

SYSTEMATIC REVIEW

Complex interventions for improving independent living and quality of life amongst community-dwelling older adults: a systematic review and meta-analysis

LEONARD HO¹, STEPHEN MALDEN¹, KRIS MCGILL¹, MICHAL SHIMONOVICH², HELEN FROST¹, NAVNEET AUJLA³, IRIS S.-S. HO¹, SUSAN D. SHENKIN^{1,4}, BARBARA HANRATTY³, STEWART W. MERCER¹, BRUCE GUTHRIE¹

¹Advanced Care Research Centre, Usher Institute, University of Edinburgh, Edinburgh, UK

²MRC/CSO Social & Public Health Sciences Unit, University of Glasgow, Glasgow, UK

³Population Health Sciences Institute, Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, UK

⁴Ageing and Health Research Group, Usher Institute, University of Edinburgh, Edinburgh, UK

Address correspondence to: Bruce Guthrie. Advanced Care Research Centre, Usher Institute, University of Edinburgh, Bio Cube 1, Edinburgh BioQuarter, 13 Little France Road, Edinburgh, EH16 4UX, UK. Email: bruce.guthrie@ed.ac.uk

Abstract

Background: community-based complex interventions for older adults have a variety of names, including Comprehensive Geriatric Assessment, but often share core components such as holistic needs assessment and care planning.

Objective: to summarise evidence for the components and effectiveness of community-based complex interventions for improving older adults' independent living and quality of life (QoL).

Methods: we searched nine databases and trial registries to February 2022 for randomised controlled trials comparing complex interventions to usual care. Primary outcomes included living at home and QoL. Secondary outcomes included mortality, hospitalisation, institutionalisation, cognitive function and functional status. We pooled data using risk ratios (RRs) or standardised mean differences (SMDs) with 95% confidence intervals (CIs).

Results: we included 50 trials of mostly moderate quality. Most reported using holistic assessment (94%) and care planning (90%). Twenty-seven (54%) involved multidisciplinary care, with 29.6% delivered mainly by primary care teams without geriatricians. Nurses were the most frequent care coordinators. Complex interventions increased the likelihood of living at home (RR 1.05; 95% CI 1.00–1.10; moderate-quality evidence) but did not affect QoL. Supported by high-quality evidence, they reduced mortality (RR 0.86; 95% CI 0.77–0.96), enhanced cognitive function (SMD 0.12; 95% CI 0.02–0.22) and improved instrumental activities of daily living (ADLs) (SMD 0.11; 95% CI 0.01–0.21) and combined basic/instrumental ADLs (SMD 0.08; 95% CI 0.03–0.13).

Conclusions: complex interventions involving holistic assessment and care planning increased the chance of living at home, reduced mortality and improved cognitive function and some ADLs.

Keywords: aged, Geriatric Assessment, independent living, quality of life, Community Health Services, systematic review, older people

Key Points

- Community-based complex interventions for older adults have heterogeneous components.
- Most community-based complex interventions for older adults involved holistic assessment and care planning.

- Nurses were the most frequent care coordinators in multidisciplinary care.
- Complex interventions increased the chance of living at home, but not quality of life, amongst community-dwelling older adults.
- Complex interventions also reduced their mortality, enhanced cognitive function and improved some activities of daily living.

Background

The world's population is ageing rapidly [1]. Although the speed and pattern of population ageing vary by country, the growing proportion of older adults challenges hospital-centric healthcare systems [2]. Hospital admission is expensive, and the focus of most hospital care on single conditions is poorly aligned with the needs of older adults with multimorbidity, polypharmacy and frailty [3]. In hospital settings, a range of complex interventions has been developed to meet the care needs of older adults, including Comprehensive Geriatric Assessment (CGA), other kinds of discharge planning and more complex reorganisations of care [4]. CGA takes a multidisciplinary approach to a holistic assessment of needs, with coordinated health and social care to address those needs. Although there is evidence that CGA is an effective intervention in hospital inpatients [5], the evidence of effectiveness in the community is less clear.

Community-based complex interventions decrease the risk of unplanned hospital admissions amongst older adults at risk of poor health outcomes [6], and there is some evidence they improve quality of life (QoL) and reduce caregiver burden [7]. However, previous reviews have not evaluated other critical outcomes regarding independent living, such as living at home and institutionalisation [6, 7]. Additionally, although reviews often focus on how researchers classify or name their interventions (e.g. in reviews of 'CGA'), interventions with the same name are frequently heterogeneous in their intervention components, whereas interventions with different names often share core components [8]. Such heterogeneity may influence the adoption of evidence and hence the formulation of health and social care policies.

This systematic review with meta-analysis, therefore, aims to summarise current evidence on the effectiveness of community-based complex interventions (irrespective of how they are named) intended to improve independent living and QoL of older adults.

Methods

Full methods are reported in [Box 1](#), Supplementary file, and briefly reported here. The review protocol was registered in PROSPERO (CRD42021274017). Eligible studies were randomised controlled trials (RCTs) conducted in high-income countries which recruited community-dwelling adults that either explicitly targeted older adults or where the mean participant age was ≥ 65 years. Community-dwelling was defined as living independently at home (including in

extra-care housing but excluding care/nursing home residents) regardless of the need for care assistance.

Interventions

Complex interventions include several interacting components [9], which we classified in terms of the Taxonomy of Health Systems Interventions published by the Cochrane Effective Practice and Organisation of Care [10] and the NICE (National Institute for Health and Care Excellence) multimorbidity guideline document [8] ([Table S1](#)). RCTs where the only intervention was health education workshops or group activities without individual assessment or delivery of care to individuals were excluded.

Comparators

The comparator was 'usual care' in the setting the study was based in. RCTs offering minor enhancements to usual care in the control arm, such as written educational materials, were also eligible if they explicitly stated the content of additional components.

Outcomes

The primary outcomes examined were living at home and QoL. Living at home was defined either as a reported outcome or the inverse of mortality and institutionalisation (admission to a care or nursing home) combined at the end of follow-up. QoL had to be measured by validated self-reported outcome instruments (any of Short Form (SF)-12, SF-36, EQ-5D-3L, EQ-5D-5L, 15D, QUAL-E and Cantril's Ladder). Secondary outcomes included mortality, hospitalisation (≥ 1 during follow-up), institutionalisation (≥ 1 during follow-up), cognitive function (measured by validated instruments) and functional status (measured by validated assessments of activities of daily living (ADLs), instrumental activities of daily living (IADLs), combined ADLs/IADLs or physical mobility).

Search strategy and selection criteria

Six electronic databases (MEDLINE, Embase, CINAHL, PsycINFO, Web of Science, Cochrane Library) and three trial registries (ClinicalTrials.gov, ISRCTN, ICTRP) were searched from inception to February 2022. Search strategies are defined in [Box 2](#), Supplementary file, with additional hand-searching of reference lists. Covidence (<https://www.covidence.org/>) was used for data management, with title, abstract and full-text screening done by two independent

reviewers. Discrepancies were resolved by discussion and, if necessary, involvement of a third reviewer.

Data extraction, risk of bias assessment and quality of evidence assessment

Characteristics and outcome data of the eligible studies were extracted by a single reviewer with validation by a second reviewer, using the pre-specified data extraction sheet. Risk of bias assessment was conducted for all included studies using the Cochrane risk-of-bias tool for RCTs-2 [11]. The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was adopted for the assessment of the overall quality of evidence of meta-analyses [12].

Data synthesis

Meta-analysis

Dichotomous outcomes, including living at home, mortality, hospitalisation and institutionalisation were synthesised using risk ratios (RRs) and continuous outcomes, including QoL, cognitive function and functional status were pooled using standardised mean differences (SMDs). A fixed-effects model was used when the heterogeneity was low ($I^2 < 30\%$), and a random-effects model otherwise [13]. For RCTs with multiple periods of follow-up, only the outcome results from the longest follow-up were pooled in meta-analyses [13], and only results from intention-to-treat analyses were synthesised [14]. Results from per-protocol analyses and other unpooled results are shown in Table S2, with unpooled results also synthesised narratively.

Small-study effects were examined using funnel plots and Egger's regression tests [15]. For the primary outcomes, sensitivity analyses included leave-one-out analysis to explore whether findings were driven by single studies [16] and comparison of pooled results between studies at low/moderate versus high risk of bias [13]. For continuous outcomes, further sensitivity analysis compared pooled results between studies reported in change score from baseline against those reported in follow-up score [17]. For meta-analyses with ≥ 10 studies [13, 18], subgroup analyses were conducted stratified by: length of follow-up (short- versus medium-versus long-term follow-up); location of intervention delivered (home-only versus non-home settings \pm home); frailty, disability or functional decline of participants (present versus absent); multidisciplinary care (scheduled versus not); home/telephone follow-up (scheduled versus not); and self-management (planned versus not).

Results

Study selection and characteristics

In total, 18,714 unique records were screened, 333 full texts assessed and 50 RCTs conducted between 1984 and 2019 were included in this review (Figure 1). The list of included

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articles is shown in Box 3, Supplementary file. Fifteen (30%) RCTs took place in the European Union, 14 (28%) in the United States and 3 (6%) in the United Kingdom (Table 1). The majority ($n = 37$; 74%) of studies adopted frailty, disability or functional decline as an inclusion criterion. Twenty-nine (58%) studies involved interventions provided in day hospitals, general practice surgeries or other health and community care providers. The duration of intervention ranged from 10 weeks to 48 months. A total of 31,659 participants were involved in the studies, with the average age (mean or median) ranging from 69.5 to 86.3 years.

Descriptions of interventions and comparators

Intervention components for each included study are summarised in Table 2, with details documented in Table S3. Forty-seven (94%) RCTs reported using holistic assessment (non-disease-focused) as one of their intervention components, and 45 (90%) studies included care planning, including multidisciplinary care plans, self-management plans or developing care plans for routine primary care management. Amongst the 27 RCTs reporting multidisciplinary care, 8 (29.6%) had their interventions delivered mainly by primary care teams without the involvement of geriatricians or other specialist clinicians, 12 (44.4%) mainly by secondary care teams without the involvement of primary care professionals and 7 (25.9%) by primary and secondary care teams (Table 3). Over half of the studies involved nurses or advanced practice nurses (APNs; $n = 20$; 74.1%), general practitioners (GP; $n = 15$; 55.6%) and/or physiotherapists ($n = 14$; 51.9%) as care coordinators. In 18 (66.7%) studies, nurses or APNs were responsible for coordinating the multidisciplinary care. Fourteen (28%) and eight (16%) studies provided their participants with home and telephone follow-up only, respectively, with 10 (20%) others providing both. Finally, a total of 16 RCTs reported the adoption of planned self-management as an intervention component (Table 2).

Three (6%) RCTs reported the use of additional components to enhance usual care, including the provision of health educational materials [19–21] and standard needs assessment [22].

Risk of bias assessment

Risk of bias assessment is shown in Table S4. Overall, 11 were low risk of bias, 25 moderate and 14 at high risk. Twenty-seven studies had moderate risk of bias for not reporting details on randomisation and/or allocation sequence concealment, and one [23] was at high risk of bias for not concealing allocation sequence. Thirteen RCTs were at high risk of bias because they adopted per-protocol analysis for all outcomes, and three [24–26] had moderate risk of bias for not implementing the intention-to-treat analysis on all outcomes. Twenty-three studies had moderate risk of bias in the selection of reported results for not providing accessible study protocols.

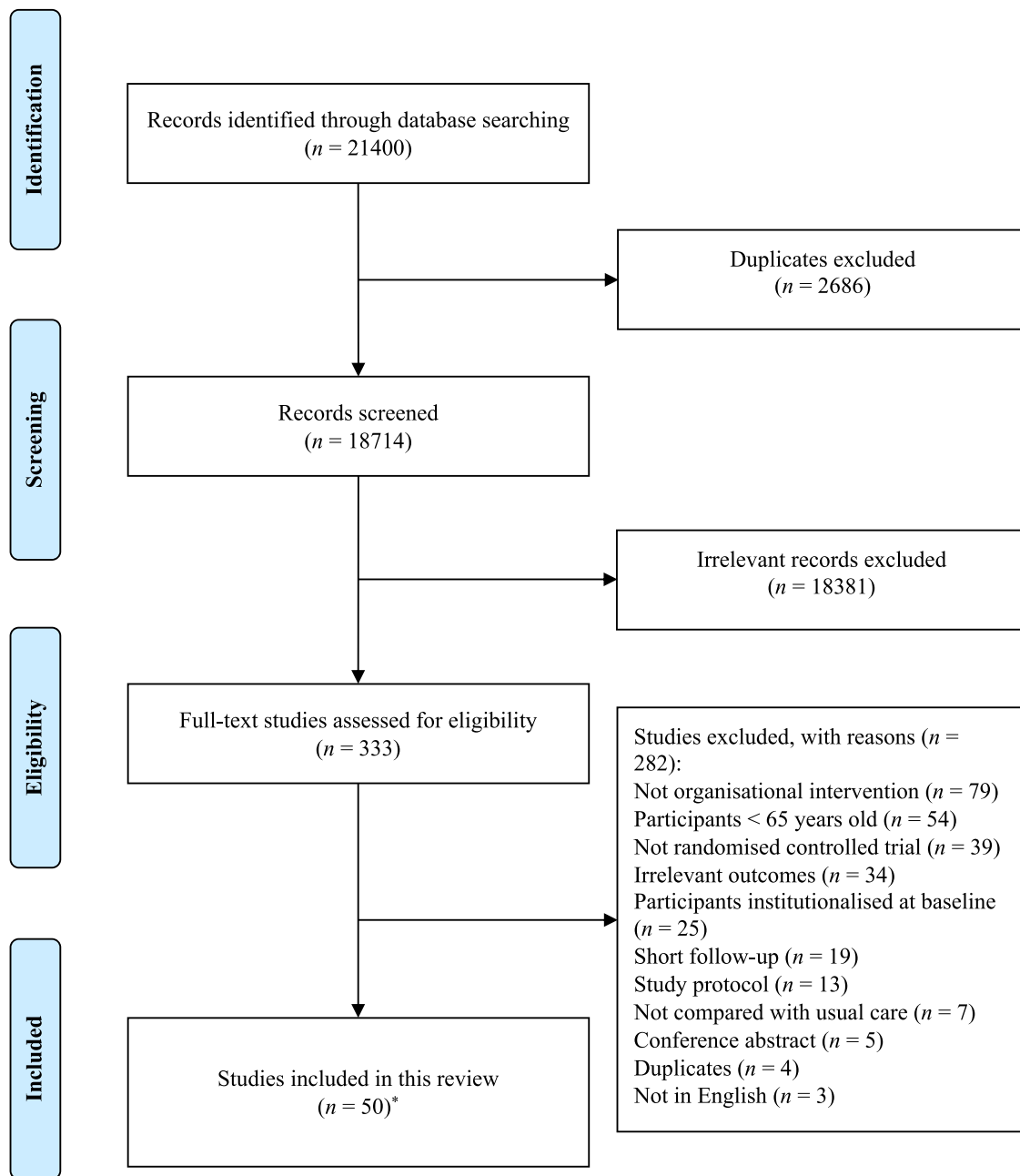


Figure 1. Flow of literature search and selection. *One RCT was reported across two included papers [19, 20]

Effects of interventions

Primary outcomes

Living at home In 11 RCTs with 4,538 participants, interventions were significantly superior to usual care in increasing the likelihood of older adults living at home (RR 1.05; 95% confidence interval (CI) 1.00–1.10; $P = 0.048$; $I^2 = 46\%$; GRADE moderate-quality evidence) (Table 4 and Figure S1). In the sensitivity analysis, there was no significant difference ($P = 0.46$) between studies at low/moderate versus high risk of bias. The leave-one-out analysis found that the significance of the pooled results was sensitive to

seven studies (results became non-significant) [22, 23, 27–31] (Table S5). Little evidence of small-study effects was observed (Egger's test: $P = 0.21$).

QoL (overall) In nine RCTs with 9,460 participants, interventions made little or no difference to overall QoL in older adults (SMD 0.01; 95% CI –0.04 to 0.05; $P = 0.72$; $I^2 = 0\%$; GRADE high-quality evidence) (Table 4 and Figure S2). Neither of the two unpooled RCTs reported significant results on the outcome (Table S2). In the leave-one-out analysis, the significance of the pooled results was not sensitive to any individual studies (Table S5).

Table 1. Characteristic of included randomised controlled trials

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Beland (2006)	Canada	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Older than 64 years old; Community-dwelling; Residing within the two local community services centre territories; Being competent in French or English (participant or caregiver); Having a participating caregiver (if a caregiver existed); and Having at least moderate disability, defined by the Functional Autonomy Measurement System scale 	<ul style="list-style-type: none"> Having pending nursing home admission; or Moving out of the local community services centre territories 	22 months	I: 606 C: 624	I: Median 82.0; Range 74.0–104.0 C: Median 82.0; Range 64.0–104.0
Bernabei (1998)	Italy	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Aged 65 and over; and Receiving home health services or home assistance, usually because of multiple geriatric conditions 	Not reported	12 months	I: 99 C: 100	I: 80.7 (7.1) C: 81.3 (7.4)
Bleijenberg (2016)	Netherlands	<ul style="list-style-type: none"> Home 	<ul style="list-style-type: none"> Potentially frail individuals aged 60 and older 	<ul style="list-style-type: none"> Terminal illness or estimated life expectancy of ≤ 3 months; or Living in assisted-living facilities or nursing homes 	12 months	I: 790 (Screening group) I: 1,446 (Screening + Nurse-Led Care group) C: 856	I: 73.5 (8.2) (Screening group) I: 74.0 (8.2) (Screening + Nurse-Led Care group) C: 74.6 (8.8)
Blom (2016)	Netherlands	<ul style="list-style-type: none"> GP surgeries 	<ul style="list-style-type: none"> Aged ≥ 75; Community-dwellings; and Complex problems (3+ from: (i) Poor outcomes on disability; (ii) Feelings of loneliness; (iii) Poor health-related QoL; or (iv) Less GP contact time) 	<ul style="list-style-type: none"> Terminal illness or estimated life expectancy of ≤ 3 months 	12 months	I: 288 C: 1,091	I: Median 82.0; IQR 78.8–86.9 C: Median 83.7; IQR 79.8–88.0
Boult (2011)	United States	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> High risk of generating high healthcare expenditures during the following year, estimated by the Hierarchical Condition Category predictive model 	Not reported	20 months	I: 404 C: 446	I: 77.8; Range 66.0–96.0 C: 77.1; Range 66.0–106.0
Boult (2013)	United States	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> High risk of generating high healthcare expenditures during the following year, estimated by the Hierarchical Condition Category predictive model 	<ul style="list-style-type: none"> Did not have a telephone; Did not speak English; Planning extended travel; Failed the brief cognitive screen; or Did not have a proxy who could provide consent 	32 months	I: 485 C: 419	I: 77.2 (SD not reported) C: 78.1 (SD not reported)

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Bretschneider (2015)	Germany	• Home	<ul style="list-style-type: none"> • Older than 80 years; • Residing in Leipzig or Halle; and • Lived at home or planned discharge to home 	<ul style="list-style-type: none"> • Had insufficient German language skills; • Suffered from cognitive impairment; • Unable to give informed consent; or • Had a care level > 1, according to German long term care insurance 	18 months	I: 133 C: 145	I: 84.9; 3.5 C: 84.7; 3.5
Burns (2000) ^a	United States	• Multidisciplinary clinics for the study	<ul style="list-style-type: none"> • 65 years of age or older; • Admitted to either the medical, surgical, or neurology services at the Memphis Veterans Affairs Medical Centre; and • Having two or more of the following: (i) ≥ 1 ADL deficits; (ii) ≥ 2 chronic medical conditions; (iii) ≥ 2 acute care hospitalisations in the previous year; or (iv) ≥ 6 scheduled prescription drugs 	<ul style="list-style-type: none"> • Having admitted to nursing home; • Required inpatient Geriatric Evaluation and Management and/or rehabilitation during hospital stay; • Having a terminal illness with a life expectancy of <6 months; • Having moderate to severe dementia (MMSE score < 18); • Having end stage disease; or • Chose not to participate in the study 	24 months	I: 60 (Analysed: 49) C: 68 (Analysed: 49)	I: 71.7; 6.3 C: 70.8; 3.7
Buss (2016) ^a	Germany	• Home	<ul style="list-style-type: none"> • Aged >60 years; • Ability to communicate motorically, cognitively, and psychologically; • Ability to communicate in German; • Residing in Hamburg; and • Having functional mobility impairment of the musculoskeletal system or stroke 	<ul style="list-style-type: none"> • Deficient orientation to place or time; • Cognitive impairment (MMSE score < 25); or • Receiving palliative care 	12 months	I: 32 (Analysed: 24–27) C: 33 (Analysed: 28–31)	I: 81.8; 8.4 C: 83.0; 7.5
Caplan (2004) ^b	Australia	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 75 or older; and • Discharged home from the emergency department 	<ul style="list-style-type: none"> • Living in nursing home; • Had previously already been enrolled in this study; or • Living out of the local area of the hospital 	18 months	I: 370 (Analysed: 293–370) C: 369 (Analysed: 282–369)	I: 82.1; 6.6 C: 82.4; 5.2
Coleman (1999)	United States	<ul style="list-style-type: none"> • Home 	<ul style="list-style-type: none"> • 65 years of age or older; and • At high risk of hospitalisation and functional decline, defined by validated computer-based predictive index 	<ul style="list-style-type: none"> • Too ill to participate; • Having moderate to severe dementia; • Residence in a nursing home; • Having terminal illness; or • Disenrolled 	24 months	I: 96 C: 73	I: 77.3 (SD not reported) C: 77.4 (SD not reported)

(Continued)

Table I. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Counsell (2007)	United States	• Home	<ul style="list-style-type: none"> • Age 65 years or older; • At least 1 visit to a primary care clinician at the same site within the past 12 months; and • Having income less than 200% of the federal poverty level 	<ul style="list-style-type: none"> • Residence in a nursing home; • Living with a study participant already enrolled in the trial; • Enrolled in another research study; • Receiving dialysis; • Severe hearing loss; • English-language barrier; • No access to a telephone; • Severe cognitive impairment, defined by SPMSQ score; or • Without an available caregiver to consent to participate 	24 months	I: 474 C: 477	I: 71.8; 5.6 C: 71.6; 5.8
Di Pollina (2017)	Switzerland	• Home • Day hospitals	<ul style="list-style-type: none"> • 60 years and older; and • Presence of frailty, defined by the Resident Assessment Instrument-Home Care 	<ul style="list-style-type: none"> • Did not meet frailty criteria; or • Could not speak French 	36 months	I: 122 C: 179	I: 81.8; 8.2 C: 81.9; 8.2
Dolovich (2019)	Canada	• Home • Health care providers • Community care providers	<ul style="list-style-type: none"> • Aged 70 years or older; and • Living in Hamilton 	<ul style="list-style-type: none"> • Away for more than 50% of trial duration; • Receiving long-term/palliative care; or • Neither they nor their family member spoke English 	6 months	I: 158 C: 154	I: 78.1; 6.3 C: 79.06; 6.6
Engelhardt (1996)	United States	• Day hospitals	<ul style="list-style-type: none"> • Aged 55 or older; • Were above average users (10 or more clinic visits) of Department of Veterans Affairs Medical Centre outpatient clinic services in the previous 12 months; and • With at least two impairments on ADLs or IADLs 	<ul style="list-style-type: none"> • 1. Hospitalised with a psychiatric diagnosis within the previous year; • 2. With severe cognitive impairments as assessed by SPMSQ; • 3. Received care within a year before screening from: (i) Oncology or renal clinics; (ii) Hospital-based home care; (iii) Adult health day care; or (iv) an Inpatient Geriatric Evaluation and Management Unit; • Residing in nursing homes; or • Reported receiving the majority of care in the previous year from non-veterans affairs providers 	16 months	I: 80 C: 80	I: 71.7; 6.8 C: 72.6; 5.8
Fabacher (1994) ^a	United States	• Home	<ul style="list-style-type: none"> • Veterans of the United States armed services; • Age 70 years or older; • Not currently enrolled in a Veterans Affairs outpatient clinic; and • Not suffering from a known terminal disease or dementia 	<ul style="list-style-type: none"> • Not reported 	12 months	I: 131 (Analysed: 100) C: 123 (Analysed: 95)	I: 73.5; 4.3 C: 71.8; 7.0

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Ford (2019) ^a	United Kingdom	<ul style="list-style-type: none"> GP surgeries 	<ul style="list-style-type: none"> Aged 18 or over; and Identified as in the top 2% for risk of unplanned admission and diagnosed with at least two of 40 morbidities in Barnett's analysis of multimorbidity 	<ul style="list-style-type: none"> Deemed to be unable to participate in goal-setting in the G's professional opinion; Had received a care planning consultation in the previous 3 months; or Required translation services to communicate verbally 	6 months	I: 24 (Analysed: 18) C: 28 (Analysed: 23)	I: 80.4; 8.7 C: 77.2; 9.4
Fristedt (2019)	Sweden	<ul style="list-style-type: none"> Home Health care providers 	<ul style="list-style-type: none"> Aged ≥ 75 years; Community-dwelling; Having more than 3 chronic diagnoses; Prescribed 6 or more pharmaceutical drugs for continuous use; and With > 3 hospital stays (> 24 hours in hospital) during the last 6 month 	<ul style="list-style-type: none"> Deceased; Lived in a nursing home; and Had a hospital admission not relevant to the Mobile Geriatric Team concept 	12 months	I: 31 C: 31	I: 84.0; 5.1 C: 86.0; 5.7
Gitlin (2006)	United States	<ul style="list-style-type: none"> Home 	<ul style="list-style-type: none"> Aged 70 and older; Cognitively intact (MMSE > 23); English speaking; Not receiving home occupational therapy or physical therapy; and Functionally vulnerable (needing help with two IADLs, having difficulty performing one ADL, or experiencing one or more falls within 1 year before study entry) 	<ul style="list-style-type: none"> Totally dependent; Homebound; or Receiving services to address functional problems 	12 months	I: 160 C: 159	I: 79.5; 6.1 C: 78.5; 5.7
Godwin (2016) ^a	Canada	<ul style="list-style-type: none"> Home 	<ul style="list-style-type: none"> 80 years or older; and Functioning well cognitively and living independently in the community 	<ul style="list-style-type: none"> Living in a nursing home; Not able to give informed consent; MMSE score < 25; Had profound communication difficulties; or Receiving in-home care without which they would require admission to a nursing home 	12 months	I: 121 (Analysed: 95) C: 115 (Analysed: 86)	I: 85.3; 4.5 C: 85.7; 3.6
Hendriksen (1984)	Denmark	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Aged 75 years or more; and Living in a suburb (Roedovre municipality) of Copenhagen 	Not reported	36 months	I: 285 C: 287	I: Median 78.4; Range 75–96 C: Median 78.6; Range 75–95

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Hoogendijk (2016)	Netherlands	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 65 or over; • Community-dwelling; and • Had moderate to severe disability, as defined by PRISMA-7 score of 3 or more 	Not reported	24 months	I: 1,147 C: 1,147	I: 80.5; 7.5 C: 80.5; 7.5
Kerse (2014) ^a	New Zealand	<ul style="list-style-type: none"> • GP surgeries 	<ul style="list-style-type: none"> • Aged 75 years and older; • Community-dwelling; and • Participating primary care practices 	<ul style="list-style-type: none"> • Living in residential care; • Receiving palliative care; or • Terminally ill 	36 months	I: 2,049 (Analysed: 1,553–2,049) C: 1,844 (Analysed: 1,428–1,844)	I: 80.4; 4.6 C: 80.3; 4.5
Kono (2012)	Japan	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 65 years or older; • Certified as Support Level 1 or 2 in the Long-Term Care Insurance; • Living at home at the baseline survey; and • Not having utilised formal long-term care services, which are reimbursed by the Long-Term Care Insurance, for the past 3 months 	Not reported	24 months	I: 161 C: 162	I: 80.3; 6.7 C: 79.6; 6.4
Lewin (2013)	Australia	<ul style="list-style-type: none"> • Home 	<ul style="list-style-type: none"> • ≥65 years of age; • Referred for personal care; • Not having a diagnosis of dementia or other progressive neurological disorders • Not receiving palliative care; and • Able to communicate in English 	Not reported	12 months	I: 375 C: 375	I: 82.7; 7.7 C: 81.8; 7.2
Lihavainen (2012)	Finland	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • 75-year-old and older; and • Residing in Kuopio, Eastern Finland 	<ul style="list-style-type: none"> • Refused to participate; or • Moved out of the area 	24 months	I: 404 C: 377	I: 81.0; 4.9 C: 81.1; 5.1
Liimatta (2019)	Finland	<ul style="list-style-type: none"> • Community care providers • Home 	<ul style="list-style-type: none"> • 75 years old or older; • Home dwellings; • Not receiving home help or nursing services; • Finnish speaking; and • Living permanently in the Hyvinkää area 	Not reported	24 months	I: 211 C: 211	I: 80.8; 4.3 C: 81.8; 4.3

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Markle-Reid (2010) ^a	Canada	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 75 years and older; • Newly referred to and eligible for home support services through the Community Care Access Centres; • Living in the community (not in a nursing home or other long-term care facility); • Mentally competent to give informed consent; and • Competent in English or with a translator available 	Not reported	6 months	I: 54 (Analysed: 49) C: 55 (Analysed: 43)	I: 75–85 (<i>n</i> = 28) I: 86 or older (<i>n</i> = 21) C: 75–85 (<i>n</i> = 22) C: 86 or older (<i>n</i> = 21)
Markle-Reid (2006) ^a	Canada	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • 75 years of age or older; and • Newly referred to and eligible for personal support services through the Community Care Access Centres 	<ul style="list-style-type: none"> • Refused to give informed consent; • Unable to understand English; or • Deemed eligible for nursing services 	6 months	I: 144 (Analysed: 120) C: 144 (Analysed: 122)	I: 75–85 (<i>n</i> = 90) I: 86 or older (<i>n</i> = 30) C: 75–85 (<i>n</i> = 78) C: 86 or older (<i>n</i> = 44)
Metzelthin (2015)	Netherlands	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 70 years or older; • Community-dwelling; and • Frail, as defined by a Groningen Frailty Indicator of 5 or higher 	<ul style="list-style-type: none"> • Terminally ill; • Confined to bed; • Had severe cognitive or psychological impairments; or • Unable to communicate in Dutch 	24 months	I: 193 C: 153	I: 77.5; 5.3 C: 76.8; 4.9
Newbury (2001) ^a	Australia	<ul style="list-style-type: none"> • GP surgeries 	<ul style="list-style-type: none"> • Aged 75 years or over; and • Living independently in the community 	Not reported	12 months	I: 50 (Analysed: 45) C: 50 (Analysed: 44)	I: Median 80; Range 75–91 C: Median 78.5; Range 75–88 I: 82.7; 7.3 C: 83.5; 7.6
Parsons (2017)	New Zealand	<ul style="list-style-type: none"> • Home 	<ul style="list-style-type: none"> • Aged ≥65 years; and • At high risk of permanent institutional care by the regional assessment agency (dementia, with associated behavioural problems; incontinence; carer stress; repeated falls; or frailty) 	<ul style="list-style-type: none"> • Needed immediate placement in residential care; or • Inability to communicate in English 	24 months	I: 56 C: 57	I: 79.1; 6.9 C: 76.9; 7.6
Parsons (2013)	New Zealand	<ul style="list-style-type: none"> • Home 	<ul style="list-style-type: none"> • Older than 65 years (55 years if Maori or Pacific Islander); • Community-dwelling; and • New referral for home care 	<ul style="list-style-type: none"> • Severe cognitive impairment (Abbreviated Mental Test score of less than 7); or • Referral for assessment for admission to a residential facility, carer support, or short-term services 	6 months	I: 108 C: 97	I: 79.1; 6.9 C: 76.9; 7.6

(Continued)

Table I. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Ploeg (2010) ^b	Canada	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 75 years or older; • They or their proxy is able to answer questions in English; and • Resided in the city of Hamilton 	<ul style="list-style-type: none"> • Received home care services; • Lived in a nursing home or long-term care home; • Identified by family physician as needing palliative care; • Scheduled for major elective surgery in the next year; or • Planning to leave the country for more than one month during the 12-month follow-up period 	12 months	I: 361 (Analysed: 331–361) C: 358 (Analysed: 314–358)	I: 81.0; 4.1 C: 81.3; 4.4
Radwany (2014)	United States	<ul style="list-style-type: none"> • Home 	<ul style="list-style-type: none"> • ≥ 60 years of age; • Newly enrolled in PASSPORT (Ohio's community-based, long-term care Medicaid waiver programme); • Eligible for both Medicare and Medicaid benefits; • Passed mental status screening (Mental Status Questionnaire); and • Had one of the following: (i) Congestive heart failure and being actively treated; (ii) Chronic obstructive pulmonary disease and on home oxygen; (iii) Diabetes with renal disease, neuropathy, visual problems, or coronary artery disease; (iv) End-stage liver disease or cirrhosis; (v) Cancer (active, not history of) except skin cancer; (vi) Renal disease and actively receiving dialysis; (vii) Amyotrophic lateral sclerosis with history of aspiration; (viii) Parkinson's disease stages 3 and 4; or (ix) Pulmonary hypertension 	<ul style="list-style-type: none"> • Active alcoholics (drink ≥ 2 drinks per day on average); • Illegal substance users; • Had schizophrenia or psychotic; • Unable to pass the Mental Status Questionnaire; or • Already enrolled in hospice 	12 months	I: 40 C: 40	I: 69.5 (SD not reported) C: 68.8 (SD not reported)
Reuben (1999) ^a	United States	<ul style="list-style-type: none"> • GP surgeries 	<ul style="list-style-type: none"> • 65 years of age or older; • Community-dwelling; and • Had failed a screen for at least one of four conditions (falls, urinary incontinence, depressive symptoms or functional impairment) 	<ul style="list-style-type: none"> • Did not speak English; • Did not have a telephone; • Did not have a primary care physician; • Were demented or had MMSE < 24; or • Had other mental, emotional, or physical disorders to the extent that they could not be expected to complete the questionnaires and protocol required for the study 	15 months	I: 180 (Analysed: 176) C: 183 (Analysed: 175)	I: 75.8; 6.1 C: 75.9; 5.7

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Rosstad (2017)	Norway	• Home	<ul style="list-style-type: none"> • 70 years or older; and • Served by one of the included clusters or scheduled to receive home care services (because of functional and/or cognitive impairment) after discharge from hospital • 75 years and older; • Healthy • Aged 18 years or older; and • With at least three types of chronic condition 	<ul style="list-style-type: none"> • Caregivers or health personnel responsible for the care services (cognitive impairments) 	12 months	I: 163 C: 141	I: 83.1; 5.7 C: 82.4; 5.7
Sahlen (2006)	Sweden	• Home	<ul style="list-style-type: none"> • 75 years and older; • Healthy • Aged 18 years or older; and • With at least three types of chronic condition 	Not reported	24 months	I: 248 C: 346	I: 79.7; 3.9 C: 79.8; 4.3
Salisbury (2018)	United Kingdom	• GP surgeries	<ul style="list-style-type: none"> • Aged 18 years or older; and • With at least three types of chronic condition 	<ul style="list-style-type: none"> • Had a life expectancy of less than 12 months; • At serious suicidal risk; • Known to be leaving the practice within 12 months; • Unable to complete questionnaires in English; • Taking part in another healthcare research project; • Lacked the capacity to give consent (in Scotland only, for legal reasons); or • Unsuited to be invited for other reasons, deemed by GPs 	15 months	I: 797 C: 749	I: 71.0; 11.6 C: 70.7; 11.4
Shapiro (2002)	United States	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 60 or older; • On a waiting list to receive social services through the State of Florida's Community Care for the Elderly programme; and • Characterised as 'moderate risk' based on a uniform state-wide assessment device (based on chronic health conditions, ADL limitations and other measures of physical and psychological impairment) • 75 years old; • Living at home; and • Registered at the participating healthcare centres 	<ul style="list-style-type: none"> • Moved out of the moderate-risk classification; • Died; • Unable to be contacted by telephone; • Unable to self-report; or • Institutionalised 	18 months	I: 40 C: 65	I: 77.7 (SD not reported) C: 77.1 (SD not reported)
Sherman (2016)	Sweden	• Home	<ul style="list-style-type: none"> • 75 years old; • Living at home; and • Registered at the participating healthcare centres 	Not reported	12 months	I: 176 C: 262	I: 75 (SD not reported) C: 75 (SD not reported)

(Continued)

Table I. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Spooorenberg (2018)	Netherlands	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Aged 75 and over; Living at home or in a home for the elderly; and INTERME-D-E-SA ≥ 16 (Complex care needs)/INTERMED-E-SA < 16 and Groningen Frailty Indicator ≥ 5 (Frail)/INTERMED-E-SA < 16 and Groningen Frailty Indicator < 5 (Robust) 75 years of age or older; and Living at home 	<ul style="list-style-type: none"> Long-term admission to a nursing home (not just for rehabilitation); Receiving an alternative type of integrated care; or Participating in another research study 	12 months	I: 747 C: 709	I: 80.6; 4.5 C: 80.8; 4.7
Stuck (1995) ^b	United States	<ul style="list-style-type: none"> Home 	<ul style="list-style-type: none"> 75 years of age or older; and Living at home 	<ul style="list-style-type: none"> Had severe cognitive impairment; Had language problems; Planned to move to a nursing home; Planned to move away; Self-reported terminal disease; Participated in another randomised trial; or Had severe functional impairment 	36 months	I: 215 C: 199	I: 81.0; 3.9 C: 81.4; 4.2
Suijker (2016)	Netherlands	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Aged 70 years and over; and At risk of functional decline (ISAR-PC score ≥ 2) 	<ul style="list-style-type: none"> Had a life expectancy of less than three months; Suffered from dementia; Did not understand Dutch; Planned to move or spend a long-time abroad; or Lived in a nursing home 	12 months	I: 1,209 C: 1,074	I: Median 82.6; Range 76.8–86.8 C: Median 82.9; Range 77.3–87.3
Szanton (2011) ^a	United States	<ul style="list-style-type: none"> Home 	<ul style="list-style-type: none"> Aged 65 and older; Cognitive function MMSE score ≥ 24; Reported difficulty with one or more ADLs or two or more IADLs; Low income (household income 199% of the Federal Poverty Level); and Be able to stand with or without assistance 	<ul style="list-style-type: none"> Receiving in-home rehabilitation (nursing, physical therapy, or occupational therapy); Had a terminal diagnosis with less than 1 year expected survival as determined by their physician; Receiving active cancer treatment; Had plans to move in less than 1 year; or Not competent to provide informed consent 	6 months	I: 24 C: 16	I: 79.0; 8.2 C: 77.0; 7.1
Thomas (2007)	Canada	<ul style="list-style-type: none"> Home Health care providers Community care providers 	<ul style="list-style-type: none"> Aged 75 years or older; Living at home; Not receiving formal home care; and Able to identify an informal caregiver 	Not reported	48 months	I: 175 (Intervention 1 group); 170 (Intervention 2 group) C: 175	I: 80.7; 4.3 (Intervention 1 group) I: 80.4; 4.4 (Intervention 2 group) C: 80.7; 4.5

(Continued)

Table 1. Continued

First author (publication year)	OECD country	Location of intervention delivery	Inclusion criteria	Exclusion criteria	Duration of intervention	Sample size	Participant age mean (SD)
Tuntland (2015) ^a	Norway	• Home	<ul style="list-style-type: none"> • Aged 18 years or older; • Home-dwellings; • Living in the municipality of Voss in Western Norway; • Able to understand Norwegian; and • Had a functional decline in one or more ADLs 	<ul style="list-style-type: none"> • In need of institution-based rehabilitation or nursing home placement; • Terminally ill; or • Moderately or severely cognitively reduced (subjectively assessed by health-care providers based on observation and communication) 	10 weeks	I: 31 (Analysed: 25–28) C: 30	I: 79.9; 10.4 C: 78.1; 9.8
van Hout (2010)	Netherlands	<ul style="list-style-type: none"> • Home • Health care providers • Community care providers 	<ul style="list-style-type: none"> • Aged 75 years and older; • Listed as primary care practice patient; • Living at home; and • Frail (self-reported score in the worst quartile of at least 2 of 6 COOP/WONCA charts: overall health ≥ 4; physical fitness ≥ 5; changes in health ≥ 4; daily activities ≥ 4; mental health ≥ 3; social activities ≥ 3) 	<ul style="list-style-type: none"> • Terminally ill as determined by primary care physicians; • With dementia symptoms (self-report of memory deterioration and MMSE < 24 or 7-minute screen $> 50\%$); • Living in residential homes; or • Participating in other research projects 	18 months	I: 331 C: 320	I: 81.3; 3.9 C: 81.5; 4.3
Walters (2017)	United Kingdom	• Home	<ul style="list-style-type: none"> • Aged ≥ 65 years; • Registered with a participating general practice; • Scoring as 'mildly frail' on the Rockwood Clinical Frailty Scale; • Community-dwelling (including extra care housing); • A life expectancy of > 6 months; • Capacity to consent to participate (including those with dementia or communication difficulties who retained capacity) 	<ul style="list-style-type: none"> • Living in care homes; • Had moderate to severe frailty or who are not frail (according to the Rockwood Clinical Frailty Scale); • Were on the GP register for palliative care or dementia; • Were housebound; • Were already case managed; • Were lacking capacity to consent; • Inappropriate to have an invitation to participate for at this time, as judged by their GP 	6 months	I: 26 C: 25	I: 80.38; 6.89 C: 79.68; 6.36
Zimmer (1985) ^a	United States	• Home	<ul style="list-style-type: none"> • Home-bound; • Wishing to remain at home; • Having significant illness (not primarily psychiatric) requiring medical care; • Not having a physician who would make home visits; • Living within Monroe County; • Having a family member or friend ('caretaker') who could assist in their care at home; and • Willing to participate 	Not reported	6 months	I: 82 C: 76	I: 73.8 (SD not reported) C: 77.4 (SD not reported)

C, control group; I, intervention group; INTERMED-E-SA, The INTERMED for the Elderly Self-Assessment; ISAR-PC, Identification of Seniors At Risk—Primary Care; MMSE, Mini-Mental State Examination; OECD, Organisation for Economic Co-operation and Development; SPMISQ, Short Portable Mental Status Questionnaire. ^aStudies adopted per-protocol analysis for all outcomes. ^bStudies adopted per-protocol analysis for some outcomes (further detailed in Table S2).

Table 2. Intervention components of the included randomised controlled trials

Study	Component of intervention					
	Holistic assessment	Multidisciplinary care	Care plan development	Home follow-up	Telephone follow-up	Self-management
Beland (2006)	•	•	•			
Bernabei (1998)	•	•	•	•		
Bleijenberg (2016)	• ^a	•	• ^a	• ^a		
Blom (2016)	•		•			
Boult (2011)	•		•		•	•
Boult (2013)	•		•		•	•
Brettschneider (2015)	•		•	•		•
Burns (2000)	•	•	•		•	
Buss (2016)			•	•	•	•
Caplan (2004)	•	•	•			
Coleman (1999)	•		•			•
Counsell (2007)	•	•	•	•	•	
Di Pollina (2017)	•	•	•			
Dolovich (2019)	•	•	•	•		
Engelhardt (1996)	•	•	•			
Fabacher (1994)	•		•	•		
Ford (2019)		•	•			
Fristedt (2019)	•	•	•	•		
Gitlin (2006)				•	•	
Godwin (2016)	•		•	•		
Hendriksen (1984)	•					
Hoogendijk (2016)	•	•	•	•	•	
Kerse (2014)	•	•	•			
Kono (2012)	•	•	•	•	•	
Lewin (2013)	•	•	•		•	•
Lihavainen (2012)	•	•	•			
Liimatta (2019)	•		•			•
Markle-Reid (2006)	•	•	•			•
Markle-Reid (2010)	•	•	•	•	•	•
Metzelthin (2015)	•	•	•	•	•	
Newbury (2001)	•		•			
Parsons (2013)	•	•	•			
Parsons (2017)	•		•	•		
Ploeg (2010)	•	•	•	•	•	
Radwany (2014)	•		•		•	
Reuben (1999)	•		•		•	•
Rosstad (2017)	•		•			
Sahlen (2006)	•				•	
Salisbury (2018)	•		•			
Shapiro (2002)	•	•	•		•	
Sherman (2016)	•			•		
Spoorenberg (2018)	• ^b	• ^b	• ^b	• ^b		•
Stuck (1995)	•		•	•		•
Suijker (2016)	•	•	•	•		•
Szanton (2011)	•	•	•			•
Thomas (2007)	•					
Tuntland (2015)	•	•	•	•		•
van Hout (2010)	•		•	•	•	
Walters (2017)	•		•	•	•	•
Zimmer (1985)	•	•	•	•		
Number (%) of studies with each component	47 (94)	27 (54)	45 (90)	24 (48)	18 (36)	16 (32)

^aOnly applicable to Screening + Nurse-Led Care group. ^bOnly applicable to Complex Care Needs group and Frail group.

QoL (physical component) In six RCTs with 5,902 participants, interventions had little or no effect on the physical component of QoL (SMD 0.00; 95% CI -0.08 to 0.08; $P = 0.97$; $I^2 = 54\%$; GRADE low-quality evidence) (Table 4

and Figure S3). Neither of the two unpooled RCTs reported significant impacts on the outcome (Table S2). No significant difference ($P = 0.41$) was identified between studies reporting change scores from the baseline versus studies

Table 3. Composition of multidisciplinary teams in the included randomised controlled trials

Study	Level of care team	Involved health care or social care professionals										Case coordinator(s)			
		Nurse	APN	GP	Geriatrician	Other specialist doctors	Dentist	Social worker	Physiotherapist	Occupational therapist	Dietitian or nutritionist		Speech therapist	Pharmacist	Psychologist
Beland (2006)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N or SW
Bernabei (1998)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	Details not reported
Bleijenberg (2016) ^a	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN
Burns (2000)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN or GP or SW or Psy
Caplan (2004)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N
Counsell (2007)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN and SW
Di Pollina (2017)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N
Engelhardt (1996)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	G
Fristedt (2019)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	G
Hoogendijk (2016)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN and G
Kerse (2014)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN and GP
Kono (2012)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN and SW and CM
Lewin (2013)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N and PT and OT
Lihavainen (2012)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N
Markle-Reid (2010)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	CM
Metzelthin (2015)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN
Parsons (2013)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N
Ploeg (2010)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN
Spoorenberg (2018) ^b	Primary + Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN or SW
Suijker (2016)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN
Szanton (2011)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N and OT
Tuntland (2015)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	PT and OT
Zimmer (1985)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	APN or GP or SW
Dolovich (2019)	Primary	•	•	•	•	•	•	•	•	•	•	•	•	•	GP
Ford (2019)	Primary and Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	GP
Markle-Reid (2006)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	N
Shapiro (2002)	Secondary	•	•	•	•	•	•	•	•	•	•	•	•	•	CM

CM, care manager (profession not reported); G, geriatrician; N, nurse; OT, occupational therapist; Psy, psychologist; PT, physiotherapist; SW, social worker. ^a Only applicable to Screening + Nurse-Led Care group. ^b Only applicable to Complex Care Needs group and Frail group.

Table 4. Effect estimates and quality of evidence ratings for all outcomes

Dichotomous outcomes										
Outcome	Number of RCTs (Number of participants)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Pooled result in RR (95% CI)	P	I ²	Quality of evidence
Living at home	12 (4538)	No	Serious	No	No	Not detected	1.05 (1.00–1.10)	0.048	46%	⊕⊕⊕⊕ Moderate
Mortality	20 (9455)	No	No	No	No	Not detected	0.86 (0.77–0.96)	0.007	9%	⊕⊕⊕⊕ High
Hospitalisation	15 (6244)	No	Very serious	No	No	Not detected	0.93 (0.84–1.03)	0.19	59%	⊕⊕⊕⊕ Low
Institutionalisation	15 (5231)	No	No	No	No	Not detected	0.89 (0.75–1.04)	0.14	23%	⊕⊕⊕⊕ High
Continuous outcomes										
Outcome	Number of RCTs (Number of participants)	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Pooled result in SMD (95% CI)	P	I ²	Quality of evidence
QoL (overall)	9 (9460)	No	No	No	No	Not assessed	0.01 (-0.04 to 0.05)	0.72	0%	⊕⊕⊕⊕ High
QoL (physical component)	6 (5902)	No	Very serious	No	No	Not assessed	0.00 (-0.08 to 0.08)	0.97	54%	⊕⊕⊕⊕ Low
QoL (mental component)	6 (5902)	No	Very serious	No	No	Not assessed	0.07 (-0.02 to 0.16)	0.11	59%	⊕⊕⊕⊕ Low
Cognitive function	5 (2149)	No	No	No	No	Not assessed	0.12 (0.02–0.22)	0.02	0%	⊕⊕⊕⊕ High
Functional status (ADL)	6 (2476)	No	Serious	No	No	Not assessed	0.10 (0.00–0.20)	0.052	26%	⊕⊕⊕⊕ Moderate
Functional status (IADL)	4 (1687)	No	No	No	No	Not assessed	0.11 (0.01–0.21)	0.02	0%	⊕⊕⊕⊕ High
Functional status (Combined ADL and IADL)	5 (7751)	No	No	No	No	Not assessed	0.08 (0.03–0.13)	0.002	0%	⊕⊕⊕⊕ High

reporting follow-up scores. The significance of the pooled results was not sensitive to any individual study (Table S5).

QoL (mental component) In six RCTs with 5,902 participants, interventions had little or no effect on the mental component of QoL (SMD 0.07; 95% CI -0.02 to 0.16; $P = 0.11$; $I^2 = 59\%$; GRADE low-quality evidence) (Table 4). The single unpooled RCT did not report significant results on the outcome (Table S2). There was a significant difference ($P = 0.01$) between studies ($n = 3$) reporting change scores from the baseline and the single study reporting scores at the end of follow-up (Figure S4), with the latter [32] having a positive result. The significance of the pooled results was sensitive to van Hout *et al.* [33] (results became significant) (Table S5).

Secondary outcomes

Mortality In 20 RCTs with 9,455 participants, interventions reduced mortality in older adults (RR 0.86; 95% CI 0.77–0.96; $P = 0.007$; $I^2 = 9\%$; GRADE high-quality evidence) (Table 4 and Figure S5). Only one [19, 20] of the six unpooled RCTs reported that the interventions were superior to usual care in reducing mortality at 12-month follow-up (Table S2). Little evidence of small-study effects was observed (Egger's test: $P = 0.10$).

Hospitalisation In 15 RCTs with 6,244 participants, interventions had little or no effect on hospitalisation (RR 0.93; 95% CI 0.84–1.03; $P = 0.19$; $I^2 = 59\%$; GRADE low-quality evidence) (Table 4 and Figure S6). None of the five unpooled RCTs reported significant results for hospitalisation (Table S2). Little evidence of small-study effects was observed (Egger's test: $P = 0.56$).

Institutionalisation In 15 RCTs with 5,231 participants, interventions had little or no effect on institutionalisation (RR 0.89; 95% CI 0.75–1.04; $P = 0.14$; $I^2 = 23\%$; GRADE high-quality evidence) (Table 4 and Figure S7). None of the four unpooled RCTs reported significant results for institutionalisation (Table S2). Little evidence of small-study effects was observed (Egger's test: $P = 0.21$).

Cognitive function In five RCTs with 2,149 participants, interventions were effective in improving cognitive function (SMD 0.12; 95% CI 0.02–0.22; $P = 0.02$; $I^2 = 0\%$; GRADE high-quality evidence) (Table 4 and Figure S8). One [34] of the two unpooled RCTs reported that the interventions were superior to usual care in slowing down cognitive decline at 12-month follow-up (Table S2).

Functional status (ADLs, IADLs and combined ADLs/IADLs) In six RCTs with 2,476 participants, interventions had little or no effect on ADLs (SMD 0.10; 95% CI 0.00–0.20; $P = 0.052$; $I^2 = 26\%$; GRADE moderate-quality evidence) amongst older adults associated with complex interventions (Table 4 and Figure S9). However, one [35] of the two unpooled RCTs reported that the interventions were more effective than usual care in improving ADLs at 12-month follow-up (Table S2). Interventions had positive effects on IADLs (SMD 0.11; 95% CI 0.01–0.21; $P = 0.02$; $I^2 = 0\%$; four RCTs with 1,687 participants; GRADE high-quality

evidence) and combined ADLs/IADLs (SMD 0.08; 95% CI 0.03–0.13; $P = 0.002$; $I^2 = 0\%$; five RCTs with 7,751 participants; GRADE high-quality evidence) (Table 4 and Figures S10 and S11). Although neither of the two unpooled RCTs measuring IADLs reported significant results, the unpooled RCT measuring combined ADLs/IADLs showed that the interventions were more effective than usual care at 12-month follow-up (Table S2). Amongst these three outcomes, no significant differences ($P = 0.62$; $P = 0.74$; $P = 0.91$) were identified between studies reporting change scores from the baseline versus studies reporting follow-up scores.

Functional status (physical mobility) Four RCTs measured the change in physical mobility of 1,475 participants. Compared with usual care, interventions reduced self-reported difficulties in walking at 36-month follow-up [36], improved the Short Physical Performance Battery overall, balance and gait speed scores at 6-month follow-up [37] and increased the total hand grip strength at 6-month follow-up [38] (Table S2).

Subgroup analysis

Subgroup analyses found that the location of intervention delivered ($P = 0.01$), home/telephone follow-up ($P = 0.03$) and self-management ($P = 0.03$) modified the effect of community-based complex interventions on institutionalisation (Figures S12–S14). Home-based interventions were associated with a lower institutionalisation rate amongst older adults (RR 0.65; 95% CI 0.48–0.87; $P = 0.004$; $I^2 = 0\%$). Interventions involving scheduled home/telephone follow-up (RR 0.75; 95% CI 0.60–0.93; $P = 0.01$; $I^2 = 17\%$) or self-management (RR 0.58; 95% CI 0.38–0.88; $P = 0.01$; $I^2 = 0\%$) also reduced institutionalisation rate amongst the population. However, the covariates in the analyses were unevenly distributed, meaning that the findings should be interpreted with caution [18]. No significant difference was identified in analyses of subgroups defined by length of follow-up, frailty, disability or functional decline of participants, or multidisciplinary care.

Discussion

Summary of findings

This systematic review found that holistic assessment and care plan development are the core components of >90% community-based complex interventions for improving independent living and QoL of older adults. Meta-analyses showed that interventions increased the likelihood of living at home (moderate-quality evidence) but had little to no effect on improving QoL (high-quality evidence for overall QoL; low-quality evidence for physical and mental components of QoL). Interventions also reduced mortality (high-quality evidence) and improved cognitive function (high-quality evidence), IADLs (high-quality evidence) and combined ADLs/IADLs (high-quality evidence). Although there was no impact on institutionalisation in the main

analysis, subgroup analysis found significant reductions in institutionalisation for interventions delivered at home, with scheduled home/telephone follow-up, or with planned self-management.

Strengths and limitations

Strengths of this review include the performance of a comprehensive literature search in multiple databases and the adoption of the GRADE approach to evaluate quality of evidence. The review is also distinctive in including a wide range of trials with similar intervention components rather than searching based on the labels given to the intervention by researchers (e.g. CGA). Although the heterogeneity of interventions was a potential limitation, considerable heterogeneity within studies with the same label was also present [4, 8].

There are several further limitations. First, intervention components were variably and very likely incompletely reported by many studies. For this reason, we did not attempt network meta-analysis. Similarly, the limited number of studies and imbalanced covariates between subgroups meant that meta-regression could not be robustly applied [13]. Instead, we used subgroup analysis to explore potential effect modifiers of multifaceted interventions, but interpretation should be cautious given variable reporting, and some subgroup analyses were not possible (for example, further analysis of subgroups defined by multidisciplinary team make-up and the status or degree of frailty of the participants in the primary studies, because of lack of provision of this information in the original papers). Second, some studies did not report mortality, hospitalisation and institutionalisation in a way which could be pooled in meta-analyses, so could only be synthesised narratively. Third, mortality was not accounted for as a competing risk in individual study analyses [39]. Given the intervention impact on mortality, the interpretation of effects on hospitalisation and institutionalisation should be cautious. Fourth, given the variability in health and social care systems and infrastructures, the findings in this review may not be applicable in all settings. Finally, as only studies published in English were eligible for inclusion, the effect sizes in this review might have been overestimated or underestimated.

Comparisons with other reviews

Ellis *et al.* [5] found high-quality evidence that inpatient CGA increased the chance of living at home at discharge and decreased nursing home admissions but had no effect on mortality. Chen *et al.* [7] found that inpatient and community-based CGA improved the QoL of older adults, but the effects were not significant in the community-based subgroups. In reviews of interventions for community-dwelling older adults, Briggs *et al.* [6] found a decreased risk of hospital admissions but no effect on mortality and nursing home admissions, and Wong *et al.* [40] reported possible benefits on the mental component of QoL but not on overall and the physical component of QoL, or on ADL/IADL. The review [8] for the NICE multimorbidity guidelines

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mentioned that complex interventions had limited benefits in critical outcomes (e.g. mortality and QoL). Our study found evidence of benefits for some outcomes (living at home, mortality, cognitive function, IADLs and combined ADLs/IADLs) but not others (QoL, hospitalisation or institutionalisation). The more favourable findings may be because we included a larger range of complex interventions (with shared core components) rather than only including interventions with specific labels such as 'CGA' (which is not a homogeneous group either, given variable intervention components).

Implications for practice

We focused this review on complex interventions for community-dwelling older adults with similar components instead of relying on intervention labels, such as CGA. Two near ubiquitous components were identified: (i) holistic assessment (94% of trials) and (ii) care plan development (90% of trials), and these should therefore be considered as the cores for health services planning to implement such interventions. There was some evidence that scheduled home/telephone follow-up and self-management positively modified the effect of complex interventions on institutionalisation. There was no clear evidence that multidisciplinary care was beneficial, although its component was poorly reported by the included studies. Before implementing holistic assessment, organisers should ensure the trust between health and social care professionals carrying out the task and facilitate inter-professional communications [41]. The scope of assessment should also balance the needs of older adults with complicated problems and the limited assessment time [41]. However, specialist staff may not be necessary to in-home assessment for an ideal model of complex interventions [42, 43].

Implications for research

A weakness of the existing literature is poor reporting of both intervention components and 'usual care', including the lack of clarity about multidisciplinary team composition and the frequency and duration of intervention components. Detailed reporting using the Template for Intervention Description and Replication [44] or the Criteria for Reporting the Development and Evaluation of Complex Interventions in healthcare 2 [45] checklists would significantly improve interpretation and future evidence synthesis. Similarly, the trials examined in this review varied considerably in the outcomes measured, and how outcomes were measured. The use of a core outcome set with standardised instruments in future trials would ensure that future evidence is more comparable and easier to synthesise [46]. The core outcome set development should involve a panel of key stakeholders who will utilise, deliver and/or evaluate the complex interventions (i.e. researchers, clinicians, policy-makers, older adults and caregivers) in the form of Delphi surveys or semi-structured group discussions [46]. Outcomes for research on geriatric rehabilitation [47], older adults with frailty [48] and participants with multimorbidity

[49], including health-related QoL, ADL/IADL and mental health, may also be adopted.

Conclusions

Holistic assessment and care plan development are the common components of complex interventions for improving independent living and QoL of community-dwelled older adults. Complex interventions increased the likelihood of living at home but had little to no effect on improving QoL. They reduced mortality and improved cognitive function, IADLs and combined ADLs/IADLs. Subgroup analyses suggested that complex interventions involving scheduled home/telephone follow-up or self-management might reduce institutionalisation rate amongst older adults; however, further evidence is needed to confirm such findings.

Supplementary Data: Supplementary Data mentioned in the text are available to subscribers in *Age and Ageing* online.

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