their use as a starting point for quality improvement activities.[470]

Staff and staff–resident interactions

Six (9%) studies focused on measures to improve staff practice and staff–resident relationships to long-term care outcomes. Three studies assessed methods to improve change in staff behaviour by monitoring their adherence to protocols and procedures[418,452] and their responses to provider feedback.[455] Two[420,465] focused on improvement measures to staff and resident interactions and the impact that this would have on the quality of care. Only one study[438] focused on measures that examine the impact of quality improvement on indirect staff outcomes such as retention rates, financial indicators (e.g. wages), complaints and deficiencies.

Summary: approaches to evaluation

Over half of the mapped studies were concerned with general aspects of evaluation in care homes, with measurements of quality of care, quality of life or well-being. A majority employed descriptive methods. Experimental approaches were most often applied to specific interventions, rather than general approaches to care.

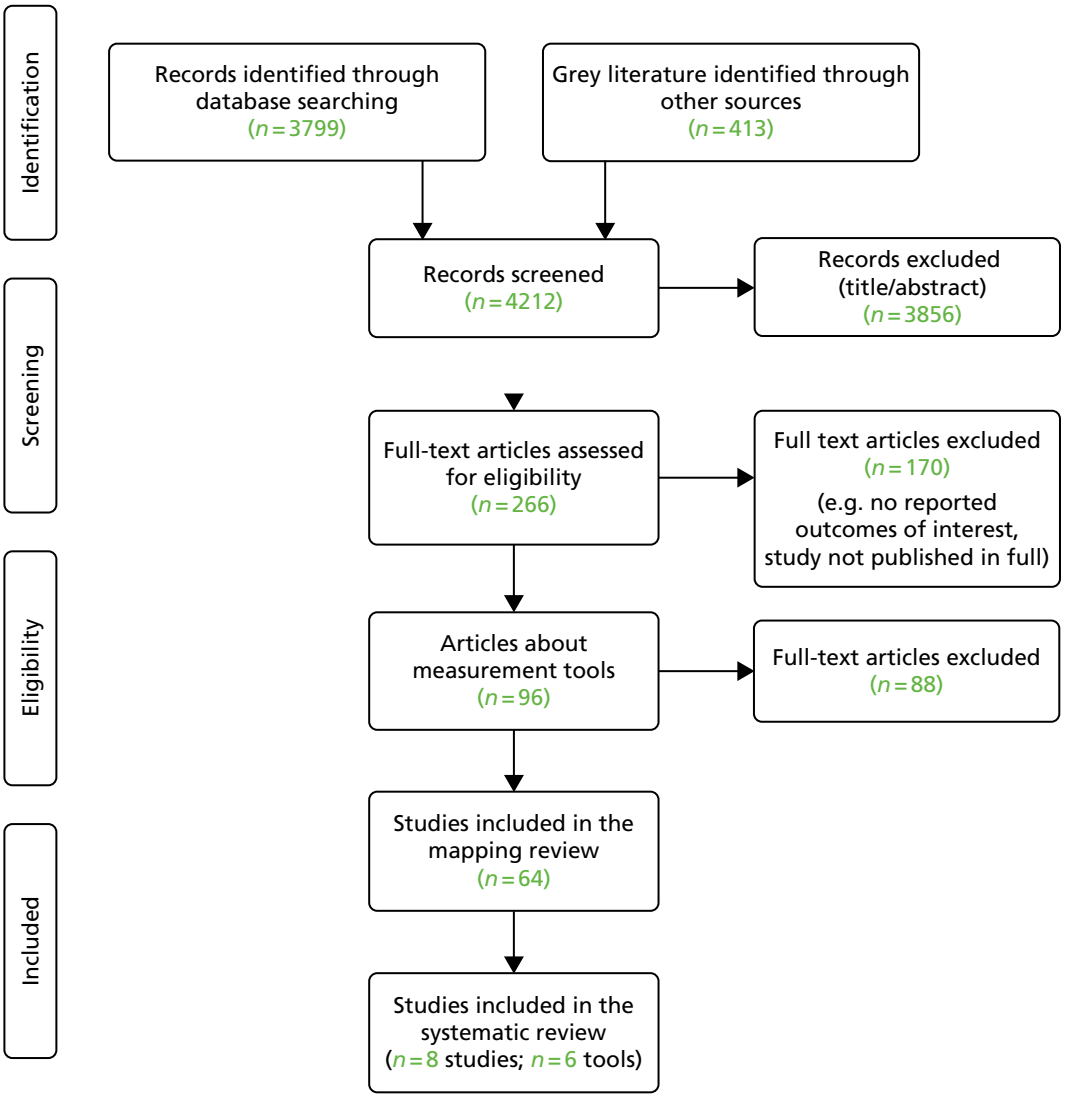

FIGURE 3 Evaluation PRISMA flow diagram.

Methods: evaluation – measurement tools validated in UK care homes

Scrutiny of the mapped literature and specific, focused searches were used to identify articles that described measurement tools used in care homes. Further database searching and an examination of the reference lists of articles using the identified tools served to locate papers describing the validation process. The following section describes tools that have been validated in the UK for use in care homes.

For methods, see *Chapter 3*. The PRISMA flow diagram is shown in *Figure 3*.

TABLE 11 Evaluation: UK-validated tools

Validation study (authors, year of publication)	Measurement tool	Description	Patient/participant characteristics	Population size	Assessor
Dutta *et al.*, 2015[477]	MMRI-R	Measures a resident's risk of dying within the next 6 months	Nursing home residents Median age 87 years; 55.7% female	183	Researchers
Faulkner *et al.*, 2006[478]	CARE profiles	Identifies the frequency of positive events over a specified time based on the perceptions of residents, relatives and staff in care home settings	Care home residents ($n = 23$), relatives ($n = 53$) and staff ($n = 55$) Mean ages: relatives (60.85 years), staff (36.5 years), residents (78.95 years)	131	Researchers (RNs)
Fossey *et al.*, 2002[479]	DCM	Observational tool that looks at the care of people with dementia from the viewpoint of the person with dementia	Nursing and residential home residents Cohort A (mean age 82.3 SD 7.4 years) Cohort B (mean age 78.2 SD 9.1 years)	Cohort A ($n = 123$) Cohort B ($n = 54$)	Researchers
Moniz-Cook *et al.*, 2001[480]	CBS	A behavioural rating scale for older adults living in care with behaviour that staff find difficult to manage	Nursing and residential home residents Mean age 82.7 years (SD 8.14 years)	382	Nursing home staff
Sutcliffe *et al.*, 2000[481]	GDS-12R	A short version of the 30-item GDS, which is a measure for depression among older adults	Nursing and residential home residents Mean age 83 years (SD 7.6 years); 69% female	308	Researchers
Towers *et al.*, 2015[482]	ASCOT	Measures the outcomes of social care for individuals living in a variety of care settings	28 professional and 17 lay stakeholders for care homes	45	Researchers

ASCOT, Adult Social Care Outcomes Toolkit; CARE, Combined Assessment of Residential Environments; CBS, Challenging Behaviour Scale; DCM, dementia care mapping; GDS, Geriatric Depression Scale; GDS-12R, Geriatric Depression Scale – Residential; MMRI-R, Minimum Data Set Mortality Risk Index – Revised; SD, standard deviation.

Findings of systematic evidence synthesis

Tools evaluated for use in UK care homes The complete list of tools used in care homes is presented in *Appendix 4*. Further details of the retrieved articles are presented in *Report Supplementary 1, Table 4.* In total, we identified 65 tools.

In this section, data are presented on six tools that were identified as having been validated in a UK care home setting (*Table 11*).

Measurement tools and evidence of reliability and validity

All of the included studies report on measurement of various aspects of health and well-being in care homes, including dementia, challenging behaviour, depression and general social care. Internal consistency was evaluated in four of the studies,[478–481] followed by criterion validity (measured in three studies)[479–481] and then reliability in two studies[479,480] and content validity[482] and hypothesis testing[477] in one study each. None of the studies evaluated measurement error, structural validity, or cross-cultural validity and responsiveness for their corresponding tools, and none of the studies applied any item response theory models to their tests, and therefore the results of these properties were not presented. All studies that evaluated the methodological quality for internal consistency were scored as poor because they did not provide information on whether or not factor analysis was performed, nor did they refer to any similar study where it could be performed. For criterion validity, all three studies were scored as poor because the criterion used to judge the measurement could not be considered an adequate reflection of a gold standard.[483] *Table 12* provides a summary of the methodological qualities of these measures and *Description of measurement tools* presents a narrative summary of these measures.

Description of measurement tools

Minimum Data Set Mortality Risk Index – Revised (MMRI-R) The MMRI-R tool is a 10-item score sheet simplified from the original Minimum Data Set Mortality Risk Index designed to monitor quality of care in nursing homes. It uses selected Minimum Data Set (MDS) items to determine a resident's risk of dying within the next 6 months.[484] The quality of hypotheses testing for the tool was rated as good after the study theorised that the MMRI-R score could predict 6-month mortality. In this case, hypotheses testing refers to the degree to which the scores of the MMRI-R tool derived from the theory are supported. The evidence, presented as area under the curve of 0.723 for death at 6 months, was consistent with the value of 0.76 in the original MMRI-R validation study based in the USA.[477]

Combined Assessment of Residential Environments profiles The Combined Assessment of Residential Environments (CARE) profiles were developed to identify the frequency of positive events over a specified

TABLE 12 Evaluation: UK-validated tools – methodological quality of measurement tools

Authors, year of publication	Tool	Internal consistency	Reliability	Content validity	Hypothesis testing	Criterion validity
Dutta *et al.*, 2015[477]	MMRI-R	N/A	N/A	N/A	Good	N/A
Faulkner *et al.*, 2006[478]	CARE profiles	Poor	N/A	N/A	N/A	N/A
Fossey *et al.*, 2002[479]	DCM	Poor	Fair	N/A	N/A	Poor
Moniz-Cook *et al.*, 2001[480]	CBS	Poor	Good	N/A	N/A	Poor
Sutcliffe *et al.*, 2000[481]	GDS-12R	Poor	N/A	N/A	N/A	Poor
Towers *et al.*, 2015[482]	ASCOT	N/A	N/A	Good	N/A	N/A

ASCOT, Adult Social Care Outcomes Toolkit; DCM, dementia care mapping; GDS-12R, Geriatric Depression Scale – Residential; MMRI-R, Minimum Dataset Mortality Risk Index – Revised; N/A, not applicable.

time based on the perceptions of residents, relatives and staff in care home settings.[478] They were derived from the Events Frequency Approach,[485] which encourages the involvement of representative members of a target group, including residents and staff. The process takes place in two phases. Phase 1 involves asking target members to nominate events that they believe are important and enjoyable in a care home. Phase 2 involves judging the nominated events using a 5-point rating scale. Based on limited evidence, Cronbach's alpha, a statistic used to measure the degree of internal consistency between items in a questionnaire,[486] showed acceptable scores (≥ 0.7) ranging from 0.7 to 0.89 for residents, 0.91 to 0.94 for relatives and 0.78 to 0.92 for staff.[478] However, owing to poor methodological quality (factor analysis not being performed), the quality of internal consistency of the tool was rated as poor.

Dementia care mapping Dementia care mapping (DCM) is an approach used to improve the quality of care for people with dementia living in various care settings.[487] It was developed in the UK by the Bradford Dementia Group from the psychosocial theories of dementia.[488] DCM involves recording observations every 5 minutes for up to 6 hours on a patient's behaviour and assigning a behaviour category code and perceived quality of life, and assigning a well-being and ill-being score. To assign a behaviour category code, the observer selects from a list of 24 codes, the one that best describes the behaviour of the resident during the 5-minute observation period, whereas well-being and ill-being values are judged on a six-point scale from very negative (–5) to very positive (+5).[479] Internal consistency, test–retest reliability and concurrent validity were evaluated by investigating the correlations between key DCM indices, the hour before lunch and the total observation period, respectively, using Spearman's rank correlation.[489] Although the study showed that there was excellent agreement between the different DCM indices, internal consistency of the study was rated as poor because of factor analysis not being performed on the tool. The study showed good levels of agreement for well-being ($r = 0.58$; $p < 0.0001$) and well-being and ill-being score ($r = 0.55$; $p < 0.0001$) and more moderate scores for activities ($r = 0.4$; $p = 0.003$) and social withdrawal ($r = 0.33$; $p = 0.007$); however, the test–retest reliability of the tool was rated as fair because the study did not report on whether there were any missing items or participants and this affected the rating.[483] The quality of criterion validity was also rated as poor because the measurement tool that DCM was evaluated against, the Blau Scale,[490] could not be considered as gold standard[483] even though there was evidence of strong correlation between the well-being and ill-being score (DCM) and quality of life score (Blau Scale) ($r = 0.73$; $p < 0.0001$).

Challenging Behaviour Scale The CBS is a 25-item rating scale that records staff reports of the incidence, frequency and management difficulty of residents' behaviour, and it can also identify challenging residents through a computed score. The frequency of a behaviour is rated from 1 (occasionally present or less than once per month) to 4 (present daily) and severity of the behaviour is rated from 1 (minimal management difficulty) to 4 (extreme management difficulty). Scores are then calculated as totals of incidence (0–25), frequency (0–100) and difficulty (0–100). The fourth measure, a computed score, is calculated as the sum of the products of frequency and difficulty ratings for each behavioural item on the scale (0–400).[480] Internal consistency of the scale was rated as poor because of factor analyses not being performed;[483] however, based on the limited evidence presented in the study, Cronbach's alpha[486] for the four subscales showed acceptable scores: 0.85 (incidence), 0.82 (frequency), 0.87 (difficulty) and 0.85 (challenge).[480] Criterion validity of the tool was also rated as poor because the analysis was explored by correlating the total scores for each of the four CBS measures: incidence ($r = 0.45$; $p = 0.01$), frequency ($r = 0.46$; $p = 0.001$), difficulty ($r = 0.36$; p0.001) and challenge ($r = 0.35$; $p = 0.001$). It was difficult to ascertain if this criterion method could be considered as gold standard.[483] Reliability of the scale was rated as good based on the presented evidence, and test–retest and inter-rater reliability were shown to be good.[480]

The Geriatric Depression Scale (Residential) The Geriatric Depression Scale – Residential (GDS-12R) scale is a screening measure for depression appropriate for use with older people in nursing and residential care. It is a short form of the 30-item Geriatric Depression Scale (GDS), shown to be effective in distinguishing between depressed and non-depressed older adults. The GDS-12R is based on the 15 item Geriatric Depression Scale (GDS-15) and reflects the differences between living in the community and living in institutions such as nursing homes. The scale consists of 12 questions, with responses awarded points for

either positive statements [yes (0) and no (1)] or negative statements [yes (1) and no (0)]. The total score is calculated as the sum of points for all 12 questions with a minimum score (0) and maximum score (12).[481] Based on the evidence presented in the study, internal reliability scores were all high (> 0.8) for each of the three data collection points: at admission (alpha = 0.85), at 5 months (alpha = 0.848) and at 9 months (alpha = 0.812). The quality of assessing internal consistency was rated as poor, however, as factor analyses were not performed in the study.[483] Based on limited evidence, using another indicator of depressed mood from another tool, the Affect Balance Scale[491] as a comparator showed that the GDS-12R gives higher levels of specificity and sensitivity than the original GDS-15. However, criterion validity was rated as poor because no current measurement tools are considered to be an adequate gold standards for comparison.[483]

Adult Social Care Outcomes Toolkit The Adult Social Care Outcomes Toolkit (ASCOT) was developed as a multiattribute preference-weighted measure of social care-related quality of life. It has eight conceptually distinct attributes: personal cleanliness and comfort, food and nutrition, control over daily life, personal safety, accommodation cleanliness and comfort, social participation and involvement, occupation, and dignity. The toolkit can be administered as self-completion questionnaires, face-to-face interviews or observations depending on the needs of an individual, and service users applying the relative importance or preference weights to obtain an overall social care-related quality of life score, which is rated between zero and one and quantifies the a service user's well-being based on personal experiences.[492] Face validity of the study was rated as good because experts within the field were asked to reflect on whether or not the toolkit actually measured the construct it was supposed to measure, based on their experiences in social care.[482]

Discussion

This review identified six measurement tools that have undergone some validation for use in UK care homes. These included measures of depression, behaviours that staff find difficult to manage, a resident's risk of dying within 6 months and dementia care from the resident's perspective. Only two measures of more general outcomes of care were included: ASCOT and CARE. None of the included tools scored highly in our assessment of measurement properties.

A broad range of measurement tools have been described in the English-language care home literature. From 65 articles in our mapping that described use of a tool or measure published since the year 2000, we were able to identify only six tools with associated, published validation work from the UK. Validation of one of the general measures, the care home version of ASCOT, involved 29 professional and 17 lay stakeholders, However, this supplements development work for the original, earlier versions of this measure. Validation of the remaining five tools involved study populations of between 131 and 308. In all but one study, researchers performed the assessments.

Many care home residents living with cognitive impairment or dementia may be unable to respond to surveys or interview questions. Proxy respondents in the form of staff or relatives are often used to provide a resident's perspective. Some measures, such as the CARE profiles, deliberately seek responses from all parties to generate a rounded picture. Others may need specific tailoring to application by a proxy. Both approaches have strengths and weaknesses, and the important point is that they should be explicitly addressed in tool development and administration. In this study, we made no comment on the length of the tools, although this is relevant to all residents and likely to influence completion rates.

The search for appropriate performance measures in long-term care has been the subject of an extensive literature.[493,494] A manual of 94 institutional-level indicators for use in long-term care has been produced by a European consortium that included the My Home Life Project authors.[494] Starting from a conceptual analysis of quality of care and quality of life in this setting, the indicators were derived from a range of sources, including regulatory frameworks. Although a majority of these indicators do not require a specific measurement tool, the extent of this project serves to illustrate the complexity of evaluating the outcomes of care in this setting.[494] A number of the indicators related directly to the domains of the CARE framework.

Strengths and limitations

To be comprehensive, this review accepted a broad definition of measure or tool, but this has generated a heterogeneous group of studies. Restricting this work to research published after the year 2000 gave a focus on measures likely to be in current usage. The search for validation papers was not restricted by year so that it would reflect the times involved in the development and adoption of new measures. Many measurement tools used in care homes will be dementia specific, and it is possible that our focus on the care home setting led us to overlook some of these. Similarly, by focusing on UK-validated measures, we will have omitted tools that may work well in the UK. (The Oral Health Assessment Tool, for example, features in National Institute for Health and Care Excellence guidance, but was developed for use in Western Australia.[495]) It is also plausible that measures used in hospitals or during primary care consultations could be transferable to the care home setting. However, the unique context provided by care homes, which are home to residents living with multiple conditions and frailty, and have staff who may not be familiar with the application of measurement tools, suggests that tools should be tested in that environment.

Implications

This review did not identify a well-validated general outcome measure for use in UK care homes. Our assessment of the methodological quality of ASCOT and CARE identified strengths, weaknesses and possible areas for future work. A broad range of measures has been used in care homes worldwide. Some of these measures merit assessment of their suitability for use in a UK setting to avoid the need to develop completely new tools.

Close scrutiny of the measures in this review provides some guidance as to the sources and types of data that may be helpful to evaluate the quality and impact of health and other service inputs to care homes. There is no comprehensive, easily accessible source of information on health, well-being or quality of life in care homes across England and Wales. However, this information could inform the future development of any care home minimum data set.

Section 4: care home workforce

Background

A care home's workforce is its life blood, and is central to the provision of high-quality care. Yet, for a range of reasons, recruitment and retention in this sector are ongoing challenges. The low-wage economy is an important factor in the employment of care assistants. In a recent review of the literature on training and ongoing professional development for the RN workforce, the absence of a career path for care home nurses, low levels of confidence in their own skills and poor access to training were particular areas of concern.[496] High staffing levels and job satisfaction are believed to be associated with better-quality care, whereas high staff turnover is linked with poor outcomes for residents.[497–500] The drive to enhance care has led to calls for innovative thinking around the care home workforce, the skills and expertise required of staff and the roles adopted.

This section of the report presents a mapping review of literature on the care home workforce. It aims to inform flexible and innovative uses of the nursing and support workforce to benefit resident care. The linked rapid review examines the relationship between staffing levels (the ratio of RNs and support staff to residents or different levels of support staff) and resident outcomes.

Methods

See *Chapter 3* for overview section.

TABLE 13 Workforce mapping review: included studies

First author	Year of publication	Review
Abraham[501]	2008	Workforce
Abrahamson[502]	2013	Workforce
Adams-Wendling[503]	2005	Workforce
Akinci[504]	2005	Workforce
Alexander[505]	2008	Workforce
Alzheimer's Society[506]	2007	Workforce
Anderson[507]	2004	Workforce
André[508]	2014	Workforce
Anonymous[511]	2001	Workforce
Anonymous[509]	2005	Workforce
Anonymous[510]	2009	Workforce
Anonymous[512]	2009	Workforce
Anonymous[316]	2011	Workforce
Arling[513]	2007	Workforce
Atkins[514]	2010	Workforce
Backhaus[516]	2014	Workforce
Backhaus[515]	2015	Workforce
Banaszak-Holl[517]	2015	Workforce
Bates-Jensen[518]	2004	Workforce
Berta[519]	2013	Workforce
Blekken[520]	2015	Workforce
Blinkhorn[521]	2012	Workforce
Boorsma[522]	2011	Workforce
Bostick[524]	2002	Workforce
Bostick[523]	2004	Workforce
Bostick[525]	2006	Workforce
Boumans[526]	2008	Workforce
Bowblis[527]	2011	Workforce
Bowers[528]	2000	Workforce
Brown[529]	2007	Workforce
Brown[530]	2016	Workforce
Brulhart[531]	2011	Workforce
Buettner[532]	2009	Workforce
Bunn[533]	2015	Workforce
Burgio[534]	2004	Workforce
California Health Care Foundation[536]	2006	Workforce
California Health Care Foundation[535]	2008	Workforce

continued

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Care Quality Commission[573]	2013	Workforce
Carrier[537]	2009	Workforce
Carter[538]	2003	Workforce
Cassidy[331]	2005	Workforce
Cassie[539]	2012	Workforce
Castle[540]	2000	Workforce
Castle[541]	2001	Workforce
Castle[542]	2005	Workforce
Castle[543]	2006	Workforce
Castle[544]	2006	Workforce
Castle[545]	2007	Workforce
Castle[546]	2007	Workforce
Castle[547]	2008	Workforce
Castle[548]	2008	Workforce
Castle[549]	2008	Workforce
Castle[550]	2008	Workforce
Castle[551]	2010	Workforce
Castle[552]	2011	Workforce
Castle[553]	2011	Workforce
Castle[554]	2011	Workforce
Castle[555]	2012	Workforce
Castle[556]	2014	Workforce
Castle[557]	2015	Workforce
Chang[559]	2005	Workforce
Chang[558]	2006	Workforce
Chapman[560]	2007	Workforce
Chen[561]	2015	Workforce
Cherubini[562]	2012	Workforce
Chipantiza[563]	2014	Workforce
Choi[564]	2012	Workforce
Chou[566]	2002	Workforce
Chou[565]	2003	Workforce
Chu[567]	2014	Workforce
Clare[568]	2013	Workforce
Collier[569]	2008	Workforce
Collier[570]	2008	Workforce
Comondore[571]	2009	Workforce
Corazzini[572]	2013	Workforce

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Crickard[574]	2005	Workforce
de Jonge[575]	2014	Workforce
Decker[576]	2008	Workforce
Dellefield[577]	2000	Workforce
Dhaini[578]	2016	Workforce
Dill[579]	2013	Workforce
Dixon[580]	2010	Workforce
Donoghue[581]	2007	Workforce
Donoghue[582]	2010	Workforce
Dwyer[583]	2011	Workforce
Dwyer[584]	2015	Workforce
Dyck[586]	2004	Workforce
Dyck[585]	2007	Workforce
Eckstrom[587]	2016	Workforce
Ersek[588]	2014	Workforce
Eyers[589]	2003	Workforce
Figueiredo[590]	2013	Workforce
Finnema[591]	2005	Workforce
Fitzler[592]	2016	Workforce
Freeman[593]	2003	Workforce
Gao[594]	2014	Workforce
Sandoval Garrido[595]	2014	Workforce
Gloth[596]	2011	Workforce
Goldberg[597]	2000	Workforce
Gorski[598]	2004	Workforce
Goyder[599]	2012	Workforce
Grabowski[600]	2008	Workforce
Gray-Siracusa[601]	2005	Workforce
Halcomb[602]	2009	Workforce
Harahan[603]	2011	Workforce
Harden[604]	2015	Workforce
Harrington[608]	2000	Workforce
Harrington[606]	2003	Workforce
Harrington[607]	2012	Workforce
Harrington[605]	2016	Workforce
Harvath[609]	2008	Workforce
Hasson[355]	2008	Workforce

continued

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Havig[610]	2011	Workforce
Havig[611]	2014	Workforce
Heath[612]	2012	Workforce
Hedrick[613]	2009	Workforce
Heeren[614]	2014	Workforce
Hegeman[615]	2005	Workforce
Help the Aged[616]	2007	Workforce
Hendrix[618]	2000	Workforce
Hendrix[617]	2001	Workforce
Heponiemi[619]	2011	Workforce
Hewison[358]	2009	Workforce
Hickey[620]	2005	Workforce
Hodgkinson[621]	2011	Workforce
Hofmann[622]	2003	Workforce
Hollingsworth[623]	2016	Workforce
Horn[624]	2005	Workforce
Horn[625]	2010	Workforce
Hovey[626]	2015	Workforce
Hunt[627]	2014	Workforce
Hutt[629]	2003	Workforce
Hutt[628]	2008	Workforce
Hyde[630]	2014	Workforce
Hyer[631]	2011	Workforce
Ikegami[632]	2013	Workforce
Intrator[633]	2011	Workforce
Irvine[634]	2013	Workforce
Jette[635]	2004	Workforce
Jogerst[636]	2008	Workforce
Johnson[637]	2005	Workforce
Jordan[638]	2009	Workforce
Kajonius[639]	2016	Workforce
Kang[640]	2008	Workforce
Karsh[641]	2005	Workforce
Kash[643]	2006	Workforce
Kash[642]	2010	Workforce
Katz[645]	2009	Workforce
Katz[644]	2011	Workforce
Kayser-Jones[646]	2003	Workforce

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Kayser-Jones[647]	2008	Workforce
Kayyali[648]	2014	Workforce
Keogh[302]	2014	Workforce
Kerr[649]	2008	Workforce
Killett[650]	2013	Workforce
Kim[651]	2006	Workforce
Kim[652]	2009	Workforce
Kim[653]	2009	Workforce
King[654]	2001	Workforce
Kinjerski[655]	2008	Workforce
Kirkevold[658]	2004	Workforce
Kirkevold[657]	2006	Workforce
Kirkevold[656]	2008	Workforce
Klay[659]	2005	Workforce
Klitch[660]	2000	Workforce
Konetzka[662]	2005	Workforce
Konetzka[661]	2008	Workforce
Kovner[663]	2000	Workforce
Kovner[665]	2000	Workforce
Kovner[664]	2001	Workforce
Kramer[666]	2002	Workforce
Krichbaum[667]	2000	Workforce
Kris[669]	2004	Workforce
Kris[668]	2009	Workforce
Krueger[670]	2002	Workforce
Kuo[671]	2008	Workforce
Laakso[672]	2001	Workforce
Laging[673]	2015	Workforce
Landreville[674]	2005	Workforce
Lange[675]	2011	Workforce
Lapane[677]	2004	Workforce
Lapane[676]	2007	Workforce
Lapane[678]	2011	Workforce
LaPorte[679]	2007	Workforce
Lee[682]	2002	Workforce
Lee[681]	2009	Workforce
Lee[680]	2014	Workforce

continued

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Leland[683]	2012	Workforce
Lerner[684]	2013	Workforce
Lerner[498]	2014	Workforce
Lewis[685]	2004	Workforce
Li[686]	2015	Workforce
Lin[687]	2014	Workforce
Lisk[688]	2012	Workforce
Liu[689]	2011	Workforce
Lucas[691]	2007	Workforce
Lucas[690]	2009	Workforce
Maas[692]	2008	Workforce
MacEntee[693]	2007	Workforce
Manitoba Nurses' Union[694]	2006	Workforce
Marcotte[695]	2009	Workforce
Masterson[696]	2004	Workforce
Matsudaira[697]	2012	Workforce
Mattingly[698]	2015	Workforce
Mayrhofer[699]	2016	Workforce
McAiney[700]	2008	Workforce
McGilton[701]	2007	Workforce
McGilton[702]	2014	Workforce
McGregor[704]	2005	Workforce
McGregor[705]	2011	Workforce
McGregor[703]	2014	Workforce
McKinney[706]	2016	Workforce
McNulty[707]	2006	Workforce
Meade[708]	2016	Workforce
Meehan[709]	2015	Workforce
Miller[710]	2016	Workforce
Mitchell[711]	2003	Workforce
Molinari[712]	2008	Workforce
Monarch[713]	2005	Workforce
Monkhouse[714]	2003	Workforce
Morgan[715]	2008	Workforce
Moxon[716]	2001	Workforce
Moxon[717]	2003	Workforce
Moyle[718]	2003	Workforce
Mueller[719]	2006	Workforce

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Mueller[720]	2012	Workforce
Muirhead[721]	2004	Workforce
National Center for Health Workforce Analyses[722]	2004	Workforce
Nazir[403]	2013	Workforce
Neuman[723]	2014	Workforce
Noel[724]	2000	Workforce
Older People's Commissioner for Wales[725]	2014	Workforce
Orellana[726]	2014	Workforce
Ottem[727]	2004	Workforce
Painter[728]	2000	Workforce
Painter[729]	2000	Workforce
Park[730]	2009	Workforce
Parsons[731]	2003	Workforce
Paulsen[732]	2005	Workforce
Personal Social Services Research Unit[733]	2011	Workforce
Phillips[734]	2000	Workforce
Pillemer[735]	2008	Workforce
Pittman[736]	2015	Workforce
Rahnfeld[737]	2016	Workforce
Rai[738]	2012	Workforce
Rantz[739]	2014	Workforce
RCN[740]	2004	Workforce
RCN[742]	2010	Workforce
RCN[743]	2010	Workforce
RCN[741]	2012	Workforce
Redfern[744]	2002	Workforce
Rico[745]	2013	Workforce
Riggs[746]	2001	Workforce
Rondeau[747]	2009	Workforce
Rosen[748]	2011	Workforce
Ryden[749]	2000	Workforce
Sawan[750]	2016	Workforce
Schnelle[751]	2004	Workforce
Schwendimann[752]	2016	Workforce
Scott-Cawiezell[753]	2007	Workforce
Scottish Care[754]	2015	Workforce
Scottish Care[755]	2015	Workforce

continued

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Scottish Care[756]	2016	Workforce
Scottish Care[757]	2016	Workforce
Shin[758]	2008	Workforce
Shin[759]	2008	Workforce
Shin[760]	2012	Workforce
Shin[761]	2013	Workforce
Shin[762]	2014	Workforce
Shin[763]	2015	Workforce
Shipman[764]	2007	Workforce
Shippee[765]	2015	Workforce
Simmons[767]	2001	Workforce
Simmons[766]	2004	Workforce
Spector[768]	2013	Workforce
Spilsbury[499]	2011	Workforce
Spilsbury[496]	2015	Workforce
Spilsbury[769]	2015	Workforce
Stearns[770]	2007	Workforce
Stolee[771]	2006	Workforce
Suen[772]	2006	Workforce
Tamura[773]	2013	Workforce
Temple[774]	2011	Workforce
Thomas[777]	2009	Workforce
Thomas[776]	2010	Workforce
Thomas[775]	2014	Workforce
Thompson[778]	2002	Workforce
Tong[779]	2011	Workforce
Trinkoff[780]	2005	Workforce
Trinkoff[500]	2013	Workforce
Unruh[781]	2005	Workforce
Wagner[782]	2008	Workforce
Walker[783]	2008	Workforce
Wan[784]	2006	Workforce
Way[785]	2008	Workforce
Weech-Maldonado[786]	2004	Workforce
Wild[787]	2010	Workforce
Woo[788]	2005	Workforce
Xing[789]	2013	Workforce
Xu[790]	2013	Workforce

TABLE 13 Workforce mapping review: included studies (*continued*)

First author	Year of publication	Review
Yamaguchi[791]	2016	Workforce
Yassi[792]	2004	Workforce
Yeatts[793]	2000	Workforce
Yeh[794]	2002	Workforce
Zhang[795]	2004	Workforce
Zhang[796]	2005	Workforce
Zhang[797]	2008	Workforce
Zhang[798]	2009	Workforce
Zhang[799]	2013	Workforce
Zimmerman[800]	2002	Workforce
Zúñiga[802]	2014	Workforce
Zúñiga[801]	2015	Workforce

RCN, Royal College of Nursing.

Findings of mapping review

Number and characteristics of studies

After deduplication, 5383 studies were identified for title and abstract screening, and 535 identified for full-text screening. Three hundred and sixteen articles met the broad inclusion criteria for the mapping review (*Table 13*).

Countries

The USA was the setting for two-thirds of the work ($n = 201$, 64% studies). A further 48 (15%) were from high-income countries other than the USA and Europe. Forty-one studies (13%) were conducted in the UK, and the remaining 26 (8%) studies were conducted in the rest of Europe (for study details see *Report Supplementary Material 1*).

Study design

Twenty-nine (9%) of the included studies presented a review of existing research evidence, of which 14 (4%) used a systematic approach. Thirty-one (10%) were experimental and quasi-experimental studies. Observational studies were the biggest single group by design ($n = 159$, 50%); the majority of these were cross-sectional ($n = 127$, 40%). Fifteen (5%) were purely qualitative studies, and a further 21 (7%) used mixed methods. The remaining studies were reports ($n = 18$, 6%), descriptive or case studies ($n = 26$, 8%), or opinion pieces ($n = 17$, 5%) (for study details see *Report Supplementary Material 1*).

Staff groups of interest

All of the included articles were concerned in some way with care home staffing, but the main focus varied. In *Report Supplementary Material 1*, *Table 5*, all articles are labelled with the aspect of staffing that they cover. One-third of the articles (109, 34%) were focused on topics that were the most likely to inform new or flexible ways of working; staff roles ($n = 35$, 11%), mix of staff ($n = 35$,11%), training ($n = 27$, 9%), teamworking ($n = 7$, 2%) and leadership ($n = 5$, 2%) (for study details see *Report Supplementary Material 1*).

When studies covered more than one aspect of staffing, the most prominent or important was selected for the mapping. In most cases, this was staff numbers. One hundred and forty of the mapped studies (44%) dealt with staff numbers or staff hours. Smaller numbers of studies were included on job satisfaction

(*n* = 16, 5%), turnover (*n* = 42, 13%), regulations for minimum staff numbers (*n* = 5, 2%) and staff absenteeism (*n* = 2, 1%) (for study details see *Report Supplementary Material I*).

Target population

The population of interest was recorded for each mapped study. (Many studies included more than one staff group, so percentages total more than 100.) Two hundred and thirteen articles (67%) were concerned with nurses; in 160 (51%) of these the nurses were registered or licensed. NAs or aids were the subject of 100 (32%) studies, and 49 (16%) studies were concerned with management or administrative staff. Physicians were the subject of 11 (3%) studies. Sixty-six (21%) studies dealt with residents and a further 16 (5%) dealt with families.

Outcomes

A majority of studies (*n* = 228, 72%) measured or discussed resident outcomes. Among these, clinical outcomes were the most commonly reported (*n* = 136, 43%). A smaller number of studies reported on resident functional status (*n* = 47, 15%) and satisfaction, well-being or quality of life (*n* = 45, 14%). Almost half of the mapped studies discussed staff outcomes (*n* = 142, 45%). Process measures of care, and system outcomes, such as service utilisation, were considered in 55 (17%) and 86 (27%) studies respectively (for study details see *Report Supplementary Material 1*).

UK studies

Forty-one (13%) of the mapped studies were published from the UK between 2000 and 2016. The majority (*n* = 28) were published from 2010 onwards. One-third of UK studies (*n* = 15) were reports, primarily from care home organisations and non-governmental organisations, such as Skills for Care and the Royal College of Nursing. Seven publications presented syntheses of existing evidence, three of which were systematic reviews. Five were mixed-method studies, six were cross-sectional studies, two were RCTs, two were quasi-experimental studies, two were descriptive studies, two were qualitative studies, one was a case study and one was an opinion piece (for study details see *Report Supplementary Material 1*).

Novel staff roles or ways of working for care home staff

To describe the evidence base for novel staff roles and new or flexible ways of working in more detail, two researchers screened the titles of the mapped literature for publications that provided empirical data on these topics. The full texts of 36 titles were examined and 20 of these were selected for closer scrutiny. *Table 14* provides information on the selected studies, including aim, design, outcomes and findings. Seven US studies were included, as were three each from the UK and Australia, two each from Canada and the Netherlands and one from Finland (for study details see *Report Supplementary Material 1*). A majority reported data from single or very small sites, including a single general practice[708] and one,[521,532,672,793] two,[526,560,602,716] or three[749,771,787] care homes. Studies were not subject to quality appraisal, but they varied widely in study design, size and setting. All of the published studies reported positive findings.

In the following section, the mapped literature that was pertinent to new care home staff roles or new ways of working is described.

Working together in care homes

The need for different health and social care disciplines to work together was a common theme in the literature on new ways of working in care homes. Nazir and colleagues[403] conducted a systematic review of RCTs of interdisciplinary interventions in care homes, and examined their impact on resident outcomes. A change in staff roles is implied, but this was not always explicit in the included studies. In formal team-based care, communication, co-ordination and leadership were consistent features of success. Involving the residents' primary care provider was also associated with positive outcomes.

A systematic review and individual studies in this mapping review also described complex models of care, with implied changes in working practice for care home staff. For example, introducing person-centred care would require the adoption of new or different ways of working by many staff. The review by

TABLE 14 Workforce mapping review: novel roles or ways of working

Authors, year of publication, country	Aim of study	Design	Sample size	Sample characteristics	New staff role or way of working	Outcomes and measures	Findings	Positive outcome?
Blinkhorn *et al.*, 2012, Australia[521]	To improve the oral health of residents in an aged care mental health unit through the introduction of an innovative nursing intervention	Mixed methods	28 residents; nursing staff from nine hospital wards NP	Residents of a aged care mental health unit; qualified nurses	Enhanced role for staff in oral hygiene	Resident: plaque and gingival index, pocket depth, views of new protocol Staff: interviews	Staff training and implementation of protocols resulted in improved oral care for residents. Reductions were seen in plaque scores, gingivitis and pocket depths. The oral hygiene protocol was positively accepted into a daily routine and the knowledge of staff in matters relating to oral health increased	Yes
Boumans *et al.*, 2008, Netherlands[526]	To examine the implementation of integrated care in nursing homes and its effects on the quality of caregivers' work	Quasi-experimental (pre and post)	Two nursing homes	Intervention nursing home (three physical disability wards and two psychogeriatric wards). Control nursing home (two physical and two psychogeriatric wards)	Integrated care model with three components: home-like environment, care in line with resident demands and co-ordinated care provision	Demographic and ward characteristics, care load (SIVIS-Help Index), bespoke scale measuring three characteristics of integrated care Quality of work measures. Staff satisfaction	Integrated care intervention was only successful on the wards caring for people with physical disabilities, where it was easier to implement Increases were reported in collaboration and support from supervisors and a decrease in job demands. There were no changes in workers' outcomes, such as job satisfaction	Yes
Brownie and Nancarrow, 2013, Australia[418]	Effects of person-centred care on residents and staff in aged care facilities: a systematic review	Systematic review	Nine studies	One cluster RCT, eight controlled quasi-experimental or pre–post design	Interventions to deliver person-centred care. These were multifaceted, and included leadership and management changes, staffing models to empower staff, and allocating staff to individual residents, as well as modifications to the environment	A broad range of outcome measures, including resident, family and staff satisfaction, resident quality of life, functional status, psychological well-being and infection rates	Some of the included studies describe interventions that are likely to require new ways of working by care home staff. The authors concluded that some person-centred interventions were associated with improved outcomes for residents. However, the quality of the included studies in this review was low, making it difficult to draw robust conclusions. Specific interventions, such as the Eden alternative (a framework for introducing person-centred care), were highlighted as being associated with improvements in residents' psychological well-being, including reduction in boredom and loneliness	Some
Buettner, 2009, USA[532]	To evaluate a training programme to improve staff knowledge and skills in engaging residents in meaningful activity	Descriptive	29 staff staff members of one care home		New role for recreational therapist as trainer for care home staff	Twenty-item multiple-choice questionnaire on dementia, skills in engaging residents observed and rated on a 5-point scale, measure of perceived stress	A recreational therapist delivering 10 training sessions to care home staff was able to increase staff knowledge and reduce their stress levels	Yes

continued

TABLE 14 Workforce mapping review: novel roles or ways of working (*continued*)

Authors, year of publication, country	Aim of study	Design	Sample size	Sample characteristics	New staff role or way of working	Outcomes and measures	Findings	Positive outcome?
Burgio *et al.*, 2004, USA[534]	To compare resident and staff outcomes across two types of staffing patterns, permanent and rotating assignment (or primary and team nursing), and work shift	Between-groups comparison	91 CNAs delivering primary nursing, 87 team nursing	CNAs from four nursing homes (two using primary care nursing/permanent assignment staffing and two using team nursing/ rotating assignment staffing)	Primary care nursing model vs. team nursing	CNAs' job satisfaction, burnout, absenteeism and turnover rates	In homes using primary care/ permanent assignment staffing, personnel were assigned to specific residents. With this model, absenteeism was higher, but CNAs had greater job satisfaction. Evening shifts had higher turnover rates in all homes	Yes
Chapman and Toseland, 2007, USA[560]	To evaluate the effectiveness of an AICT in two nursing homes	RCT (partial crossover design)	118 residents in two nursing homes	Residents with a diagnosis of dementia, scoring ≤ 23 on the MMSE and ≥ on the GDS, plus requiring assistance on ≥ 4 ADLs	Formation of AICTs from care home staff, with external input from clinical social workers	Resident clinical outcomes: Cohen-Mansfield Agitation Inventory; Face, Legs, Activity, Cry, Consolability Behavioral Pain Scale; Cornell Scale for Depression in Dementia; Pain in Advanced Dementia	Working in multidisciplinary advanced illness care teams made up of care home and external staff led to reduced pain and agitation among residents	Yes
Finnema *et al.*, 2005, Netherlands[591]	To evaluate the effect of emotion-orientated care on care home residents with dementia and NAs	RCT	146 residents and 99 staff	Residents with dementia in 14 care homes; 99 NAs	NAs trained to provide emotion-orientated care	Measures of resident mood and behaviour. NA stress and general health	NAs were trained to deliver care aimed at improving emotional and social functioning and quality of life was integrated with usual care Positive effects were reported on anxiety and dissatisfaction for residents with mild or moderate dementia. Staff who felt that they had acquired skills reported fewer stress reactions	Yes
Halcomb, 2009, Australia[803]	To examine the feasibility, acceptability and sustainability of multidisciplinary case conferencing in residential care	Mixed methods	31 case conferences	Staff in two aged care facilities in Australia	Care staff taking a leading role in multidisciplinary case conferencing	Interviews with 11 residential care staff; questionnaires with all participating staff	Multidisciplinary case conferencing in residential care appears to be feasible, with care staff playing a role. Finding time to complete resident assessments before case conferences was challenging, but staff found the meetings valuable for learning more about residents' health and care	Yes
Hollingsworth *et al.*, 2016, USA[623]	To compare the quality of feeding assistance provided by trained non-nursing staff with care provided by CNAs	Mixed methods	126 residents and 113 staff	Residents: 61 in intervention group, 65 in usual care control group Staff: 50 in intervention group plus 39 trained staff and 73 CNAs (for interview)	Non-nursing staff trained in feeding assistance	Care processes including standardised observations of feeding assistance care processes, calories per meal, in-depth interviews with staff	Staff who received feeding assistance training performed significantly better than CNAs for 12 of 13 care process measures. Residents also consumed significantly more calories per snack offer from trained staff. The majority of staff reported a positive impact of the training programme	Yes

Authors, year of publication, country	Aim of study	Design	Sample size	Sample characteristics	New staff role or way of working	Outcomes and measures	Findings	Positive outcome?
Laakso and Routasalo, 2001, Finland[672]	To explore how nursing home residents, families and nurses experienced a change to primary nursing in a nursing home	Qualitative interviews	30 interviewees (10 care home residents, 10 family members, 10 nursing staff)	Ten residents, 10 family members and 10 nursing staff	Primary nursing/patient-centred working	Qualitative exploration of experiences of the change in care	Primary nursing provided continuity of care staff for individual residents. Residents reported no change in care. Family members noticed a change in nurse behaviour. Nurses felt that their job was more challenging and rewarding, but some felt that the new model was a threat	Yes; mixed views
Lisk *et al.*, 2012, UK[688]	To explore the impact of four strategies to reduce hospital admissions for nursing home residents	Quasi-experimental	1954 residents	Hospital admissions from nursing homes over a 3-year period in one NHS trust	Change in ways of working with NHS services, involving regular in-person and telephone meetings	Reduction of emergency admissions, length of stay in hospital, cost analysis	Geriatrician input into nursing homes had a significant impact on admissions from nursing homes and length of stay. Costs (service and medication use) were reduced	Yes
Low *et al.*, 2013, Singapore[180]	A systematic review of interventions to change staff care practices to improve resident outcomes in nursing homes	Systematic review	63 studies	RCTs and quasi-experimental studies	Interventions to change staff practice to improve resident outcomes (educational materials, training, audit and feedback, monitoring, champions, team meetings, policy or procedures and organisational restructure)	Staff behaviour, other staff outcomes, resident clinical outcomes, but not satisfaction	No single intervention component; combination of components or increased number of components was associated with greater likelihood of enhanced outcomes. Studies targeting care tasks (e.g. oral care) were more likely to produce positive outcomes than those addressing more global changes. This review did not explicitly identify new staff roles, and many included studies describe improved delivery of existing roles	Yes
McAiney *et al.*, 2008, Canada[700]	To examine the impact of a practice model for NPs in long-term care homes on staff confidence, hospital admission and early discharge	Descriptive/cross-sectional survey	21 staff members, 2135 clinical NP contacts over 12 months	Three NPs and 18 directors of care	Integration of NPs into long-term care homes	Nurse practitioner clinical activities over a 1-year period: number of referrals, contacts, contact location, referral source and person. Promotion and impact of early hospital discharge (back to long term care). Impact on staff confidence	The majority of contacts were for uncomplicated medical problems or more complex but straightforward medical issues, and had positive outcomes. NPs judged that their intervention prevented hospital admission in 43% of cases. NPs had a positive impact on improving staff confidence, but did not promote early discharge from hospital	Yes

continued

TABLE 14 Workforce mapping review: novel roles or ways of working (*continued*)

Authors, year of publication, country	Aim of study	Design	Sample size	Sample characteristics	New staff role or way of working	Outcomes and measures	Findings	Positive outcome?
Meade *et al.*, 2016, Australia[708]	To describe and examine the effect on service provision and GPs of a new nurse-led model of team care for rural aged care facilities in a rural general practice	Mixed-methods case study	Six staff from one general practice	Four GPs, one practice nurse and one practice manager Analysis of claims data on RACF service provision in 2005–6 and 2009–10	A new team model of nurse-led primary care for residents. The GP practice nurse was the lead	Number of standard and after-hours consultations, before and after implementing new model Payment claims for comprehensive medical assessments, medication reviews and GP contribution to care plans. Qualitative data on perceptions and experiences of the new model	Residents in RACF access to GP consultations almost doubled, (from 6.69 to 14.09 per resident per year). After-hours consultations were reduced. The provision of quality improvement services increased. GPs reported decreases in workload and stress, and increase in professional satisfaction	Yes
Moxon *et al.*, 2001, UK[716]	(1) To determine if training will increase the ability of residential care home staff to recognise depression, and (2) to implement a care planning intervention to help residents to manage their depression	Before-and-after study; no comparison group	22 care staff in two residential care homes	Care staff with no previous training in depression	Enhanced role for care staff in detecting depression	Detection of depression using Brief Assessment Scale and Judgements of Residential Health Status scale	Training for residential care staff by community mental health team (four x 3 hours), was associated with increased ability to detect depression over time. A care planning intervention was successfully implemented with eight residents	Yes
Nazir *et al.*, 2013, USA[403]	To study the impact of interdisciplinary interventions on resident health outcomes, and document features of successful interventions, in the nursing home setting	Systematic review	27 studies	All RCTs of interdisciplinary interventions from 1990 to August 2011. Ten trials in the USA, four in Australia, three in the UK, three in Netherlands and the remainder in other countries	Shift to integrated working with health-care professionals. Provision of education for staff	Various resident clinical/ functional outcomes, including reduction in antipsychotic use, falls, depression, pain, incontinence, restraint use, and increase in appropriate medication use and positive nutritional status	This review was concerned with interdisciplinary working. A change in staff role is implied by this, but is not explicit in all included studies. All interventions that included residents' primary care providers and/or a pharmacist had positive outcomes. In trials that used formal team-based care, communication, co-ordination and leadership were consistent features of successful interventions	Yes, $n = 18$ studies. Without benefit, $n = 7$ studies; no, $n = 2$ studies
Ryden *et al.*, 2000, USA[749]	To determine the effect on clinical outcomes when APNs worked with care home staff	Quasi-experimental (controlled pre and post)	319 residents in three nursing homes	Newly admitted residents	Introduction of APNs into care homes	Four clinical outcomes: incontinence (Modification of Incontinence Monitoring Schedule), pressure ulcers (Braden Scale for Pressure Sore Risk; Staging of Pressure Ulcers), depression (Geriatric Depression Scale, Philadelphia Geriatric Center Morale Scale, Apparent Emotion Scale), and aggressive behaviour (Ryden Aggression Scale), plus the MMSE	Residents with APN input experienced significantly greater improvement or less decline in incontinence, pressure ulcers and aggressive behaviour, and they had higher mean composite trajectory scores compared with residents receiving usual care Residents in the treatment group experienced significantly less deterioration in mood	Yes

Authors, year of publication, country	Aim of study	Design	Sample size	Sample characteristics	New staff role or way of working	Outcomes and measures	Findings	Positive outcome?
Stolee *et al.*, 2006, Canada[771]	To identify factors that facilitate or impede implementation of the NP role in three long-term care facilities	Mixed methods	110 staff	109 long-term care facility staff and 1 NP	Assignment of NP to three long-term care facilities	Views of long-term care staff on the impact of the NP on various practice activities, including preadmission assessments, timely access to care, availability of geriatric assessment, continuity of care, comprehensive documentation, effectiveness and satisfaction with the NP role The NP's views of their involvement in the long term care	The NP was introduced to conduct pre-admission assessments and medication reviews, but high caseload and rapid admissions meant this was not achieved. Staff perceived the NP to be greatest benefit in wound management, and appreciation of the NP increased, with greater contact	Yes
Wild *et al.*, 2010, UK[787]	To provide an in-depth evaluation of approaches to enhancing care in residential homes (through education and training for staff to take on extended care or new roles)	Qualitative/ multimethod	141 staff in three residential care homes	Staff with NVQs. RNs from two homes, number not stated	Staff trained for extended care and/or new roles	Bespoke questionnaires, interviews, focus groups, documentary analysis	The three participating care homes adopted different approaches: 1. flexible skill mix, in which care staff were trained to deliver some nursing roles, with support from an external RN 2. enhanced training for staff in social and personal care delivery 3. a local authority partnership approach with an in-reach team to deliver nursing and physiotherapy and train staff No single approach was ideal, but aspects of all showed promise and could be combined. In particular, developing skills in carers appeared to be of potential benefit to residents	Yes
Yeatts and Seward, 2000, USA[793]	To define and provide the rationale for SMWTs and examine factors influencing performance	Qualitative (observation, interviews)	31 staff in one care home	CNAs, RNs, supervisors, managers	Autonomous working teams in nursing homes	Staff turnover, job satisfaction	Higher job satisfaction for SMWTs. The facility employing SMWTs had a lower staff turnover than average	Yes

AICT, advanced illness care team; GP, general practitioner; NP, nurse practitioner; NVQ, National Vocational Qualifications; SMWT, self-managed working team.

Brownie and Nancarrow[418] investigated the impact of person-centred care in care homes, but drew limited conclusions because of the quality of the included studies. In a study in the Netherlands,[526] care described as integrated was introduced into two nursing homes. The provision of a home-like environment, care in line with resident demands and co-ordination of care produced positive outcomes for staff and for residents with physical disabilities.

Teams in care homes

The formation of teams to deliver care is a common approach in long-term care. However, in this set of studies, some potentially novel initiatives were described. Chapman and colleagues[560] described a multidisciplinary advanced illness care team that drew in external professionals to work in a team with existing care home staff. In a RCT with 118 residents, this approach was successful in reducing pain and agitation among residents with dementia. Staff from residential facilities often have limited involvement in case conferences dominated by health-care providers. In an Australian study,[602] residential care staff were given a leading role in multidisciplinary case conferences. An analysis of 31 case conferences suggested that staff found this greater involvement beneficial for learning more about their residents' health and care, but finding the time to prepare for the case conferences was a challenge.[602] In 2000, Yeatts and Seward[793] gave a qualitative account of the development of a self-managed team within a US care home, where a group of staff worked with a high level of autonomy, organising their own schedules and making decisions. This was the only publication identified on this topic, which suggests that it may not have been widely adopted.

In nursing, different approaches to team working have been in place for a number of decades. A Cochrane review[621] compared established primary and team nursing models. Primary nursing describes the situation where nurses are consistently allocated to care for the same resident, providing continuity and enhanced understanding of each resident's needs. Team nursing is a model in which staff are rotated and responsibilities shared. Two additional studies in this mapping review also addressed this question. Hodgkinson's 2012 review[621] (discussed in the systematic evidence synthesis shortly) reported some evidence for improved resident outcomes with primary nursing. In the two additional studies from different countries, primary nursing was also perceived to be more rewarding for staff, but also more challenging.[534,672]

Enhanced roles for care home staff

Studies that described novel roles for care home staff fell into two categories. In the first, the staff took on tasks or responsibilities that would not normally be allocated to someone in their discipline. For example, in a novel UK study,[787] care home staff were trained to take on tasks that are generally the responsibility of RNs. This was a genuinely new role for staff without nursing training, which appeared to offer potential benefits to residents, staff and care home organisations. Other studies described an enhanced role for staff in tasks that are already part of the daily routine in a care home. In one study, staff were given training in helping residents at meal times, which led to the adoption of a more standardised approach to support eating and an increase in residents' calorie intake.[623] Similar programmes have been described to enhance staff roles in oral hygiene and emotion-orientated care (reminiscence).[521,591] Some initiatives formalised an aspect of care that is likely to be happening already but on an ad hoc basis. An example of this is provided by Moxon and colleagues,[716] who described a training programme to extend the role of care staff to detect depression and implement appropriate care planning.

Low and colleagues[804] conducted a systematic review of interventions to change staff practice to improve resident outcomes. The interventions included training, audit and feedback, monitoring, champions, team meetings and new procedures. These are likely to have encompassed both new and enhanced roles for staff, although not described in these terms. Interventions that were compliant with intervention theory and those directed at specific care tasks were more likely to be associated with improved resident outcomes.

Specialist nurses in new roles in care homes

Specialist nurses have been introduced into care homes in a number of countries. Their remit has included a focus on newly admitted residents[749,771] and acceptance of referrals for specialist advice.[700] Generally,

they worked with care home staff to provide clinical input and pass on their knowledge and expertise. There is also one report included of a nurse from a single general practice who was tasked with leading on care home resident care, which appeared to reduce some of the perceived burden on doctors.[708] The long-term implications of this model for staff relationships and resident outcomes are unknown.

Summary

This mapping of literature relevant to the care home workforce, published since the year 2000, has identified an extensive body of work. It is dominated by work from the USA and of cross-sectional design. Identifying literature on new ways of working is challenging, as novelty is context specific. In general, initiatives that promote joint working within and beyond the care home appear to be associated with enhanced outcomes for residents. Promising interventions include multidisciplinary teams, primary nursing and a focus on specific care tasks. Only one study from the UK[787] described personnel taking on traditional nursing tasks without the qualifications, but this was perceived to show promise.

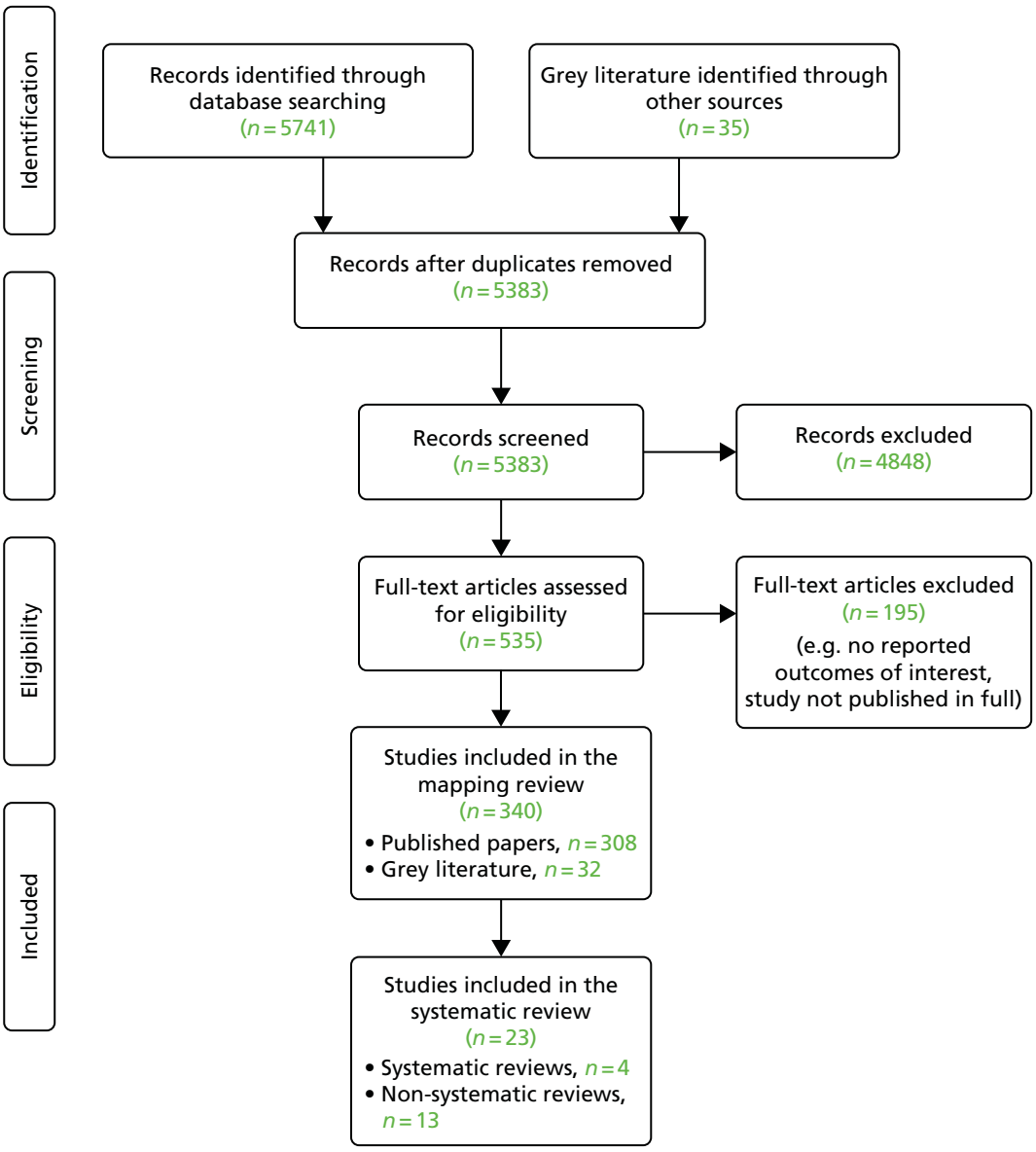

FIGURE 4 Workforce PRISMA flow diagram.

Findings of systematic evidence synthesis

What are the effects of care home staffing levels on staff and resident outcomes?

For methods, see *Chapter 3*.

Figure 4 shows the flow of studies through the mapping and review process. The literature searches identified 5741 abstracts, with an additional 35 identified from grey literature sources. After deduplication, 5383 were screened for eligibility and 340 were included in the mapping. Of those, 13 were deemed eligible for inclusion in the systematic review.

Study populations

Study populations were reported as the number of residents or the number of wards/units in nursing homes/facilities, or a standardised measure of person-year observations. When the number of residents was reported, this ranged from 380[794] to 365,895.[585]

Nurse staffing measures

The main measures of staffing in this review are (1) numbers of staff in different grades/roles of nurse staffing [i.e. RN, licensed practical nurse (LPN), CNA/NA], (2) the ratio of staff members to residents, (3) employment of agency staff and (4) imposition of staffing standards.

Data sources from the USA

A small number of key sources provided many of the US data. In the USA, certified providers of long-term care are required to submit a MDS based on a standardised assessment system. To receive funding from Medicaid and Medicare a provider must meet certain quality conditions. Annual inspections are carried out by state surveyors, and any shortfall in care quality is noted as a 'deficiency' in a range of domains, including food sanitation, accident environment, unnecessary medications and dignity. Staffing is one of the assessed quality domains that may result in a deficiency.

Nursing Home Compare is a national online nursing home report card that provides information on Medicare- and Medicaid-certified nursing homes in each US state. It provides information by provider and facility on (1) the results of state inspections from a database containing survey information [Online Survey, Certification and Reporting (OSCAR)], (2) the results of fire and safety inspections and (3) the history of penalties or complaints over the last 3 years.

Nineteen quality measures are used for public reporting on long-term care facilities in the USA. They are generated out of the MDS and highlight issues of clinical importance, such as pain, pressure ulcers, changes in ADL and use of long-term urinary catheters. Each nursing home also receives a rating on a scale of one to five stars based on health inspection results, quality measures and staffing levels.

Results of evidence synthesis

Thirteen reviews of the literature published since the year 2000 were identified as potentially relevant to this review. They are listed in *Tables 15* and *16*. Nine reviews explored the relationship between staffing and quality of care (broadly defined); four reviews[208,692,763,790] considered resident quality of life as an outcome. One review[584] considered staffing among a number of influences on emergency transfers to hospital for care home residents.

Four of these[516,584,621,790] reviews used systematic methods, and met the criteria for inclusion for our review. To decide if a review could be considered as a systematic review, criteria used by the University of York Centre for Reviews and Dissemination DARE (www.crd.york.ac.uk/CRDWeb/) were used:

1. Were inclusion/exclusion criteria reported?
2. Was the search adequate?
3. Were the included studies synthesised?

TABLE 15 Workforce: non-systematic reviews of evidence

Authors, year of publication	Date of searches	Question or aim	QoL	QoC	Study designs and numbers	Finding	Comment
Castle, 2008[549]	2006	To review the evidence on staffing levels and quality in nursing homes		Y	Cross-sectional and longitudinal studies ($n = 59$)	Higher staffing levels appear to be associated with better quality indicators. The methodological limitations of research in this area are emphasised	
Collier and Harrington, 2008[570]	2007	To synthesise the literature on staffing levels, turnover and QoC in nursing homes (literature from 2002 to 2007)		Y	Expert opinion, reports, published studies, qualitative and quantitative ($n = 71$)	The author concludes that RN staffing levels should be increased and action taken to reduce turnover to enhance quality	
Dellefield, 2000[577]	Not stated	To review literature that has addressed the relationship between traditional nurse staffing in nursing homes and various types of quality indicator		Y	Not stated	Higher total staffing levels are associated with some quality indicators. The relationship between staff skill mix and outcomes are unclear, making conclusions about staff skill mix premature	
Maas *et al.*, 2008[692]	Not stated	To summarise research on the relationship between staffing levels and QoC and QoL of care home residents	Y	Y	Not stated	The author concludes that RN staffing is related to quality and minimum staffing standards are needed	
Masterson, 2004[696]	Not stated	Review of some of the literature that care home managers and commissioners might find useful in planning staff skill mix of services		Y	Not stated	The relationship between staffing and outcomes is complex. Attention is required to the attitudes, values and training of staff. High levels of educated and senior RN involvement are needed	Overview, informed by literature
Mattingly, 2015[698]	Not stated	Not stated. Review of staffing and appropriate antipsychotic use in care homes		Y	Not stated ($n = 11$)	Inverse relationship between staffing levels and antipsychotic use; no link between staffing hours and antipsychotic use	Clinician overview; no methods presented
My Home Life, 2007[208]	2005	To adopt an appreciative inquiry approach to synthesising the literature on experiences of residents, family caregivers and staff to identify strategies to enhance the QoL of residents and support caregivers	Y	Y	A broad range of study designs was included	This is a broad-ranging review, with multiple narrative findings across a range of domains	

continued

TABLE 15 Workforce: non-systematic reviews of evidence (*continued*)

Authors, year of publication	Date of searches	Question or aim	QoL	QoC	Study designs and numbers	Finding	Comment
Shin and Bae, 2012[763]	2011	To produce an integrated literature review of the relationship between staffing and QoL and QoL outcomes in US nursing homes	Y	Y	Cross-sectional or longitudinal ($n = 17$), experimental/quasi-experimental ($n = 4$), not stated ($n = 7$)	Higher staffing levels are associated with better outcomes, but the methodological quality of the evidence is low	
Spilsbury *et al.*, 2011[499]	February 2008	To review the evidence for the relationship between nursing home nurse staffing (proportion of RNs and support workers) and how this affects QoC for nursing home residents, and to explore methodological lessons for future international studies		Y	Cohort and cross-sectional studies ($n = 50$)	There is tentative evidence that total nurse, RN and NA numbers have a positive influence on resident care. The existing evidence base has multiple limitations	Systematic mapping review

QoC, quality of care clinical outcomes; QoL, quality of life; Y, yes.

TABLE 16 Workforce: systematic reviews of evidence

Authors, year of publication	Date of searches	Question or aim	QoL	QoC	Study designs and numbers	Finding	Quality assessment
Backhaus *et al.*, 2014[516]	April 2013	To summarise the findings from longitudinal studies on the relationship between nurse staffing and QoC in nursing homes		Y	Longitudinal studies ($n = 20$ studies)	No consistent evidence was found for a positive relationship between staffing and QoC. Major methodological and theoretical weaknesses limit interpretation of results	High quality (++)
Dwyer *et al.*, 2015[584]	August 2014	To synthesise evidence on clinical and organisational determinants of emergency transfer to hospital for acute illness or injury among frail, elderly people living in residential aged care facilities		Y	Observational studies ($n = 78$)	Facilities with poorer staff-to-patient ratios have higher transfer rates than those with higher RN and medical practitioner staffing	Acceptable (+)
Hodgkinson *et al.*, 2011[621]	August 2007	To identify which staffing models are associated with the best patient and staff outcomes in long-term aged care		Y	Interrupted time series ($n = 1$); controlled before-and-after study ($n = 1$)	A primary care model of nursing produces slightly better resident outcomes than the comparator (team nursing or usual care). Overall little firm evidence	High quality (++)
Xu *et al.*, 2013[790]	March 2012	To synthesise evidence on the association between nursing home ownership, affiliation, location, chain membership, percentage of private rooms, facility size, staffing and residents' QoL	Y		Cross-sectional studies ($n = 10$); longitudinal, quasi-experimental ($n = 1$)	Studies rated as having low or medium risk of bias found that RN, LPN/LVN and total nursing staff had no significant relationship with QoL	High quality (++)

LVN, licensed vocational nurse; QoC, quality of care; QoL, quality of life.

4. Was the quality of the included studies assessed?
5. Are sufficient details about the individual included studies presented?

To be included, reviews had to meet at least four out of the five criteria.

Quality assessment

The methodological quality of each study was assessed using the ROBINS-I tool. This tool provides a detailed framework for assessing and judging the of risk of bias that may arise from confounding, selection of participants into the study, measurement of interventions, departures from intended interventions, missing data, measurement of outcomes and selection of reported results.

Based on a review of the literature concerning confounders, age, ethnicity or race, physical activity and education were identified as critical confounders that required suitable adjustment for study results to be rated as having a low risk of bias.

Each domain is determined to exhibit low, moderate, serious or critical risk of bias. Low risk indicates that the study is comparable with a well-performed randomised trial in the domain being evaluated. Moderate risk indicates that the study is sound for a non-randomised study but not comparable with a rigorous randomised trial. Serious risk indicates that the presence of important problems, whereas critical risk of bias indicates that the study is too problematic to provide any useful evidence on the effects of intervention. If insufficient information is provided to determine the risk of bias of a certain domain, the domain is marked as having no information.

It is worth noting that the domains for classification of interventions and deviations from interventions were omitted as they did not apply to this review. All of the studies were cross-sectional (secondary data from surveys), and, therefore, no interventions were administered. The ROBINS-I tool is equally appropriate for cross-sectional studies as quality assessments are independent of study design.

Table 16 lists the systematic reviews that were included in our review.

Summary of previous systematic reviews

Evidence from reviews

Four relevant systematic reviews were identified, three of high quality[516,621,722] and one that was assessed as of acceptable quality[584] (see *Table 16*). A systematic scoping review[499] has also been included in this synthesis. Spilsbury and colleagues' review[499] was not classified as systematic because it contained no explicit assessment of the quality of individual studies. However, study quality and its implications are discussed at length, and (with the exception of quality assessment) systematic review methods were adopted. In addition, this work formed the starting point for one of our included reviews, which searched for literature published after Spilsbury and colleagues' review.

Two reviews restricted their work by study design. Hodgkinson's Cochrane review[621] was limited to quasi-experimental studies and Backhaus and colleagues restricted their review,[516] published in 2013, to longitudinal studies. The remaining reviews included observational studies.

Risk of bias in individual studies

Of the 18 observational studies included, eight were rated as being at serious risk of bias, two were rated as being at critical risk and eight were rated as being at moderate risk. Whereas those at serious and critical risk of bias do not offer robust evidence, those with a moderate rating offer some evidence to support interventions; although they cannot be considered as robust as evidence derived from a good-quality RCT. Full details of the validity assessment are presented in the *Appendix 3*, *Table 21*. The quality of reporting was variable between studies and across the criteria. The majority of the studies had moderate issues with missing data and selection of the reported results, two important areas of bias. However, those

TABLE 17 Workforce review: individual included studies

Authors, year of publication, country	Study design	Sample size	Data sources	Outcomes and measures	Overall risk of bias	Results
Abrahamson *et al.*, 2013,[502] USA	Secondary data analysis of cross-sectional survey data	$n = 14,381$ (13,983 residents)	The 2007 Minnesota Nursing Home Resident Quality of Life and Consumer Satisfaction Survey	Influence of nursing facility characteristics (staffing levels) on resident quality of life using the Minnesota Nursing Home Resident Quality of Life and Consumer Satisfaction Survey	Serious	Activity and certified nursing aide staff significantly associated with higher QoL ($p < 0.001$; $p = 0.012$); no statistically significant association between RN and LPN staff hours per resident day and QoL ($p > 0.05$)
Alexander, 2008,[505] USA	Cross-sectional study: retrospective	$n = 510$ nursing homes	Nursing home Compare site in February 2004 database	Eleven long-stay quality measures; five short-stay quality measures	Serious	Significant differences in outcomes associated with CNA/LPN/RN staffing-level mix, with two measures (loss of bowel and bladder control, and assistance with ADL) and two short-stay measures (moderate to severe pain and presence of pressure ulcers)
Backhaus *et al.*, 2015;[515] Backhaus *et al.*, 2017,[805] the Netherlands	Cross-sectional study	$N = 282$ wards [$n = 117$ somatic wards ($n = 2604$ residents); $n = 165$ psychogeriatric wards ($n = 3541$ residents)] and $N = 6145$ residents	Questionnaire data on 95 Dutch long-term care facilities	Relationship between staffing levels and clinical, process-related and administrative outcomes		No consistent relationship was found between nurse staffing and QoC; higher staffing levels were associated with better as well as lower QoC indicators
Bowblis, 2011,[527] USA	Cohort study (panel data)	$n = 94,371$ survey observations	The OSCAR surveys from 1999 to 2004 merged with Minimum Direct Care Staffing requirements	Outcome quality measures in the following: pressure ulcers; facility-acquired pressure ulcers; incontinent (bladder); incontinent (bowel); significant weight change; rash; and total number of deficiencies	Moderate	Higher MDCS requirements increase the total number of staff in a nursing home. Skill mix moved slightly towards using more CNAs, whereas among licensed staff, LPNs are substituted for RNs
Carrier *et al.*, 2009,[537] Canada	Cross-sectional study	395 residents in 38 public nursing homes	Interviews with cognitively intact residents; primary institutional caregivers completed a questionnaire for cognitively impaired residents	Resident quality of life measures using the Quality of Life in Dementia instrument; and measures of activity and positive and negative affect	Moderate	Ratio of residents per RA significantly associated with Quality of Life in Dementia in cognitively intact ($\beta = 0.458$; $p = 0.016$) and cognitively impaired residents ($\beta = 0.454$; $p = 0.023$)

continued

TABLE 17 Workforce review: individual included studies (*continued*)

Authors, year of publication, country	Study design	Sample size	Data sources	Outcomes and measures	Overall risk of bias	Results
Castle and Engberg, 2008,[545] USA	Secondary analysis of cross-sectional survey data	$n = 6005$ nursing homes	Survey of nursing home administrators conducted March–June 2005 and January–March 2006; 2004 Nursing Home Compare; 2005 OSCAR; and 2006 Area Resource File	Eleven long-stay quality measures; three quality measures for short-stay residents	Serious	Dependent variables (Nursing Home Compare). Variables not statistically significantly different ($p > 0.05$) from national averages reported in Nursing Home Compare for 2004
Castle *et al.*, 2008,[546] USA	Secondary analysis of survey data	$n = 2946$ surveys returned in 2005	National Nursing Home Staffing Study; OSCAR database; Nursing Home Compare web-based report card; and Area Resource File data	Eleven long-stay quality measures; three quality measures for short-stay residents are percentage of residents	Moderate	Use of nurse aide agency staff of < 14 full-time equivalents per 100 beds has little influence on quality; nurse aide agency staff of > 25 full-time equivalents per 100 beds has a substantial influence on quality
Chen and Grabowski, 2015,[561] USA	Secondary analysis of panel survey data	$n = 45{,}738$ nursing home-year observations	The OSCAR database, with the state regulation data (Survey of the Nursing Home Staffing Standards, and a Department of Health and Human Services 2003 report)	Five facility-level quality measures to examine the effects of minimum nursing hours per resident day regulations on nursing home staffing levels and care quality (deficiencies, use of physical restraints, catheters, psychoactive medications and pressure ulcer incidence)	Moderate	The percentage of nursing homes with a severe deficiency decreased by 60%; high prevalence of psychoactive drug usage (50%) was present in nursing homes; nearly one-third of the residents had contractures; and about 7% of the residents had pressure ulcers
Gray-Siracusa, 2005,[601] USA	Cross-sectional survey	$n = 81{,}023$ residents	Ohio nursing home data from Centers for Medicare and Medicaid Services OSCAR; MDS in 2000	Prevalence of range of no motion, the use of antipsychotics and pressure ulcers Outcomes in nutrition or physical functioning; adverse outcomes, including skin care, maintenance of catheters and prevention from infection or accidents; adverse outcomes with behavioural or emotional patterns and the use of antipsychotropic drugs	Serious	As the RN staffing difference increased by 1.0 HPRD (less staffing) the prevalence of residents with weight loss decreased by 2.2%, with tube feedings increased by 3.2% and remaining bedfast increased by 1.9%

Authors, year of publication, country	Study design	Sample size	Data sources	Outcomes and measures	Overall risk of bias	Results
Havig *et al.*, 2011,[610] Norway	Cross-sectional study	$n = 40$ wards (one–four wards in 21 nursing homes)	Self-report questionnaires; interviews/questionnaires; telephone interviews; field observations	Satisfaction of care, social activities and social interactions appraised by staff, relatives and field workers using self-report questionnaires	Moderate	Non-significant associations in ratio of RNs to outcomes ($p > 0.05$); ratio of unlicensed staff showed a significant relationship with quality as assessed by relatives ($p < 0.05$) and field observations ($p < 0.01$), but not with quality as assessed by staff ($p > 0.05$)
Heeren *et al.*, 2014,[614] Belgium	Survey	$n = 570$ older adults, 23 wards within seven nursing homes from the Flemish Navigator Network	Data collected from 1 November to 31 December 2011	Relationship between staffing levels and use of physical restraints	Critical	Compared with non-restrained residents, restrained residents were cared for by a caregiver with significantly fewer NAs and fewer LPNs and more RNs ($p < 0.05$)
Kajonius and Kazemi, 2016,[639] Sweden	Cross-sectional survey	$n = 95{,}000$ elderly people	National survey, including a wide range of quality indicators for elderly care services, conducted in 2012 at the request of the Swedish National Board of Health and Welfare	Elderly persons' perceived satisfaction with quality of care and nursing home staffing	Moderate	Non-significant association between nursing home staffing and satisfaction with care (0.09; $p > 0.05$)
Leland *et al.*, 2012,[683] USA	Cross-sectional survey	$n = 230{,}730$ individuals	MDS	Relationship between nursing home staffing levels and residents' falls	Moderate	Nursing homes with more CNAs had lower rates of falls (adjusted odds ratio 0.97, 95% confidence interval 0.95 to 0.99; $p < 0.05$); RN and LPN hours per resident per day was not significant in predicting falls ($p > 0.05$)
Lerner, 2013,[684] USA	Secondary data analysis of cross-sectional data	$n = 225$ nursing homes	Nursing Home Compare website	The association between nurse staffing levels, and skill mix and number and severity of nursing home deficiencies	Serious	Severity of deficiencies influenced by number of beds (b = 0.29) location of the home (b = –0.138) and NA hours per patient day (b = –0.206)

continued

TABLE 17 Workforce review: individual included studies (*continued*)

Authors, year of publication, country	Study design	Sample size	Data sources	Outcomes and measures	Overall risk of bias	Results
Lin, 2014,[687] USA	Secondary data analysis of panel data	$N = 3275$ nursing homes	OSCAR (1999–2003); Area Resource File; Centres for Medicare & Medicaid Services; and most recent population census	Relationship between nursing home staffing levels and reported deficiencies using OSCAR	Moderate	Both RN and NA staffing have a non-significant impact on quality of care ($p > 0.05$); increasing RN staffing by 0.3 hours per resident day (one standard deviation in the data) would increase quality by > 16%, which is equivalent to lowering the number of deficiencies from the average of 7.4 to 6.2; NA staffing does not have a statistically significant impact on quality of care
Park and Stearns, 2009,[730] USA	Secondary data analysis of panel data	$n = 55,248$ facility-year observations	OSCAR (1998–2001); state minimum staffing standards from Harrington 2002[806] and U.S. Department of Health and Human Services 2003;[807] state Medicaid per-diem rates from Brown University Survey of State Policies and State Data Book on Long-Term Care Programme and Market Characteristics[808] Market-level variables from the Area Resource File, a publicly available data set containing economic and demographic variables for each county (U.S. Department of Health and Human Services 2006) Population data from the US Census Bureau	Impact of state minimum staffing standards on the level of staffing and quality of care (restraint use and deficiencies)	Serious	Minimum standards were associated with reductions in restraint use ($p < 0.01$) and the number of total deficiencies ($p < 0.01$) at all types of facilities except for-profit facilities

Authors, year of publication, country	Study design	Sample size	Data sources	Outcomes and measures	Overall risk of bias	Results
Zhang *et al.*, 2008,[799] USA	Cross-sectional study	$n = 14,184$ Medicare- and Medicaid-certified facilities	2003 OSCAR data; Area Resource File data from 2000 from the Health Resources and Services Administration	Relationship between facility service environments and psychosocial care quality using 2003 OSCAR data	Critical	Qualified social service and mental health staffing is significantly negatively associated with psychosocial care deficiencies ($p < 0.05$); qualified social service staff (OR 0.132, 95% CI 0.050 to 0.349); mental health services staff (OR 0.024, 95% CI 0.001 to 0.571)
Zhang *et al.*, 2013,[797] USA	Secondary data analysis of panel survey data	$n =$ not reported	OSCAR (1997–2009)	Relationship between nursing home nurse staffing and resident needs (medications, pressure ulcers, catheter use and ADL) based on data from OSCAR	Serious	Private-concentrated nursing homes: mismatch between changes in RN hours per resident day and the percentage of Medicare residents; Medicare-concentrated nursing homes: mismatch between changes in LPN hours per resident day and the number of medications per resident
Zúñiga *et al.*, 2015,[801] Zúñiga *et al.*, 2014,[802] Switzerland	Cross-sectional study	$n = 400$ units In Zúñiga *et al.*[802] (2015), 4311 care workers from 402 units and 77 additional care team were not assigned to a specific unit (e.g. night shift team)	Swiss Nursing Home Human Resources Project; survey administered between May 2012 and April 2013	Relationship between nursing home staff turnover and long-term absence with quality of care (pressure ulcers, fall-related injuries and weight loss) using survey data	Serious	Work environment factors, work stressors and rationing of nursing care were significantly related to quality of care, whereas staffing level, staff mix and turnover were not

CI, confidence interval; HPRD, hours per resident day; MDCS, minimum direct care staffing; OR, odds ratio; QoC, quality of care; QoL, quality of life.

rated as being at serious or critical risk of bias generally also had issues of bias in terms of confounding. Issues with bias across several of the domains greatly reduces the reliability of the findings. The quality of the studies for each of the individual interventions is summarised alongside the results (*Table 17*).

With no RCTs included, there is a lack of high-quality, robust evidence; however, the eight observational studies rated as being at moderate risk of bias provide some support for the potential effectiveness of the workforce interventions.

Care home staffing and resident quality of life

Evidence of the association between staffing and resident quality of life is presented in the following section, separate from other resident outcomes. Quality of life and resident well-being are being highlighted here as they are important direct or indirect outcomes of care that have been relatively neglected in studies of care home staffing.[499]

Evidence on staffing and quality of life, from previous reviews

Four reviews[621,692,763,790] were identified that investigated the relationship between staffing and care home resident quality of life. Two met the quality threshold and were included in our study. Xu and colleagues[790] synthesised data from US studies[790] and found no clear evidence of an association between nurse staffing and quality of life. The four studies in Xu and colleagues'[790] review were assessed as being at low or medium risk of bias, and found no relationship between RN, LPN/licensed vocational nurse (LVN), and total nurse staffing and residents' quality of life. Other findings were inconsistent, with the majority suggesting either no association or a tendency for higher staffing levels to be beneficial for residents.

Hodgkinson[621] conducted a Cochrane review to identify and assess the quality of all experimental research designed to evaluate the effectiveness of specific nursing models in improving resident quality of life and health outcomes. Two studies were included in their review, one interrupted time series and one controlled before-and-after study. Both studies compared a primary nursing model with either team-based nursing or usual care. (The primary care nursing model consisted of 24-hour accountability and decision-making by one nurse for several patients, direct communication between caregivers and a change in the head nurse's role to more of a facilitator. By contrast, team nursing is a hierarchical system in which patient care is supervised by a RN, and the provision of care is assigned to personnel of different skill levels, according to the complexity of the patients' needs.) The primary care model performed slightly better on some resident outcomes but had no impact on resident well-being.[621]

Evidence from additional individual studies

Two additional studies[502,537] were identified that were not part of the reviews discussed above. One was a more recent publication[502] and the other was conducted in Canada.[537] Both were assessed as being at moderate risk of bias and would not have met the threshold for inclusion in Hodgkinson's Cochrane review.[621] Both studies suggest that care assistants may be important to residents' quality of life. An analysis[502] of cross-sectional data from almost 14,000 participants of the Minnesota Nursing Home Residents Quality of Life and consumer satisfaction survey found no relationship between resident quality of life and the number of registered or licensed nurses and nursing administrators. However, CNA staff hours per resident day were associated with higher quality of life. These data are drawn from a probability sample of residents from all 388 nursing homes in the state. A much smaller Canadian study reported similar findings. A cross-sectional study[537] with 395 residents of 38 Canadian nursing homes investigated the association between quality of life and staffing as part of a study of dining experiences and food services. The ratio of residents per resident assistant was positively associated with quality of life for both cognitively intact and cognitively impaired residents.

Summary: staffing and quality of life

A single high-quality systematic review of US literature and two additional cross-sectional studies all failed to identify any relationship between the numbers of RNs or LPNs/LVNs and quality of life. A review of a primary care nursing model also found no evidence of any impact on resident well-being. There is mixed evidence that the numbers or hours of care provided by staff without nursing qualifications may be an important influence on residents' quality of life. However, it is important to acknowledge the limitations of the measures for both staffing and quality of life. This is discussed later.

Care home staffing and health-related resident outcomes

Two high-quality systematic reviews[499,516] and one systematic scoping review[621] have synthesised evidence on care home staffing and health-related outcomes.

Evidence from existing systematic reviews

Backhaus and colleagues[516] conducted a systematic review of longitudinal studies that examined nurse staffing and quality of care outcomes in nursing homes. Their intention, in focusing on longitudinal studies, was to avoid the methodological weaknesses inherent in reviews of cross-sectional studies. Searches retrieved articles published between 2007 and 2013; older longitudinal studies were extracted from Spilsbury and colleagues' review.[499] In total, 20 studies were included, one from Italy and the rest from the USA. The authors distinguished between clinical (e.g. pressure ulcers), process (e.g. restraints) and administrative (e.g. deficiencies) outcomes of care. Measures of staffing were carefully identified and documented, along with the source of outcome variables. This review found no consistent evidence of a relationship between staffing and quality of care. For pressure ulcers, there was a consensus across the studies that more staff of any grade were associated with better outcomes. For other outcomes, such as catheterisation, a greater number of staff could be associated with better or worse outcomes, depending on the study.

Evidence from additional individual studies

Seven studies that were not included in preceding reviews investigated the relationship between staffing numbers and resident outcomes. They were conducted in Norway, Sweden, Belgium, Switzerland and the USA. A majority of publications from the USA have analysed information from the nursing home MDSs, generating a body of work that uses common, mainly clinical, outcome measures. Elsewhere, researchers have collected data on outcomes, such as pressure ulcers, but greater attention has been paid to staff and resident perceptions of care outcomes.

In Norway, a cross-sectional study[610] in 21 nursing homes investigated the association between staffing and relatives' perceptions of a range of process measures of care quality. Interviews and questionnaire responses were obtained from 444 staff and 378 relatives, and supplemented with field observations. Care quality was assessed through scores for satisfaction and general ratings of care processes, including treating residents with dignity and taking the time to talk. Staffing levels and the ratio of RNs to the total number of care staff were not found to be statistically significantly related to any of the composite indices of care quality. However, the ratio of unlicensed staff to total care staff numbers was inversely related to quality as assessed by relatives and researchers' field observations, but not to quality assessed by staff. This study focused on relative- and staff-perceived satisfaction with care, social activities and social interactions, and did not include any of the commonly reported clinical outcome measures. Similar findings emerged from Sweden,[639] where a cross-sectional survey of 31,073 care home residents found no association between staffing and overall satisfaction with care. In this case, the staffing ratio was calculated as the number of trained staff relative to the total older population in each municipality.

A cross-sectional survey[802] of a nationally representative sample of 163 Swiss nursing homes found no association between staffing, turnover or long-term absences and any measured quality indicators (pressure ulcers, falls and weight loss). When 4311 Swiss care workers were surveyed,[801] care worker-perceived quality of care was also unrelated to staffing level, although an association was noted with work environment, work stressors and the implicit rationing of nursing care. In Belgium, a survey[614] of seven nursing homes (570 residents) in a Flemish network found no associations between staffing intensity and the use of restraints. Restrained residents were cared for by a team with fewer LPNs and NAs.

In the USA, OSCAR data have been used extensively in analyses of care home staffing. A comparison of trends in nursing home nurse staffing and resident nursing care needs between 1997 and 2009 revealed a complex picture.[797] Taking the data from all US care homes, the number of RNs decreased slightly, whereas the number of LPNs and NAs rose, suggesting that some substitution took place. Medications, pressure ulcers, catheter use and ADL were used as proxies for nursing needs. Levels and trends in measures of staffing and resident needs all varied depending on the proportion of Medicare, Medicaid or private residents in the homes. The authors concluded that there is a mismatch between the trends in staffing and pressure ulcers, catheters, ADLs and medications, with staffing failing to keep up with needs. In the cross-sectional analysis of OSCAR data discussed earlier,[799] the same research group investigated the

relationship between nursing home service environments, which included staffing levels, and care deficiencies. Qualified social service and mental health staffing was inversely related to the recording of psychosocial care deficiencies. The greater the number of qualified social services and mental health services staff, the higher the likelihood of good-quality psychosocial care.

Summary: staffing numbers or ratios, and resident outcomes

Outside the USA, staffing numbers or staffing resident ratios appear to have no association with resident and staff perceptions of care quality or clinical outcome measures. US data suggest that there may be a positive relationship between numbers of some staff groups and resident outcomes. However, interpreting analyses of the US MDS is complicated by the influence of funding sources and the use of regulatory judgements (deficiencies) as proxies for resident outcomes.

Staff skill mix and resident outcomes

Many of the studies in the preceding section investigated the relationship between numbers of nurses within different groups (e.g. RNs, licensed nurses, NAs) and resident outcomes. This section collates studies that had a specific focus on the comparative impact of nurses with different levels of training. One study is from the Netherlands[805] and five are from the USA[505,601,683,684,687], all of which make use of the US MDS. Three out of the five US studies make use of reported care home deficiencies as a proxy for resident outcomes.

Evidence from the Netherlands suggests that employment of nurses with higher academic qualifications may be associated with better resident outcomes in certain situations. A cross-sectional study in Dutch care homes analysed data on 6145 residents from the 2016 LPZ (Landelijke Prevalentiemeting Zorgkwaliteit or the International Prevalence Measurement of Care Problems in Care Homes).[805] The authors looked at the relationship between the employment of baccalaureate-educated RNs and a range of resident outcome measures across 282 wards in 95 care homes. They found no consistent association between the employment of baccalaureate-educated RNs and resident outcomes. On wards that looked after residents with physical disabilities, the presence of baccalaureate-educated RNs was linked to reduced numbers of medication incidents, adjusting for background characteristics. Residents in wards that provided psychogeriatric care were slightly more likely to fall and receive antipsychotic medication and less likely to have an indwelling catheter when baccalaureate-educated RNs were employed. The probability of developing pressure ulcers was not associated with the employment of baccalaureate-educated RNs in either setting.[515,805]

Five studies analysed information from the US MDSs on staff mix and resident outcomes. Data on the 230,730 people admitted to US nursing homes in 2006 were analysed in a cross-sectional study.[683] Nursing homes with higher NA staffing were noted to have lower rates of falls, but RN and LPN hours per resident per day were not predictive of falls. Routine data from 225 Maryland nursing homes[684] found that the NA hours per day influenced the number of deficiencies reported, while RN hours were associated with the severity of the deficiencies. In another study with OSCAR data (from 1999 to 2004), Lin and colleagues[687] reported that both RN and NA staffing had a small but non-statistically significant impact on quality of care, measured by reported deficiencies. Using an instrumental variables approach, they estimated that increasing RN staffing by 0.3 hours per resident day (one standard deviation in the data) would increase quality by more than 16%.

A smaller study on 510 Missouri nursing homes[505] (data from 2004) explored the relationship between staffing level mix and quality indicators in a cross-sectional study. Positive associations between staffing level mix and quality measures were reported. Two measures (the percentage of residents who become incontinent and the percentage who need help with ADL) appeared to be sensitive to change in staffing level mix.[505]

In most of the included studies in this review, staffing levels were measured without any reference to resident needs or acuity. Gray-Siracusa[601] used an established classification to calculate staffing levels based on resident case mix, and compared them with reported staffing levels. Shortfalls between reported and required staffing adversely influenced some measures of care quality (use of antipsychotic medications,

pressure ulcers) and the number of reported deficiencies recorded by the US nursing home certification authorities. This doctoral thesis was based on data from Ohio nursing homes, available from OSCAR and MDS.

Summary: staff skill mix and resident outcomes

It is difficult to extract a clear message from research on the relationship between skill or role mix and resident outcomes. The data suggest that there may be a relationship between the number of different staff available in a care home and resident outcomes. NAs and RNs both appear to influence different aspects of care. A focus on numbers of staff, and not on the role and tasks performed, limits the value of this body of work.

Minimum staffing requirements and resident outcomes

Four studies from the USA examined the relationship between regulations on minimum staffing levels and resident outcomes. All were observational studies that analysed the same data set (OSCAR) from similar time periods, and shared some common outcome measures. They differed in the geographical level under scrutiny. The four studies were rated as being at high risk of bias. The most recent study[527] examined the impact of minimum direct care staffing (MDCS) requirements on care quality outcomes (antipsychotic and psychotropic medications, use of restraints and catheters, pressure ulcer incidence) as part of a study into the impact of MDCS on nurse staffing levels and nurse skill mix. Using national data (94,371 observations) from the OSCAR surveys (1999–2004), the authors found that minimum requirements were associated with improved patient outcomes. They noted that organisations' responses to MDCS differed depending how reliant they were on Medicaid. A similar study[730] using data from 1998 to 2001 examined the impact of introducing or increasing minimum standards for staffing in nursing homes within 16 US states. Regulations varied from state to state but included numbers of total, registered and licensed staff, staff ratios and care standards. Restraint use and the total number of deficiencies fell. The imposition of minimum standards had the greatest impact on the not-for-profit homes that were at, or below, the imposed level. Facilities with higher staffing levels to start with were relatively unaffected.[730] A similar picture emerged from analyses of 45,738 observations from Californian and Ohio OSCAR data between 1996 and 2006. Increasing minimum staffing standards was associated with a decrease in the total number of deficiencies and a reduction in the rate of contractures, but no changes in any of the other four measures (use of physical restraints, catheters, psychoactive medications and pressure ulcer incidence).[561] In a related analysis of cross-sectional OSCAR data from 2003, Zhang and colleagues[799] found higher levels of reported care home deficiencies when requirements for qualified social services staffing exceeded minimum federal regulations.[799]

Summary: minimum staffing requirements and resident outcomes

Observational studies of routine US data suggest that the imposition of minimum standards for staffing in care homes has a positive impact on some resident outcomes. This is of uncertain relevance to other countries.

Discussion

Summary of findings

This systematic, rapid evidence synthesis examined the relationship between care home staffing and resident outcomes. It serves to update and extend previous reviews, the majority of which have focused on quality of care. No strong evidence was identified of a relationship between the numbers of staff, staff-to-resident ratios, staff skill mix or nursing care models and any resident outcomes. There is limited evidence to suggest that the number of staff without nursing qualifications may influence residents' quality of life. There is a paucity of research on resident outcomes from outside the USA. Studies that consider the duties and activities of different groups of staff may be more useful in defining a care home workforce that will promote health and well-being of residents. It is noteworthy that the extensive published literature on care home staffing and resident outcomes is predominantly from the USA and concerned with quality of care, defined in many different ways.

Previous reviews have identified and discussed at length the methodological limitations that are common in works on care home staffing.[499,516,692,790] Extensive use has been made of cross-sectional studies that are liable to a range of biases. Systematic reviews that have attempted to overcome this problem by focusing on longitudinal or experimental work have also reported negative findings.[516,621] This may point to a true absence of any association between staffing and outcomes, but it could also be secondary to other study limitations. Measuring resident outcomes is dominated in this work by the US MDSs. Much of the information is collected to monitor quality of care in nursing homes and determine payments. Such measures provide uncertain proxies for resident outcomes, and are unlikely to reflect resident and family priorities. Deficiencies, for example, are a measure of how well a care home meets various process and outcome measures in their annual state inspection. This variable has been used extensively in research, but it is clear that some (e.g. prescribing) may be a better measure of the outcomes of resident care than others (e.g. administration). In many instances, components of MDS information analysed in US studies have been collected at different points in time. This is problematic when measuring staffing levels, which may vary appropriately over time and with the changing needs of residents. The dearth of longitudinal studies limits our understanding of the direction of the relationship between staffing and outcomes.

Strengths and limitations

In our systematic review, we made best use of previous, high-quality evidence syntheses to avoid duplication of effort. When we looked at material that postdated the reviews, we attempted to fill in the gaps between the previous work. Spilsbury and colleagues' review[499] was wide ranging, but those that followed were limited by study design[516] or outcome measures.[790] We did not impose strict study design inclusion criteria and, as a result, have included some studies that would not have met the criteria for the previous systematic reviews. Although this has drawbacks, it served to generate a comprehensive overview of the current state of the evidence base.

The topic of new or flexible ways of working was a challenging one for a review. The subject did not lend itself to focused database searches and we were obliged to conduct a very broad mapping review. If the cataloguing and keywords did not alert us to relevant content, we were reliant on the title and abstract screening. With a large review completed in a short time, it is impossible to eliminate errors, and it is almost inevitable that we will have overlooked some relevant material. In addition, publication bias is a particular concern in this area. Roles that are perceived to be novel in one setting may be well established in another, and not worthy of publication. Similarly, facilities that trial new initiatives may seek to publish only their success stories, or find that journals have little interest in certain aspects of their work, such as flexible working.

Gaps in research knowledge

There is a paucity of UK-specific research on the care home workforce. A majority of the included studies were from the USA, where both health and long-term care are distinct from the UK context.

The majority of research in this field is observational. Studies of this type cannot answer questions about the personal qualities, values, skills and experience needed to provide care in care homes. The US data sets have generated an extensive body of observational studies, and encouraged a focus on numbers of staff and a narrow range of resident and staff outcomes.

Future research needs to appreciate the complexity of care delivery, with measurement of outcomes that are important to residents, and more nuanced insights into the nature of care delivered. This suggests a move away from numbers of staff and greater focus on resident experiences and staff roles and tasks.

Implications

There is an extensive literature on care home staffing, and it has been extensively reviewed. However, it provides few insights for UK providers and commissioners of care, as the majority originates from the USA, and analyses data sets specific to their setting. Multiple reviews have failed to identify a robust evidence

base to link staffing levels to resident outcomes. In the future, a greater focus on the fate of staff may, however, be useful, and provide insights into how to promote recruitment and retention.

Studies of staff taking on new roles or working flexibly were difficult to identify, and our mapping is unlikely to be comprehensive. Research described staff taking on genuinely new tasks, and others that involved adoption an enhanced role in an established task. Joint working within and beyond the care home, multidisciplinary teams, primary nursing and a focus on specific care tasks all appear to have potential to enhance outcomes.

Chapter 5 Discussion

This report covers four distinct topic areas. A mapping review and systematic evidence synthesis have been presented for each, with individual discussions. In the following section, some of the strengths and weaknesses of our overall approach are discussed, followed by a brief consideration of the possible implications of the work for the NHS, and recommendations for research.

Strengths and weaknesses of our approach

Our focus on care homes as a distinct setting has allowed us to collate a disparate literature and produce findings that are relevant to resident care, irrespective of diagnosis. However, a high proportion of care home residents are living with dementia, and this report should be interpreted alongside the growing body of work on that subject. The four topic areas – technology, communication and engagement, workforce and evaluation – were identified by NHS England in their strategy documents. We worked with the care home vanguard teams to define questions for systematic evidence syntheses to ensure that our work would be of use. In three of the four areas, this produced a novel and potentially useful review. In the workforce review, the question of staffing levels and resident outcomes has been addressed many times, and a number of reviews were available. Our conclusions echo those of previous authors, but the need for both a different lens on workforce issues and more robust research methods is an important point to reiterate. In retrospect, the inclusion of staffing levels in the options considered by the stakeholders should have been accompanied by clear explanations of the limitations of any future review. Following the production of this report, further work is planned to examine the relationship between staffing levels and staff outcomes, as the impact on staff health, in particular, appears to be a relatively neglected area.

The mapping reviews did not examine outcomes in any detail, with the exception of the section on new ways of working. We did investigate the nature of the outcomes, and which group of stakeholders – residents, staff, families or organisations – were involved. This has generated a resource that should be useful to people looking for information on a particular topic, but it does not substitute for a robust systematic or scoping review. In the 12 months allocated to this project, it was not possible, or our intention, to go beyond this.

Similarly, resources did not allow us to update our database searches before submitting this report. In some cases, this means that the searches are 10 months old.

Our methodological approach had a standard hierarchy of evidence at its centre. Quality appraisal of studies was completed with a tool from The Cochrane Library. This choice is justified by the identification of a number of experimental studies, particularly in the section on technology. The challenges of conducting trials in long-term care may be an argument against judging the quality of research with a framework that would be appropriate in a hospital setting. However, this implies that a lower quality of evidence may be acceptable in care home research. The potential vulnerabilities and multiple conditions among residents suggest that robust evidence for the effectiveness of interventions is essential.

Public and patient involvement

This study benefited from input from the Newcastle University Care Home Interest Group. This is an open forum of people with an interest in care home research, drawn from the general public and social and health care professionals. Members were recruited under the auspices of Voice North, a Newcastle University-led organisation to promote involvement of the public in research. All have an interest in care homes, but a number of members are current or former social care workers. They include a former Care Quality Commission inspector, current and former care home managers, specialist nurses and many people

who have cared for relatives who moved into care homes. The proposal and research questions were discussed with the wider group, and, after funding was secured, a subgroup volunteered to take a particular interest in this study. They have been involved in prioritising questions and interpreting results, and are having a major role in the development of dissemination materials.

Chapter 6 Conclusions

Implications for health care

Digital technology

Digital technology has multiple potential applications in care homes, and researchers have investigated a range of interventions using experimental study designs. However, a majority of studies are pilot or feasibility trials of insufficient size to detect clinically significant outcomes. Cost, ease of use and staff demands are frequently identified as both barriers to and facilitators of the implementation and use of technology. There is limited evidence that games that promote activity and robotic interventions may have some benefits for residents' mental well-being. However, these interventions are more likely to have been evaluated, and it is not clear that they are superior to non-technological solutions. Digital records, monitoring technologies and telehealth may also have positive impacts, but the evidence base does not allow firm conclusions to be drawn.

Communication and engagement

The evidence base for communication interventions was weak. However, the use of standardised data collection forms appears to promote the transfer of vital information with residents who are referred to hospital. The studies reviewed provided no data on the impact of transfer forms on patient outcomes. Tools to structure communication, such as SBAR, have been evaluated outside the UK and appear to have the potential to enhance clinical outcomes for care home residents. Complex interventions to improve communication may also improve resident clinical outcomes, and reduce hospital transfers, but the evidence is limited. There was, as anticipated, a paucity of research into how care homes engage with their local communities.

Evaluation

There are many measurement tools that have been used in care homes and described in the English-language literature. Only six of the recently used tools had undergone any validation in a UK setting. This does not mean that other tools are not useful, but, if they are to be introduced into routine use, some work is needed to explore their measurement properties and to ensure that they are appropriate for this context. The two general measures of care outcomes that had undergone some validation for use in UK care homes have different origins. We found no data to enable us to recommend one over the other. None of the included tools scored highly in our assessment of methodological quality.

Workforce

The literature relevant to care home staffing is extensive, but much of it has limited relevance to the UK context. Initiatives in flexible deployment of staff or in new roles were difficult to identify in the published literature. However, interventions that promote joint working within and beyond the care home, multidisciplinary teams, primary nursing and a focus on specific care tasks all appear to have merit. There is no strong evidence of a relationship between the numbers of staff, staff-to-resident ratios, staff skill mix or nursing care models and any resident outcomes. There is limited evidence to suggest that the number of staff without nursing qualifications may influence residents' quality of life.

Recommendations for research

Technology

There is a general need for appropriately powered experimental studies in this area, and to address the paucity of economic evaluations. Greater focus on interventions with practical applications to health care, such as the use of digital records and telehealth interventions, is needed. Their use and benefits could be

addressed with mixed-methods and quasi-experimental designs. The burden of new interventions on care home staff is another important topic for future research. In addition, the impact of technology on families appears to have been neglected in this research area, and this should be rectified in future studies. Joint working between care homes, researchers and the manufacturers of new technologies may be helpful to generate robust evidence of effectiveness from multiple sites.

Communication and engagement

Formal evaluation in a UK setting of the use of transfer forms and tools such as SBAR would be valuable, before, or as, they are introduced across the NHS. If the complex, multifaceted interventions that have been used in US settings are introduced to the UK, they require multimethod, long-term evaluation to produce evidence that would support wider implementation.

Investigation is needed into the most effective and appropriate ways for care homes to engage with local communities, and the long-term impact on residents and the public perception of care homes. This is an area that would benefit from ethnographic and other qualitative approaches.

Evaluation

Care home commissioners and providers would benefit from an easy to administer, robust measure of care outcomes. The two general measures of care outcomes discussed, CARE profiles and ASCOT, have had some validation for UK use; however, the assessment of methodological quality suggests that publication of further validation work would help to promote this. The burden on residents, staff and care homes, the training needed, and the costs involved in administering and analysing data from both CARE and ASCOT all merit closer scrutiny before these measures are implemented across the NHS. There are many measurement tools developed elsewhere, and our mapping review provides some evaluative work to select candidate tools for testing in the UK.

Workforce

The evidence base on the care home workforce needs to be supplemented with research that is specific to the UK. Future work could usefully consider the experiences and perceptions of staff and residents, and the qualities and values that would promote high-quality care. Further measurement or analysis of the number of staff and a search for associations with resident outcomes cannot be justified. The impact of staffing practices on staff outcomes, particularly health, may be informative.

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Contributions of authors

Barbara Hanratty (Professor of Primary Care and Public Health, Institute for Health and Society, Newcastle University) led the project and contributed to all reviews.

Dawn Craig (Director of the Evidence Synthesis Team, Institute for Health and Society, Newcastle University) led the design and provided expert methodological advice throughout the project.

Katie Brittain (Associate Professor of Ageing and Health, Northumbria University) and **John Vines** (Professor of Design, Northumbria University) led the technology review.

Karen Spilsbury (Professor of Nursing Research, University of Leeds) contributed to the design and all reviews.

Paul Wilson (Senior Research Fellow at the Alliance Manchester Business School and National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care Greater Manchester) provided expert methodological advice throughout the project.

Data-sharing statement

Owing to the nature of this study and the type of data collected, there are a limited number of data that can be shared further. All queries should be submitted to the corresponding author in the first instance.

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Appendix 1 Candidate questions for systematic evidence synthesis

Technology

1. Which technologies have a positive impact on resident health and well-being?
2. What is the impact of technologies on resident health and well-being?
3. What are the barriers to and facilitators of the use of technology in care homes?
4. How can technology improve resident engagement/social interactions?
5. What are staff and resident experiences of using technology to improve communication (and the barriers to and facilitators of this use)?

Communication and engagement

1. How can care homes engage with their local communities to promote resident well-being/quality of life?
2. What are the benefits for care homes of engaging with their local communities?
3. How should care homes and the NHS communicate to enhance resident, family and staff outcomes and experiences?

Evaluation

1. Which measurement tools have been validated for use in UK care homes?
2. Is there any evidence that any of the tools are superior to others, (reliability, validity, replicability, acceptability, cost-effectiveness)?
3. What are the common problems that evaluators encounter in this setting and how may these be overcome?

Workforce

1. What is the evidence that staffing levels (i.e. ratio of RNs and support staff to residents or different levels of support staff) influence resident outcomes?
2. What are the effects of staffing levels on staff outcomes?
3. What are the effects of introducing a new role on resident care outcomes and care home team working?

Appendix 2 List of high-income economies

Andorra, Antigua and Barbuda, Aruba, Australia, Austria, The Bahamas, Bahrain, Barbados, Belgium, Bermuda, British Virgin Islands, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Chile, Croatia, Curaçao, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, French Polynesia, Germany, Gibraltar, Greece, Greenland, Guam, Hong Kong, China, Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Korea, Kuwait, Latvia, Liechtenstein, Lithuania, Luxembourg, Macao, Malta, Monaco, Nauru, the Netherlands, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Oman, Poland, Portugal, Puerto Rico, Qatar, Saint-Martin, San Marino, Saudi Arabia, Seychelles, Singapore, Sint Maarten, Slovak Republic, Slovenia, Spain, St Kitts and Nevis, Sweden, Switzerland, Taiwan, Trinidad and Tobago, Turks and Caicos Islands, United Arab Emirates, UK, USA, Uruguay and Virgin Islands.

Source: World Bank Country and Lending Groups, 2016.[809]

Appendix 3 Quality appraisal tables

TABLE 18 Quality appraisal: technology RCTs

Authors, year of publication	Randomisation process	Timing of randomisation (cluster RCTs only)	Deviations from intended interventions	Missing outcome data	Measurement of outcome data	Selection of the reported result	Overall rating
Banks *et al.*, 2008[47]	Low	Low	Some concerns	Some concerns	Low	Some concerns	Some concerns
Beeckman *et al.*, 2013[54]	Low	Low	Low	Low	High	Low	High
De Luca *et al.*, 2016[101]	Some concerns	No information	High	High	High	Low	High
Hsu *et al.*, 2011[147]	Low	No information	High	Some concerns	Low	Low	High
Jøranson *et al.*, 2015[161]	Low	Some concerns	Some concerns	Low	High	Low	High
Lapane *et al.*, 2011[299]	Some concerns	Some concerns	Some concerns	Low	Some concerns	Some concerns	High
Lin *et al.*, 2014[177]	Low	No information	Some concerns	Low	Low	Low	Some concerns
Moyle *et al.*, 2017[203]	Low	Some concerns	Some concerns	Low	Low	Some concerns	Some concerns
Nagayama *et al.*, 2016[210]	Low	Low	Some concerns	Low	Low	Some concerns	High
Rantz *et al.*, 2017[230]	Some concerns	No information	Some concerns	Some concerns	Low	Low	Some concerns
Robinson *et al.*, 2013[236]	Low	No information	Some concerns	Low	High	Low	High
Van der Ploeg *et al.*, 2016[274]	High	Some concerns	Some concerns	High	Low	Some concerns	High
Vowden and Vowden, 2013[277]	Some concerns	Low	Some concerns	Low	High	Critical	High

TABLE 19 Quality appraisal: technology non-RCTs

Authors, year of publication	Confounding	Selection	Classification of interventions	Deviations from interventions	Missing data	Measurement of outcomes	Selection in the reported results	Overall risk of bias
Bemelmans *et al.*, 2015[56]	Serious	Serious	Low	Serious	Moderate	Serious	Moderate	Serious
Holmes *et al.*, 2007[300]	Critical	Serious	Low	No information	Serious	Serious	Low	Critical
Jung *et al.*, 2009[163]	Critical	No information	Low	No information	No information	Serious	Low	Critical
Kelly *et al.*, 2002[301]	Critical	Low	Critical	Low	Moderate	Serious	Moderate	Critical
Keogh *et al.*, 2014[166]	Serious	No information	Moderate	Low	Moderate	Critical	Low	Critical
Kidd *et al.*, 2006[169]	Critical	Critical	Serious	Critical	Critical	Serious	No information	Critical
Libin and Cohen-Mansfield, 2004[176]	Serious	Low	Low	Low	Low	Serious	Low	Serious
Pillemer *et al.*, 2012[222]	Critical	Serious	Low	No information	Moderate	Serious	No information	Critical
Rantz *et al.*, 2010[227]	Serious	Low	Low	Low	Low	Serious	Low	Serious
Shibata *et al.*, 2004[250]	Low	Moderate	Low	Low	No information	Moderate	Low	Moderate

TABLE 20 Quality appraisal: communication and engagement

Authors, year of publication	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawals and dropouts	Global rating
Arling *et al.*, 2014[322]	Moderate	Moderate	Weak	Moderate	Moderate	Weak	Weak
Bensandon *et al.*, 2014[326]	Moderate	Strong	Weak	Moderate	Moderate	Weak	Weak
Colon-Emeric *et al.*, 2013[333]	Weak	Strong	Moderate	Moderate	Moderate	Moderate	Moderate
Conway *et al.*, 2015[334]	Moderate	Weak	Weak	Moderate	Moderate	Strong	Weak
Cwinn *et al.*, 2009[339]	Strong	Weak	N/A	Moderate	Moderate	Strong	Moderate/weak?
Dalawari *et al.*, 2011[340]	Strong	Weak	N/A	?	Moderate	?	Moderate/weak?
Field *et al.*, 2011[345]	Strong	Strong	Moderate	Moderate	Strong	Strong	Strong
Hustey and Palmer, 2010[152]	Strong	Moderate	N/A	Moderate	?	Strong	Moderate
Renz *et al.*, 2013[376]	Moderate	Weak	N/A	Moderate	Moderate	Strong	Moderate
Tena-Nelson *et al.*, 2012[383]	Strong	Moderate	Strong	Moderate	Moderate	Strong	Moderate
Terrell *et al.*, 2005[384]	Strong	Moderate	N/A	Moderate	Moderate	Weak	Moderate/weak?

?, information missing; N/A, not applicable.

TABLE 21 Quality appraisal: workforce

Authors, year of publication	Confounding	Selection	Missing data	Measurement of outcomes	Selection in the reported results	Overall risk of bias
Abrahamson *et al.*, 2013[502]	Serious	Low	Moderate	Low	Serious	Serious
Alexander, 2008[505]	Serious	Low	Moderate	Low	Moderate	Serious
Backhaus, *et al.*, 2017[805]	Low	Low	Moderate	Low	Moderate	Moderate
Bowblis, 2011[527]	Low	Low	Moderate	Low	Moderate	Moderate
Carrier *et al.*, 2009[537]	Low	Low	Moderate	Low	Moderate	Moderate
Castle *et al.*, 2008[546]	Moderate	Low	Moderate	Low	Moderate	Moderate
Castle and Engberg, 2008[545]	Moderate	Low	Moderate	Low	Serious	Serious
Chen and Grabowski, 2015[561]	Low	Low	Moderate	Low	Moderate	Moderate
Gray-Siracusa, 2005[601]	Low	Low	Moderate	Low	Serious	Serious
Havig *et al.*, 2011[610]	Moderate	Low	Moderate	Low	Moderate	Moderate
Hereen *et al.*, 2014[614]	Low	Low	Critical	Low	Moderate	Critical
Kajonius and Kazemi, 2016[639]	Moderate	Low	No information	Low	Moderate	Moderate
Leland *et al.*, 2012[683]	Low	Low	Moderate	Low	Moderate	Moderate
Lerner, 2013[684]	Low	Low	Serious	Low	Moderate	Serious
Lin, 2014[687]	Moderate	Low	Moderate	Low	Moderate	Moderate
Park and Stearns, 2009[730]	Serious	Low	Moderate	Low	Serious	Serious
Zhang *et al.*, 2008[799]	Critical	Low	Low	Low	Moderate	Critical
Zhang *et al.*, 2013[797]	Moderate	Low	Moderate	No information	Serious	Serious
Zúñiga *et al.*, 2015;[801] Zúñiga *et al.*, 2014[802]	Serious	Low	Low	Low	Moderate	Serious

TABLE 22 Quality appraisal: evaluation

Authors, year	Tool	Internal consistency	Reliability	Content validity	Hypothesis testing	Criterion validity
Dutta *et al.*, 2015[477]	MMRI-R	N/A	N/A	N/A	Good	N/A
Faulkner *et al.*, 2006[478]	CARE profiles	Poor	N/A	N/A	N/A	N/A
Fossey *et al.*, 2002[479]	DCM	Poor	Fair	N/A	N/A	Poor
Moniz-Cook *et al.*, 2001[480]	CBS	Poor	Good	N/A	N/A	Poor
Sutcliffe *et al.*, 2000[481]	GDS-12R	Poor	N/A	N/A	N/A	Poor
Towers *et al.*, 2015[482]	ASCOT	N/A	N/A	Good	N/A	N/A

N/A, not applicable.

Appendix 4 Evaluation tools identified by use in care homes

1. Agitated Behavior Mapping Instrument.
2. Ambiance Scale.
3. Antipsychotic Use in Dementia Assessment.
4. Apparent Emotion Rating Scale.
5. ASCOT.
6. Attitudes About Families Checklist.
7. Beck's PAINCQ-33.
8. Brief Interview for Mental Status.
9. Care Dependency Scale.
10. Caregiver Stress Inventory.
11. Cohen-Mansfield Agitation Inventory.
12. Composite Above Average Quality Score.
13. Consumer Quality Index Long-term Care.
14. Continuous (or Continuity) Assessment Record and Evaluation.
15. Core Nurse Resource Scale.
16. Cornell Scale for Depression in Dementia.
17. Discomfort Scale – Dementia of Alzheimer Type.
18. End of Life in Dementia – Satisfaction With Care.
19. End of Life in Dementia – Symptom Management.
20. End of Life in Dementia – Comfort Assessment in Dying.
21. Falls Prevention and Management Audit Tool.
22. Family Distress in Advanced Dementia Scale.
23. Family Perceptions of Caregiving Role.
24. Family Perceptions of Physician–Family Caregiver Communication.
25. Functional Abilities Checklist.
26. Geriatric Depression Scale.
27. Huber Badrak Borders Scales.
28. Incontinence-Associated Dermatitis Intervention Tool.
29. Intellectual Disability Supplement to The Irish Longitudinal Study on Ageing.
30. International Classification of Functioning, Disability and Health – Usability Scale.
31. Malnutrition Universal Screening Tool.
32. Minimum Data Set 2.0.
33. Minimum Data Set 3.0: Brief Interview for Mental Status.
34. Minimum Data Set bedfast quality indicator.
35. Minimum Data Set versions 1 and 2: mood assessment.
36. Minimum Data Set: depression prevalence.
37. Minimum Data Set: prevalence of restraint.
38. Mini-Suffering State Examination.
39. Models of Care Instrument.
40. Neuropsychiatric Inventory.
41. Neuropsychiatric Inventory – Clinician Rating.
42. Neuropsychiatric Inventory – Nursing Home Version.
43. Neuropsychiatric Inventory – Nursing Home Version – Occupational Disruptiveness Scale.
44. Nursing Home Composite Measure Score.
45. Nursing Home Confusion Assessment Method.
46. Nursing Home Survey on Patient Safety Culture.
47. Nursing Minimum Data Set.

48. Nursing Older People – Competence Evaluation Tool.
49. Observable Indicators of Nursing Home Care Quality.
50. Older Patient Assessment of Chronic Illness Care.
51. Pain Assessment in Advanced Dementia.
52. Pain Assessment Checklist for Seniors with Limited Ability to Communicate.
53. Pain Assessment in the Communicatively Impaired.
54. Palliative Care Outcome Scale.
55. Palliative Care Survey.
56. Patient Assessment of Chronic Illness Care.
57. Patient Health Questionnaire-9.
58. Patient Health Questionnaire Observational Version.
59. Person-Centered Care Assessment Tool.
60. Pleasant Events Schedule: Alzheimer Disease.
61. Professional Care Team Burden.
62. Program of All-Inclusive Care for the Elderly.
63. Purpose-in-Life Test.
64. QUALIDEM.
65. Quality of Dying in Long-Term Care.
66. Relational Care Scale.
67. Satisfaction with Life Scale.
68. Quality of Life Scale.
69. Schedule for the Evaluation of Individual Quality of Life: Direct Weighting.
70. Scope and Severity Index.
71. Seated Posture Scale.
72. Sheffield Care Environment Assessment Matrix.
73. Special Care Unit Environmental Quality Scale.
74. Staff Perceptions of Caregiving Role.
75. Therapeutic Environment Screening Scale-2+.
76. Thriving of Older People Assessment Scale.

Appendix 5 MEDLINE search strategies

Technology review

Database(s): Ovid MEDLINE(R) 1946 to week 4 September 2016.

Search date: 11 October 2016.

Search strategy

1. Respite Care/
2. Long-Term Care/
3. exp Nursing Homes/
4. Homes for the Aged/
5. "Home? for the Aged".mp.
6. "Old Age Home?".mp.
7. "Skilled Nursing Facilit*".mp.
8. "Intermediate Care Facilit*".mp.
9. "Nursing Home?".mp.
10. "Respite Care?".mp.
11. "care home?".mp.
12. "residential home?".mp.
13. ("long-term care facilit*" or "long term care facilit*").mp.
14. ("aged care facilit*" or "aged-care facilit*").mp.
15. or/1-14
16. exp "Diffusion of Innovation"/
17. Safety Management/
18. Cloud Computing/
19. Digital Divide/
20. Electronic Health Records/
21. Electronic Prescribing/
22. Health Information Exchange/
23. Health Smart Cards/
24. Medical Records Systems, Computerized/
25. Internet/
26. exp Microcomputers/
27. Mobile Applications/
28. Video Games/
29. Radio Frequency Identification Device/
30. exp Telemedicine/
31. Remote Sensing Technology/
32. Smartphone/
33. Social Media/
34. exp Telemedicine/
35. Wireless Technology/
36. Clinical Alarms/
37. exp telemetry/
38. Point-of-Care Systems/
39. exp Technology/
40. "Meaningful Use"/
41. self-help devices/ or communication aids for disabled/

42. (technolog* or digital* or computer* or internet* or wireless).ti,ab,kf,kw.
43. (mobile device* or mobile phone* or cellphone or cell phone or smartphone* or smart phone* or ipad* or iphone* or software or app or apps or augmented realit* or virtual realit* or robot*).ti,ab,kf,kw.
44. ((tangible or user) adj2 interface*).ti,ab,kf,kw.
45. (telecare or telemedic* or telehealth).ti,ab,kf,kw.
46. (remote adj2 (care or medic* or health*)).ti,ab,kf,kw.
47. (smarthome* or smart home* or smart environment* or smartcard* or smart card*).ti,ab,kf,kw.
48. or/16-47
49. 15 and 48
50. adolescent/ or exp child/ or exp infant/
51. (adolescen* or paediatric* or pediatric*).mp.
52. (animals not (humans and animals)).sh.
53. or/50-52
54. 49 not 53
55. limit 54 to (english language and yr="2000 -Current")

Workforce review

Staff levels

Database(s): Ovid MEDLINE(R) 1946 to week 4 September 2016.

Search date: 10 October 2016.

Search strategy

1. "Personnel Staffing and Scheduling"/
2. ((staff* or nurse?) adj2 (schedul* or roster* or rota? or rotation or level? or balanc*)).ti,ab,hw.
3. staffing.ti,ab.
4. manpower.fs,ti,hw.
5. ((day* or night* or work* or job? or rotat* or team* or interval? or "long-hour?" or alternat* or enhanc* or shared or group? or overtime) adj shift?).ti,ab.
6. (skill? adj2 mix*).ti,ab.
7. personnel management/ or personnel downsizing/ or personnel selection/ or "personnel staffing and scheduling"/ or personnel turnover/
8. "Personnel Staffing and Scheduling Information Systems"/
9. or/1-8
10. Homes for the Aged/
11. Skilled Nursing Facilities/
12. Intermediate Care Facilities/
13. Nursing Homes/
14. Respite Care/
15. "Home? for the Aged".mp.
16. "Old Age Home?".mp.
17. "Skilled Nursing Facilit*".mp.
18. "Intermediate Care Facilit*".mp.
19. "Nursing Home?".mp.
20. "Respite Care?".mp.
21. "care home?".mp.
22. "residential home?".mp.
23. ("long-term care facilit*" or "long term care facilit*").mp.
24. ("aged care facilit*" or "aged-care facilit*").mp.
25. or/10-24

26. 9 and 25
27. limit 26 to (english language and yr="2000 -Current")

Staff roles

Database(s): Ovid MEDLINE(R) 1946 to week 4 September 2016.

Search date: 6 October 2016.

Search strategy

1. exp professional role/
2. Patient Care Team/
3. staff development/
4. delegation, professional/
5. (extend* adj3 (role? or skill? or scope?)).ti,ab,kw.
6. (role? adj7 (development? or develop or developing or developed)).ti,ab,kw.
7. (role? adj7 impact?).ti,ab,kw.
8. (expand* adj3 (role? or skill? or scope? or responsibilit* or practice?)).ti,ab,kw.
9. ((extra or added or additional) adj4 responsibilit*).ti,ab,kw.
10. (emerging adj3 (role? or skill? or scope? or responsibilit* or practice?)).ti,ab,kw.
11. (advanced adj2 (role? or skill? or scope? or practice?)).ti,ab,kw.
12. (blur* adj4 (boundar* or role?)).ti,ab,kw.
13. (develop* adj4 responsibilit*).ti,ab,kw.
14. ((evolution or evolv*) adj3 (practice? or role?)).ti,ab,kw.
15. non-medical.ti,ab,kw.
16. ((inter?disciplin* or inter?professional or multi?disciplin* or multi?faceted) adj5 (work or working or role? or team? or staff or practice?)).ti,ab,kw.
17. (substitut* adj2 role?).ti,ab,kw.
18. (medical adj2 substitut*).ti,ab,kw.
19. (new adj3 role?).ti,ab,kw.
20. (scope adj3 practice?).ti,ab,kw.
21. (greater adj2 role?).ti,ab,kw.
22. ((nurse or nursing) adj3 (skill? or role? or impact? or scope? or practice?)).ti,ab,kw.
23. (trends adj7 (nurse or nursing or role? or skill? or scope?)).ti,ab,kw.
24. (impact? adj9 (nurse or nursing or role? or skill? or scope?)).ti,ab,kw.
25. (integrat* adj5 (nurse or nursing or role? or skill? or scope?)).ti,ab,kw.
26. (innovati* adj5 (nurse or nursing or role? or skill? or scope? or practice?)).ti,ab,kw.
27. (co?operati* adj5 (work or working or role? or team? or practice? or nurse or nursing)).ti,ab,kw.
28. or/1-27

Communication and engagement review

Database(s): Ovid MEDLINE(R) 1946 to week 4 March 2016.

Search date: 31 March 2017.

Search strategy

1. Respite Care/
2. Long-Term Care/
3. exp Nursing Homes/
4. Homes for the Aged/
5. "Home? for the Aged".mp.
6. "Old Age Home?".mp.
7. "Skilled Nursing Facilit*".mp.

8. "Intermediate Care Facilit*".mp.
9. "Nursing Home?".mp.
10. "Respite Care?".mp.
11. "care home?".mp.
12. "residential home?".mp.
13. ("long-term care facilit*" or "long term care facilit*").mp.
14. ("aged care facilit*" or "aged-care facilit*").mp.
15. or/1-14
16. Communication/
17. Persuasive Communication/
18. Interdisciplinary Communication/
19. exp Communication Barriers/
20. Health Communication/
21. Hospital Communication Systems/ or Emergency Medical Service Communication Systems/
22. exp Computer Communication Networks/
23. exp Communications Media/
24. Information Dissemination/
25. ((share or shared or sharing or disseminat*) adj5 information).ti,ab,kf.
26. Cooperative Behavior/
27. Community-Based Participatory Research/
28. or/16-27
29. Health Facilities/
30. exp Ambulatory Care Facilities/
31. exp Hospital Units/
32. exp Hospitals/
33. Community Health Services/
34. Adult Day Care Centers/
35. Community Health Nursing/
36. Hospices/
37. Senior Centers/
38. Health Services/
39. exp Emergency Medical Services/
40. Health Services for the Aged/
41. exp Nursing Services/
42. exp Nursing Care/
43. Palliative Care/
44. exp Terminal Care/
45. Community Networks/
46. Community Participation/
47. exp Organizational Innovation/
48. or/29-47
49. 15 and 28 and 48
50. Community-Institutional Relations/ or Interinstitutional Relations/ or Intersectoral Collaboration/
51. Public-Private Sector Partnerships/
52. ((community or communities or primary care or general practice* or family practice* or hospital* or health service* or clinic* or hospice* or institution* or department* or provider* or stakeholder*) adj5 (communicat* or collaborat* or cooperat* or co-operat* or coordinat* or co-ordinat* or engag* or network* or integrat* or share* or sharing or link* or partner* or coalition* or volunteer* or relationship* or transition* or transfer* or innovat*)).ti,ab,kf.
53. or/50-52
54. 15 and 53
55. 49 or 54
56. adolescent/ or exp child/ or exp infant/

57. (adolescen* or paediatric* or pediatric*).mp.
58. (animals not (humans and animals)).sh.
59. or/56-58
60. 55 not 59
61. limit 60 to (english language and yr="2000 -Current")

Evaluation review

Initial search

Database(s): Ovid MEDLINE(R) 1946 to week 1 December 2016.

Search date: 19 December 2016.

Search strategy

1. Respite Care/
2. Long-Term Care/
3. exp Nursing Homes/
4. Homes for the Aged/
5. "Home? for the Aged".mp.
6. "Old Age Home?".mp.
7. "Skilled Nursing Facilit*".mp.
8. "Intermediate Care Facilit*".mp.
9. "Nursing Home?".mp.
10. "Respite Care?".mp.
11. "care home?".mp.
12. "residential home?".mp.
13. ("long-term care facilit*" or "long term care facilit*").mp.
14. ("aged care facilit*" or "aged-care facilit*").mp.
15. or/1-14
16. "outcome and process assessment (health care)"/ or "outcome assessment (health care)"/ or "process assessment (health care)"/
17. Program Evaluation/
18. Quality Assurance, Health Care/
19. Quality Improvement/
20. or/16-19
21. mt.fs.
22. exp "Evaluation Studies as Topic"/
23. exp "Epidemiologic Study Characteristics as Topic"/
24. or/21-23
25. 20 and 24
26. ((evaluat* or assess* or measur* or apprais* or monitor* or improv* or assur*) adj5 (methodolog* or framework* or theory or theories or approach*)).tw,kw.
27. ((evaluat* or assess* or measur* or apprais* or monitor* or improv* or assur*) adj5 (method* or model*)).ti.
28. or/26-27
29. or/25,28
30. 15 and 29
31. adolescent/ or exp child/ or exp infant/
32. (adolescen* or paediatric* or pediatric*).mp.
33. (animals not (humans and animals)).sh.
34. or/31-33
35. 30 not 34
36. limit 35 to yr="2000 –Current"

Focused searching for tools (lines 1–34 same as initial search)

Database(s): Ovid MEDLINE(R) 1946 to week 4 July 2016.

Search date: August 2016.

Search strategy

1. Respite Care/
2. Long-Term Care/
3. exp Nursing Homes/
4. Homes for the Aged/
5. "Home? for the Aged".mp.
6. "Old Age Home?".mp.
7. "Skilled Nursing Facilit*".mp.
8. "Intermediate Care Facilit*".mp.
9. "Nursing Home?".mp.
10. "Respite Care?".mp.
11. "care home?".mp.
12. "residential home?".mp.
13. ("long-term care facilit*" or "long term care facilit*").mp.
14. ("aged care facilit*" or "aged-care facilit*").mp.
15. or/1-14
16. "outcome and process assessment (health care)"/ or "outcome assessment (health care)"/ or "process assessment (health care)"/
17. Program Evaluation/
18. Quality Assurance, Health Care/
19. Quality Improvement/
20. or/16-19
21. mt.fs.
22. exp "Evaluation Studies as Topic"/
23. exp "Epidemiologic Study Characteristics as Topic"/
24. or/21-23
25. 20 and 24
26. ((evaluat* or assess* or measur* or apprais* or monitor* or improv* or assur*) adj5 (methodolog* or framework* or theory or theories or approach*)).tw,kw.
27. ((evaluat* or assess* or measur* or apprais* or monitor* or improv* or assur*) adj5 (method* or model*)).ti.
28. or/26-27
29. or/25,28
30. 15 and 29
31. adolescent/ or exp child/ or exp infant/
32. (adolescen* or paediatric* or pediatric*).mp.
33. (animals not (humans and animals)).sh.
34. or/31-33
35. 30 not 34
36. limit 35 to yr="2000 –Current"
37. ASCOT.ti. and (valid* or reliab*).ti,ab.
38. (score* or status* or scale* or survey* or indicator* or tool* or framework* or diagnos* or instrument* or assess* or inventor* or questionnaire* or index or indices or measure*).ti.
39. 15 and 38
40. *Nursing Homes/
41. (nursing home* or care home*).ti.
42. 40 or 41

43. 38 and 42
44. (valid* or reliab*).ti,ab.
45. 43 and 44
46. (valid* or reliab*).ti.
47. 43 and 46
48. 45 not 36
49. 47 not 36
50. limit 48 to english language

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HTA
PGfAR
PHR

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