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Core components and impact of nurse-led integrated care models for home-dwelling older people: a systematic review and meta-analysis

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ABSTRACT

BACKGROUND: Integrated care models are highly recommended to overcome care fragmentation in the multimorbid older population. Nurses are potentially ideally situated to fulfil the role as care coordinator to guide integrated care. No systematic review has been conducted specifically focusing on the impact of nurse-led integrated care models for older people in community settings.

OBJECTIVES: To identify core components of nurse-led integrated care models for the home-dwelling older population; to describe patient, service and process outcomes; and to evaluate the impact of these care models on quality of life, activities of daily living, hospitalisation, emergency department visits, nursing home admissions and mortality.

DESIGN: Systematic review and meta-analysis.

DATA SOURCES: English, Dutch, French, German and Spanish articles selected from PubMed and CINAHL, hand-search of reference lists of the included articles and grey literature.

REVIEW METHODS: A systematic search was conducted to identify prospective experimental or quasi-experimental studies detailing nurse-led integrated care models in the older home-dwelling population. Study characteristics and reported outcomes were tabulated. The core components of the models were mapped using the Sustainable intEgrated chronic care modeLs for multi-morbidity: delivery, FInancing, and performancE (SELFIE) framework. A random effects meta-analysis was conducted to study the overall effectiveness of the included care models on health-related quality of life, activities of daily living, hospitalisation, emergency department visits, nursing home admissions or mortality. Risk of bias was appraised using the revised Cochrane risk-of-bias tool for randomized trials and ROBINS-I tool for non-randomized studies.

RESULTS: Nineteen studies were included studying a total of 22,168 patients. Core components of integrated care for multimorbid patients such as the involvement of a multidisciplinary team, high risk screening, tailored holistic assessment and an individualized care plan, were performed in a vast majority of the studies; however variability was observed in their operationalisation. Twenty-seven different patient, provider and service outcomes were reported, ranging from 1 to 13 per study. The meta-analyses could not demonstrate a beneficial impact on any of the predefined outcomes. Most included studies were of high risk for several biases.

CONCLUSION: The summarized evidence on nurse-led integrated care models in home-dwelling older people is inconclusive and of low quality. Future studies should include key components of implementation research, such as context analyses, process evaluations and proximal outcomes, to strengthen the evidence-base of nurse-led integrated care.

KEYWORDS: Activities of Daily Living; Community Health Nursing; Delivery of health care, integrated; Frail Elderly; Health Services for the Aged; Meta-analysis; Patient-centered Care; Quality of Life.

Contribution of the paper

What is already known about the topic?

- Implementation of integrated care models is needed to provide person-centred care in the home-dwelling, multimorbid older population to avoid care fragmentation and negative health outcomes.
- Integrated care requires collaboration between health and social care providers to address the individual's multiple care problems, which are identified by performing a comprehensive geriatric assessment and are integrated in a tailored care plan.
- A team of multidisciplinary health care providers should be led by a coordinator, which could be a nurse, so that the care provided is coordinated, tailored and person-centered.

What this paper adds

- A large majority of core components deemed necessary in effective integrated care models for multimorbid people were included in the nurse-led integrated care models, except for those relating to financial aspects or technological support systems.
- Although individual studies demonstrated impact of nurse-led integrated care on quality of life, hospital admissions, emergency department visits and mortality, aggregated findings could not demonstrate a significant impact.
- Evidence-based implementation theories, context analysis and process evaluations are rarely used in the development and evaluation of nurse-led integrated care models, yet highly important to identify and overcome implementation problems that could result in intervention failure.

INTRODUCTION

The prevalence of multimorbidity, defined as the co-occurrence of at least two chronic health conditions in one person, is rising. The Survey of Health, Ageing and Retirement in Europe indicated that in 2015 41.5% of the population had multimorbidity [1]. People with multimorbidity have a lower life expectancy, a reduced quality of life, impaired functional status, poor physical and mental health and higher health care utilization [2]. Therefore, they often receive support from a large number of health and social care providers, and are subject to care fragmentation as a result of poor coordination of services and a lack of communication between all care providers involved [3]. Consequently, multimorbid people risk gaps in care delivery or duplication of services, leading to medication errors, ineffective treatment, contradictory recommendations, confusion and stress among patients and family, and higher health care costs [4-6]. With multimorbidity as well as cognitive and functional disabilities being more prevalent in older people, and the majority of older people preferring to age in their own house and community regardless of functional dependencies [7], caring for older people in the home- and community-care setting has become more complex [8, 9].

To address the complex needs of the older population, implementation of integrated care models has been recommended by the World Health Organisation (WHO), the National Institute for Health and Care Excellence and the King's Fund, among others [3, 10-13]. Integrated care has been described as a person-centred model of care that is structured to support coordinated, pro-active care led by a multidisciplinary core team and a lead coordinator communicating and cooperating across and within health sectors [4]. Integrated care interventions are complex interventions, with multiple interacting elements (i.e. different health care providers) and multiple levels targeted (i.e. organisational level or patient-level) [14]. In 2018, Leijten *et al.* reviewed the literature to determine a taxonomy of core concepts of integrated care that were considered relevant to provide integrated care to a multi-morbid population. This resulted in the Sustainable intEgrated chronic care modeLs for multi-morbidity: delivery, FInancing, and performancE (SELFIE) framework [15]. Each core concept was categorised in micro-, meso- and macro-levels for each of the six domains suggested by the WHO for a well-functioning health system, i.e., delivery of services, leadership, workforce, financing, information and research, and technology [16]. The aim of the SELFIE framework is to support the development, implementation and evaluation of integrated care programs for multi-morbid populations [15].

Care coordination by a named lead health care professional is considered one of the crucial elements in integrated care delivery [11, 15, 17]. Nurses are increasingly put forward as lead coordinators, because they often are people's first or only contact with health care professionals, are part of the local community and are holistically focused in their core activities [18-20]. The OECD has called upon advancing the role of nurses in primary care by introducing new complementary roles, such as nurse case managers or care coordinators [21]. However, no systematic review has been conducted to date to describe core concepts, outcomes and impact of nurse-led care integrated care models for community care. In 2016, Smith *et al.* evaluated the impact of interventions in patients with multimorbidity in primary and community settings and found little to no difference in medical outcomes and health services use, a modest reduction in depression scores, and a slight improvement in medication adherence and

patient-related health behaviours. However, they did not specifically focus on nurse-led models of care in the older population [22]. Mullins et al. (2016) performed a review focusing on community nurse-led and nurse-involved models of care in which the importance of evaluating the role and activities of the nurse within these care models and the impact on health outcomes was specifically stressed [23]. However, this scoping review only included US-based models of care and the aim was limited to describing the models without focusing on the effectiveness of the models. The aim of this systematic review was therefore to:

1) describe the core components of nurse-led integrated care models in home-dwelling older populations and map them according to the SELFIE framework;
2) list the patient, provider and service outcomes measured in the included studies of nurse-led integrated care models; and
3) evaluate the overall effectiveness of nurse-led integrated care models for home-dwelling older people on health-related quality of life (HR-QoL), activities of daily living (ADL), hospital admissions, emergency department (ED) visits, nursing home admissions, and mortality compared to usual care.

METHODOLOGY

The review protocol was registered in the PROSPERO database (CRD42018093679). The review process was reported using the PRISMA guidelines [24].

Search strategy

A three-fold search strategy was performed. First, the electronic databases PubMed and CINAHL were searched for relevant papers using a search string that was limited to English, Dutch, French, German and Spanish papers published between 1st January 2000 and 31st December 2018. A final update was performed in June 2019. (Supplementary Materials. Table 1) Second, a hand-search was undertaken by checking the reference lists of the included papers and relevant reviews and by citation searching in PubMed, in which articles that cited an included article were screened. Third, OpenSIGLE (http://www.opengrey.eu/) was searched to identify grey literature, while Google Scholar was used to identify additional papers on care models described in the included papers.

Eligibility and study selection

All randomized controlled trials (RCTs) and prospective quasi-experimental studies in older adults aged ≥65 or a reported mean age of ≥75 years, living at home or in a service flat (flat with domestic service) were included. Studies needed to report the impact of a nurse-led integrated care model (i.e., a nurse was assessing needs and coordinating the care) on at least one of the following outcomes: HR-QoL, ADL, hospital admissions, ED visits, nursing home admissions, or mortality. Studies were excluded if they 1) had a qualitative or retrospective design; 2) included a disease-specific population, e.g., only focusing on patients with diabetes or patients in a palliative or end-of-life phase; 3) described models of care initiated in the hospital as part of outreach activities to improve the transition between hospital and home; or 4) described nurse-involved care models (i.e. a nurse was not the lead coordinator).

After removing duplicate publications from the compiled Endnote database, the publications were screened against the in- and exclusion criteria based on title and abstract by at least one reviewer (GL, LC). Thereafter, two reviewers (GL, LC) independently screened the full-texts of the remaining publications. In case of disagreement, a third reviewer (MD) was consulted to discuss study inclusion until consensus was reached.

Data extraction, risk of bias and evidence synthesis

Data extraction forms were drafted and pilot-tested by two reviewers (LC, MD) using three of the included studies. Adjustments were made as needed. The data from the included studies were extracted and verified by at least two out of six reviewers (MD, GL, LC, KD, AK, RJ,). Study characteristics are summarized in table 1. The SELFIE framework from Leijten *et al.* (2018) was used to map the interventions described in the integrated care models in table 2 [15]. Patient, provider and service outcomes are tabulated in table 3. Risk of bias of randomized controlled trials (RCTs) and cluster RCTs was evaluated at the study level with the revised Cochrane risk of bias tool which grades the risk of selection, performance, attrition, detection and reporting bias [25], while risk of bias of the non-randomized studies was evaluated with the ROBINS-I tool [26] (Supplementary material Table 2).

Meta-analyses were performed for HR-QoL (measured using the EQ-5D or RAND Short Form health questionnaire), ADL, hospital admissions, ED visits, nursing home admission, and mortality using the data available from the last follow-up point in each study. Stratification between randomised and non-randomised studies was made. Effect sizes (i.e., standardized mean differences or odds ratio) were calculated, facilitated by an online calculator [27], and afterwards pooled by random-intercepts modelling to estimate between-study variability. Analyses were performed in SAS (SAS Institute, Cary, NC).

RESULTS

Study selection

Through the systematic search, 2834 potentially relevant articles were identified. After removing duplicates, screening the titles and abstracts, screening reference lists of included articles and additional searches, 124 full-texts were considered for inclusion. A total of 103 articles were excluded, resulting in a final number of 21 included papers, based on 19 studies [28-48] (Supplementary Material Figure 1). Seven protocol papers provided additional information regarding the methodology of the study or the content of the integrated care models [49-55].

Table 1: *Study characteristics*

Study	Name of Intervention	Country	Inclusion period	Design	Inclusion and screening criteria	Sample
Boult 2011	Guided care	US	2006-2008	Cluster-randomized controlled trial	≥65 years High risk of high health services use in next year (≤6 self-reported health status)	IG: 446 CG: 404
Bouman 2008	Home Visiting Program	Netherlands	2003-2004	Randomized controlled trial	70-84 years Poor health status (EasyCare <6)	IG: 160 CG: 170
Counsell 2007	Geriatric Resources for Assessment and Care of Elders (GRACE)	US	2002-2004	Cluster-randomized controlled trial	≥65 years Income < 200% of the federal poverty level ≥1 primary care clinician visit in the past year	IG: 474 CG: 477
Dorr 2008	Care Management Plus	US	2002-2005	Non-randomized controlled trial	≥65 years ≥ 11 months enrolment in Medicare Part B in the 1-year period before the enrolment date Depression (Patient Health Questionnaire 9)	IG: 1144 CG: 2288
Gravelle 2007	Evercare	England	2003-2005	Before-and-after study	≥65 years ≥2 emergency admissions in preceding 13 months	Intervention practices: 64
Hoogendijk 2016	Geriatric Care model (GCM)	Netherlands	2010-2011	Stepped wedge cluster-randomized controlled trial	≥65 years PRISMA-7 score ≥ 3	Group 1: 456 Group 2: 227 Group 3: 238 Group 4: 226
Imhof 2012	Health Consultation Program	Switzerland	2008-2011	Randomized controlled trial	≥80 years Cognitive intact according to Clinical Dementia Rating Scale	IG: 231 CG: 230
King 2018	Gerontology Nurse specialist	New Zealand	2009-2013	Controlled before-and-after study	≥75 years Enrolled in one of two primary healthcare practices Brief Risk Identification for Geriatric Health Tool	IG: 517 CG: 883
Looman 2014, 2016	Walcheren Integrated Care Model	Netherlands	2010-2011	Controlled before-and-after study	≥75 years Frail according to Groningen Frailty Indicator, not on waiting list for nursing home admission, life expectancy of > 6 months	IG: 184 CG: 193
Markle-Reid 2006	Proactive nursing health promotion	Canada	2001-2002	Randomized controlled trial	≥75 years Newly referred to support services through the Community Care Access Centre (CCAC) Need for assistance with personal care	IG: 144 CG: 144
Melis 2008	Dutch Geriatric Intervention Program	Netherlands	2003-2005	Pseudo cluster-randomized controlled trial	≥70 years Limitations in cognition (MMSE ≤26), (instrumental), ADL (GARS 3 ≥ 25) or mental wellbeing and MOS mental health ≤ 75	IG: 85 CG: 66

Metzelthin 2013	Prevention of Care	Netherlands	2009 -2010	Cluster-randomized controlled trial	≥70 years Frail older patients (Groningen Frailty Indicator) Exclusion of terminally ill patients, confined to bed	IG: 193 CG: 153
Morales-Asencio 2008	/	Spain	2003-2006	Non-randomized controlled trial	Terminally ill, requiring ADL assistance and are immobilised at home, or recently discharged from hospital + their main caregivers	Patients: IG: 182, CG: 160 Caregivers: IG: 117, CG: 88
Newcomer 2004	Enhanced Case Management	US	2001-2003	Randomized controlled trial	≥80 years or ≥65 years with chronic obstructive pulmonary disease, congestive heart failure, coronary disease or diabetes. Not in nursing home, Alzheimer's facility or at hospices	IG: 1537 CG: 1542
Reckrey 2015	Mount Sinai Visiting Doctors	US	2010-2011	Non-randomised controlled trial	Home bound (able to leave home only with great difficulty and for infrequent or short absences)	IG: 347 CG: 1074
Ruikes 2016	CareWell	Netherlands	2011-2012	Cluster non-randomized controlled trial	≥70 years Frail according to EASY-Care Two-Step Older Persons Screening instrument and clinical judgement, no terminal illness	IG: 287 CG: 249
Ryvicker 2011	Home Health Aids (HHA) Partnering Collaborative	US	2005-2006	Cluster-randomized controlled trial	Patients: Min. 1 HHA visit last year, life expectancy > 6 months, room for improvement in min. 1 ADL Teams: Visiting Nurse Service of Bronx, Brooklyn, Manhattan and Queens, NY	IG: 22 teams, 1516 patients CG: 23 teams, 1774 patients
Stijnen 2015a, 2015b	Getting OLD the healthy way	Netherlands	2010-2011	Cluster non-randomized controlled trial	≥75 years Not on waiting list for nursing home admission, no close medical supervision and not terminally ill	IG: 586 CG: 941
Suijker 2016	Nurse-led multifactorial care	Netherlands	2010	Cluster-randomized controlled trial	≥70 years At increased risk of functional decline (ISAR – Primary Care ≥2), life expectancy ≥3 month	IG: 1209 CG: 1074

GARS-3: *Groningen Activity Restriction Scale,* ***MMSE:*** *Mini-Mental State Examination,* ***MOS:*** *Medical Outcome Study,* ***ADL:*** *Activities of daily living,* ***IG*** *= intervention group,* ***CG*** *= control group*

Characteristics of the included studies

Six cluster RCTs, five RCTs and eight non-randomized studies were included, of which eleven were conducted in Europe, seven in North America and one in New Zealand (Table 1). The sample size ranged from 151 to 3,432 participants with the mean age of intervention patients varying from 71.8 to 85 years. Study follow-up ranged from three to 24 months. Overall, the included randomized studies were at considerable risk of bias and findings should be interpreted in that perspective (Supplementary Materials Table 2).

Description of the care models

The core components described in the included care models were summarised using the six domains and concepts at micro-level of the SELFIE framework from Leijten *et al.* (2018) [15] (Table 2).

Service delivery

In all but one model (n = 18), a person-centered care approach by means of a tailored holistic assessment or comprehensive geriatric assessment was performed. In nine studies, older people were encouraged by the care team to improve their self-management abilities by providing them advice (n = 3); improving knowledge and establishing a positive attitude towards change (n = 2); motivational interviewing (n = 1); or assessing self-efficacy (n = 1). Informal caregivers were involved in the decision-making process in 13 studies. Attention for treatment and guideline interactions in view of polypharmacy and multimorbidity was addressed in ten studies, while a clear focus on continuity of care was reported in 16 studies. Follow-up of care was described in all studies and was performed by conducting home visits (n = 18), telephone calls (n = 10) or re-assessment (n = 2) of the older person.

Leadership and governance

In most studies, shared decision-making was described as an integral part of the integrated care model (n = 14) and a named care coordinator set up an individual care plan to respond to the individuals' needs and preferences (n = 16). In complex cases, a case manager was assigned to tailor care processes (n = 10).

***Table 2**: Core concepts of the care models of the included studies according to the micro level of the Sustainable intEgrated chronic care modeL for multi-morbidity: delivery, FInancing, and performance (SELFIE) framework.*

Study	Service delivery							Leadership & governance			Workforce				Financing			Technology		Information & research	
	Person-centered	Tailored holistic assessment	Self-management support	Pro-active	Informal caregiver involvement	Treatment interaction	Continuity	Shared decision-making	Individualized care planning	Coordination tailored to complexity of care needs	Multidisciplinary team	Named Coordinator	Core group	Individual risk prediction	Coverage & reimbursement	Out of pocket costs	Financial incentives	Electronical Medical Records & patient portals	E-health tools or telemedicine	Effective use of Individual level data, i.e. automatic notification of ED visit	Computerized algorithms that recommend care pathways
Boult 2011	x	x	x	x	x	x	x		x	x	x	RN	RN, GP	x	x					x	
Bouman 2008	x	x	x	x			x	x	x		x	RN	RN, GP	x							
Counsell 2007	x	x	x	x	x	x	x	x	x	x	x	APN	APN, GP					x	x	x	
Dorr 2008	x	x	x	x	x		x	x	x	x	x	RN	RN, GP	x				x	x	x	
Gravelle 2007	x	x		x			x	x	x		x	APN	APN, GP	x						x	
Hoogendijk 2016	x	x		x	x		x	x	x		x	PN	PN, GP	x							
Imhof 2012	x	x	x	x	x	x	x	x	x	x	x	APN	APN, GP							x	
King 2018	x	x		x		x		x	x		x	GNS		x				x		x	
Looman 2014;2016	x	x		x	x		x	x	x	x	x		NP, GP	x							
Markle-Reid 2006	x	x	x	x	x	x			x		x	RN		x		x					
Melis 2008	x	x	x	x		x	x	x	x	x	x	GNS	GNS, GP	x							
Metzelthin 2013	x	x	x	x	x	x	x	x	x	x	x	PN	PN, GP	x							
Morales-Asencio 2008	x	x		x	x		x	x		x	x	RN	RN, GP								
Newcomer 2004	x	x		x	x	x			x	x	x	RN			x			x		x	
Reckrey 2015	x	x			x	x	x	x	x	x	x	NP	NP, GP, SW					x			
Ruikes 2016	x			x		x	x	x	x	x	x	CM	PN, GP, ECP, SW	x				x		x	
Ryvicker 2011		x		x	x		x	x			x	RN	RN, SW								
Stijnen 2015a, 2015b	x	x		x			x	x	x		x	PN	PN, GP								
Suijker 2016	x	x	x	x	x		x		x		x	RN	RN, GP	x							

***APN** = advanced practice nurse; **CM** = case manager; **ECP** = elderly care physician; **GNS** = geriatric nurse specialist; **GP** = general practitioner; **NP** = nurse practitioner; **PN** = practice nurse; **RN** = registered nurse; **SW** = social worker.*

Workforce

In all care models, a multidisciplinary team was involved in patient care, with a nurse as named coordinator in eighteen studies. In sixteen studies, a differentiation was made between a core group of professionals and the wider multidisciplinary team that can be called upon. The core group is responsible for regular care contacts and relationship-building, whereas the larger multidisciplinary team will see the patient depending on identified needs and treatment goals. A practice nurse, registered nurse, advanced nurse practitioner or geriatric nurse specialist, together with the GP were part of this core group in thirteen studies. The social worker was part of the core group in two studies mainly to perform home visits or to address specific social service related problems for the patient. Referrals to a specialist or other health care services took place in fourteen studies [28, 30-35, 37, 40-44, 48]. Staff training was mentioned in nine studies [32, 34-37, 40, 43, 46, 48]. Individual risk prediction, which is considered important to determine which professionals need to be involved in care planning, was performed in the majority of the studies (n = 12) but the screening tool used was different in each study.

Financing

Boult *et al.* (2011) reported the study findings in relation to the patient's health insurance and reported the following three categories: 1) older persons insured by Kaiser-Permanente, a non-for-profit integrated model of health care delivery driven by the needs of members rather than stakeholders; 2) traditional fee-for-service Medicare; and 3) the TRICARE/US Family Health Plan, a federal health insurance program for retired military personnel and their dependents. They found that guided care reduced health care services use to a greater extent in the Kaiser-Permanente subgroup [28]. No other studies reported information regarding coverage and reimbursement structures to ensure equity in financial access for those who need them. No studies reported using financial incentives to motivate persons with multimorbidity to participate in integrated care programmes.

Technology

Six studies mentioned the use of electronic medical records and three studies the use of web-based technology to support intervention delivery. No studies mentioned the use of telemedicine, assistive technologies or remote monitoring of clinical parameters.

Information and research

In eight studies, information regarding previous ED visits, details about hospital discharge and medicine-related information was used in the treatment plan. No studies reported including computerized algorithms that recommend care pathways.

Reported patient, provider and service outcomes

Twenty-seven outcomes were measured with the number of outcomes ranging from 1 to 13 per study (Table 3). Mortality, HR-QoL, ADL, and hospital admissions were most often reported, while the provider outcomes, i.e., quality of care, caregiver burden and provider satisfaction, were measured in only one study, respectively.

Table 3: *Reported patient, provider and service outcomes*

	Patient outcomes															**Provider outcomes**			**Service outcomes**									
	Health-related quality of life	ADL	Mortality	IADL	Mobility	(Fear of) Falls	Depressive symptoms	Mental health / well-being	Social functioning	Social support	Loneliness	Patient satisfaction	Health complaints	Self-related health	Coping style	Quality of care	Caregiver burden	Provider satisfaction	Hospital admissions	Emergency department visits	Nursing home admissions	Hospital readmissions	Length of hospital stay	Primary care visits	Home health care	Other community service use	Health care costs	**Total outcomes per study**
Boult 2011																			x	x	x	x	x	x	x	x		**8**
Bouman 2008	x	x	x	x			x	x	x	x	x	x	x	x	x													**13**
Counsell 2007	x	x	x	x	x		x					x				x			x	x			x					**11**
Dorr 2008			x																x	x								**3**
Gravelle 2007			x																	x						x		**3**
Hoogendijk 2016	x	x	x	x				x	x				x	x					x									**9**
Imhof 2012	x		x			x							x						x					x	x	x		**8**
King 2018			x																x	x	x	x	x		x	x		**8**
Looman 2014, 2016	x	x						x	x			x		x	x				x					x	x	x		**11**
Markle-Reid 2006	x						x	x	x	x					x												x	**7**
Melis 2008	x	x	x	x	x			x			x		x															**8**
Metzelthin 2013		x	x	x		x	x		x	x					x													**8**
Morales-Asencio 2008		x		x				x		x		x					x			x	x			x	x	x		**11**
Newcomer 2004	x																		x	x	x	x	x	x				**7**
Reckrey 2015												x						x	x			x					x	**5**
Ruikes 2016	x	x	x					x	x										x		x							**7**
Ryvicker 2011		x																										**1**
Stijnen 2015	x	x	x	x				x	x																	x		**7**
Suijker 2016	x	x	x	x		x		x											x		x			x				**9**
N studies measuring outcome	**11**	**11**	**12**	**8**	**2**	**3**	**4**	**9**	**7**	**4**	**2**	**5**	**4**	**3**	**4**	**1**	**1**	**1**	**11**	**7**	**6**	**4**	**4**	**6**	**5**	**7**	**2**	

Effect of nurse-led integrated care

Random-effects pooled estimates of EQ-5D [29, 34, 38, 39, 48] and the RAND Short Form health questionnaire [29-31, 34, 40, 44] did not show an overall significant impact on health-related quality of life (Table 4). At individual study level, Suijker *et al.* (2016) reported a statistically significant improvement in quality of life (using the EQ-5D) after 18 months and 24 months, with a standardized mean difference of 0.13 (95% CI: 0.03 – 0.23) and 0.10 (95% CI: 0.01 – 0.20), respectively [48]. Both Bouman *et al.* (2008) and Counsel *et al.* (2007) reported better mental health scores using the RAND-36 in the intervention group with standardized mean differences of 0.24 (95% CI: 0.01 – 0.47) and 0.21 (95% CI: 0.09 – 0.34), respectively [30, 31]. Stijnen *et al.* (2015) showed a significant impact on the social functioning subscale of the RAND-36 [37].

Random-effects pooled estimates of ADL measured with either Katz ADL [29, 34, 48], the Groningen Activity Restriction Scale (GARS) [37, 41, 42], the Barthel Index [43] or similar ADL instruments [30, 31, 38, 39] including a total of eleven studies did not show any significant results (Cohen's d 0.006, 95% CI -0.041 to 0.054). Also at the individual study level, no significant impact was observed on ADL outcomes [29-31, 34, 37-39, 41-43, 46, 48]

Random-effects pooled estimates including data of eleven studies showed no significant impact on hospital admission rates (OR 0.944, 95% CI 0.871 to 1.022) [28-30, 32, 34-36, 38, 39, 44, 45, 48]. A significant reduction of hospital admissions was found in one individual trial. Imhof et al. (2012) reported a significantly lower percentage of hospital admissions in a 3-month period in the intervention group (23%) compared to the control group (33%) (OR = 0.69, 95% CI: 0.47 – 0.97) [35].

Random-effects pooled estimates of ED visits including data of seven studies did not show a significant impact on ED visits (OR 1.001, 95% CI 0.844 to 1.187) [28, 30, 32, 33, 36, 43, 44]. Only one study reported a significantly lower number of cumulative ED visits in the intervention group after 2 years (n = 1445) compared to the control group (n = 1748; OR = 0.73, 95% CI: 0.58 – 0.93) [30].

Random-effects pooled estimates did not show an overall significant impact on nursing home admissions (OR 0.907, 95% CI 0.713 to 1.155) [28, 29, 36, 43, 44, 48] or mortality (OR 0.946, 95% CI 0.389 – 2.302) [29-37, 41, 42, 48]. None of the six studies reporting nursing home admission rates found a significant impact of the intervention. One of the twelve studies reporting mortality rates found a significant decrease in favour of the intervention group from 9.2% to 6.5% (OR = 0.84, 95% CI: 0.74 – 0.96) after one year follow-up. [32].

Meta-analyses were also done per outcome stratifying the randomized and non-randomized studies but this did not alter any of our findings (Table 4).

Table 4: *Pooled estimates on patient-relevant outcomes*

Outcome		N of patients	Median (Q1 – Q3) follow-up	Estimate Cohen's d (95% CI)	I^2 (95% CI)	Hetero-geneity (p-value)
HR-QoL: EQ-5D	All studies [29, 34, 38, 39, 48]	7038	24 (12 – 24)	0.022 (-0.055 – 0.098)	0.0% (0.0 – 42.1)	0.861
	Randomized	6292	24 (24 – 24)	0.025 (-0.299 – 0.348)	0.0% (. – .)	0.519
	Non-randomized	746	12 (12 – 12)	0.000 (-0.933 – 0.934)	0.0% (. – .)	0.625
HR-QoL: RAND-SF	All studies [29-31, 34, 40, 44]	10339	24 (12 – 24)	0.010 (-0.038 – 0.059)	25.8% (0.0 – 67.7)	0.232
	Randomized	9962	24 (12 – 24)	0.003 (-0.048 – 0.055)	0.0% (0.0 – 73.8)	0.441
	Non-randomized	377	12 (. – .)	0.194 (-0.008 – 0.397)	Only one study	/
Activities of daily living	All studies [31, 34, 37-39, 42, 43, 48]	10249	21 (12 – 24)	0.006 (-0.041 – 0.054)	32.5% (0.0 – 67.9)	0.148
	Randomized	7989	24 (24 – 24)	-0.020 (-0.078 – 0.038)	17.0% (0.0 – 61.8)	0.304
	Non-randomized	2260	12 (9 – 15)	0.091 (-0.048 – 0.231)	0.0% (0.0 – 79.4)	0.548
		N of patients	**Median (Q1 – Q3) follow-up**	**Estimate OR (95% CI)**	**I^2 (95% CI)**	
Hospital admissions	All studies [28, 30, 32, 34-36, 39, 44, 45, 48]	16942	12 (12 – 24)	0.944 (0.871 – 1.022)	4.7% (0.0 – 62.2)	0.399
	Randomized	9903	22 (12 – 24)	0.911 (0.796 – 1.042)	2.0% (0.0 – 75.3)	0.404
	Non-randomized	7039	20 (12 – 24)	0.980 (0.834 – 1.151)	11.5% (0.0 – 81.9)	0.340
ED visits	All studies [28, 30, 32, 33, 36, 43, 44]	16834	12 (6 – 24)	1.001 (0.844 – 1.187)	61.7% (12.5 – 83.3)	0.016
	Randomized	2455	12 (. – .)	0.995 (0.831 – 1.192)	Only one study	/
	Non-randomized	14379	16 (6 – 24)	1.004 (0.805 – 1.252)	67.9% (23.8 – 86.5)	0.008
Nursing home admission	All studies [28, 29, 36, 43, 44, 48]	5770	12 (12 – 20)	0.907 (0.713 – 1.155)	0.0% (0.0 – 44.1)	0.814
	Randomized	3538	20 (12 – 24)	0.898 (0.571 – 1.412)	0.0% (0.0 – 85.8)	0.612
	Non-randomized	2232	6 (6 – 12)	0.946 (0.389 – 2.302)	0.0% (0.0 – 88.5)	0.544
Mortality	All studies [29-37, 41, 42, 48]	18760	18 (9 – 24)	0.946 (0.389 – 2.302)	29.3% (0.0 – 64.3)	0.158
	Randomized	4478	18 (6 – 24)	0.946 (0.389 – 2.302)	0.0% (0.0 – 70.0)	0.445
	Non-randomized	14282	12 (12 – 18)	0.946 (0.389 – 2.302)	57.9% (0.0 – 84.4)	0.050

Discussion

Given the increasing care complexity of older people living at home and their preference to age in place, there is consensus among leading international institutions towards further investment in integrated care models for frail older people. In this systematic review focusing on nurse-led integrated care models, 19 studies were included measuring a total of 27 different outcomes. Individual studies demonstrated an impact on mortality [32], HR-QoL [30, 31, 48], hospital admissions [35] and ED visits [30], but no overall effect was found in the meta-analyses on any of the outcomes.

Although this is the first systematic review describing core concepts and effectiveness of nurse-led integrated care models, other reviews were conducted focusing on related care models for the home-dwelling older and/or frail population [56-59]. Two meta-analyses of RCTs studying preventive primary care outreach interventions in 19 RCTs [57] and multidimensional preventive home visit programs in 21 RCTs [59] respectively showed a beneficial effect on mortality rate and likelihood to continue living in the community, but not on nursing home admissions, hospitalisation and functional status. Hopman *et al.* (2016) reported indications of increased quality of care, better HR-QoL and lower depression scores in experimental studies of any design evaluating comprehensive care programs for patients with multiple chronic conditions or frailty of any age, but concluded that evidence remains insufficient due to the lack of good-quality studies [56]. The systematic review of Looman *et al.* (2019) including 29 controlled studies demonstrated no effect of preventive, integrated care on the majority of the reported outcomes, except for seldom-reported outcomes such as well-being. Most promising was the improvement of care processes for preventive, integrated care interventions as compared to usual care [58].

Hence, despite the clear calls from leading institutions to implement integrated care models, the current evidence base is not as conclusive as one might expect, except for some individual studies reporting a beneficial impact on several outcomes and better patient and provider experiences due to better care organisation, coordination and collaboration in integrated care models [60-62]. One of the main challenges is that integrated care models are complex interventions; a complexity that can be observed in terms of the number of and interactions between intervention components, the number and difficulty of behaviors required to deliver the intervention, the number of groups or organizational levels targeted, the number and variability of outcomes and the degree of tailoring of the intervention permitted [63]. This makes the development and evaluation of these kind of interventions challenging in different ways.

First, a good theoretical understanding is needed of how the intervention causes change, so that weak links in the causal chain can be identified and strengthened [63, 64]. A logic model describing the resources, activities, anticipated outcomes and impact should therefore be created prior to model implementation to illustrate the overall program theory and support planning, monitoring and evaluation [65]. Yet, although some of the studies did refer to theoretical frameworks underpinning their intervention (e.g. the Chronic Care Model or Behavioral Change Model), only one study reported a logic model or refered to an implementation framework [47]. Also, contextual understanding can help to ensure that each part of an intervention appropriately fits the context [66], especially for integrated care initiatives [12]. Context is also an essential consideration when evaluating an intervention [66, 67], as the same intervention may not work

equally in different settings [68]. This requires a contextual analysis of not only the micro-level, but also the meso-level of the organisations involved in integrated care and the macro-level of policy drivers that allow for integrated care models to grow in all aspects of the SELFIE framework [15]. Accordingly, implementing interventions in a real-life setting requires continuous tailoring to the intervention setting to be as effective as possible.

Second, process evaluations are essential to determine whether negative findings are due to intervention or implementation failure. Yet only five of the included studies reported process evaluations [48, 69-72], while one reported a brief implementation analysis [46]. Melis *et al.* (2008), for example, observed a change in intervention focus towards caregivers of patients with advanced dementia, and that adherence to given recommendations increased when the care plan was tailored to the patients' preferences [71]. Metzelthin *et al.* (2013) evaluated reach, fidelity, dose delivered/received and perceived barriers allowing them to give clear recommendations for future interventions, such as better identification of the target group, as well as more training on the job and opportunites to exchange among healthcare professionals [72]. Stijnen *et al.* (2015) indicated time constraints due to administrative work, team meetings and patient monitoring as one of the main implementation barriers. In response, health care providers did not adapt the intervention protocol but instead chose to target a selected group of older people who would most benefit from the visitation programme [69]. These examples illustrate that process evaluations are needed to identify feasibility and implementation problems as well as to understand which core components are key in achieving the observed impact, so they can guide future research and clinical practice [73].

Third, using a single primary outcome when evaluating complex interventions is not considered the best use of the data [63]. Measuring a range of outcomes to be able to pick up unintended consequences is rather recommended. With outcomes ranging from 1 to 13 per study, this recommendation was largely taken up. However, the range of outcomes complicated pooling the results of the individual studies, especially because the same outcome, e.g., ADL, was operationalized in different ways. Both a common understanding of expected patient, provider and service outcomes for integrated care models to be used in this kind of research should be promoted and a database with common data elements (CDEs) supporting the comparison between integrated care studies needs to be built in line with recommendations from the National Institute of Health [74]. The development of CDEs needs to consider not only distal outcomes such as hospital admission, ED visits and quality of life, as was done by the included studies, but also proximal outcomes, such as patient satisfaction, well-being and the capacity and ability of the health care providers to deliver the intervention, as they will subsequently affect long-term effectiveness [73].

In all, evaluating complex interventions is challenging and for that digging into the "the black box" of the change process and not solely focusing on effectiveness evaluation is key in further strengthening the evidence-base of integrated care. Embedding process evaluations, development of logic models, context analysis and determining CDEs of proximal and distal outcomes, which are some of the key elements of implementation science, for the evaluation of integrated care models should therefore be put high on the research agenda. This is line with the overall recommendations of Smit et al. (2018) who analysed nine proactive primary care programs for older people in the Netherlands [75].

While further strengthening the evidence base with solid and scientifically sound hybrid evaluation-implementation studies [76], existing frameworks on integrated care, such as the SELFIE framework and WHO guidelines, can guide the further optimalisation of integrated care models. We observed that the care models included many core components suggested in the SELFIE framework, especially in terms of service delivery, leadership, and workforce [15]. Individualized care planning, multidisciplinary teams, informal care giver involvement, and shared decision making were present in the majority of studies, although rarely described in much detail. On the other hand, hardly any components were reported in view of financing, although coverage and reimbursement of interventions are crucial to provide equal access to health care services, a precondition to be able to provide high quality of care and critical for the sustainability of the model [77]. Similarly, evidence-base technology or products to support intervention delivery were rarely mentioned. Yet technology can be used to enhance communication and care coordination between involved care providers, monitor chronic diseases and support self-management [78, 79]. Remote monitoring, for example, allows home care nurses to maintain patient contact in a continuous way by assessing needs, educating patients and supporting caregivers without the need to travel. It can also prevent ED visits and hospitalisations by allowing early interventions and can help shift care from the hospital to home resulting in reduced health care costs [80]. Systematic and proactive screening to identify patients at higher risk for, for example, functional dependence, hospitalisation, or frailty is also recommended as it supports identifying individuals that would benefit most from integrated care interventions. Although there is no international consensus on which screening tool to use, several have been developed and validated for the community care setting, such as the Groningen Frailty Indicator, the PRISMA-7 and the FRAIL [81, 82]. The majority of the included studies indeed focused on a more at risk subpopulation by defining study eligibility criteria or conducting population or individual risk screening prior to conducting a more in-depth geriatric assessment, but in only six models an evidence-based tool was used to do so. The SELFIE framework also suggests to promote self-management by educating on e.g., behavioural change techniques, coping strategies, navigation through the care system, and medication adherence support, [15] but none of the articles fully explained what kind of self-management activities were conducted.

Lastly, having a care coordinator to organize care for people with multimorbidity is considered a core element of integrated care. Studies have shown that nurses play a crucial role in providing and managing care for the individual, collaborating with family members and coordinating care between health care professionals in the community [83]. This role can be effectively undertaken by nurses or nurse practitioners, but obtaining the right skills and competencies to fulfill the role as central care coordinator is essential for the care model to work effectively [84, 85]. Yet, in the included studies limited information was given regarding the skills and experience of the nurses and the level of education varied from registered nurses to nurse practitioners and advanced practice nurses. Although an explorative metaregression was not conducted to determine the impact of the nursing education level on the studied outcomes, previous research does support to favor advanced practice nurses for these central roles [21]. Care provided by advanced practice nurses or teams including an advanced practice nurses is as least equal to care or care models provided by medical doctors regarding process and clinical outcomes [86].

In conclusion, while this study has shown that many components considered essential in integrated care are included in the nurse-led care models, it could not provide solid evidence regarding their impact on health outcomes of the older population based on 19 prospective (quasi-) experimental studies at considerable risk of bias. The absence of evidence-based implementation theories, multilevel context analyses, and process evaluations hinders the ability to determine whether these nonsignificant findings are due to intervention or implementation failure. Challenges in proving effectiveness of complex care interventions in the older population need to be facilitated by clear and strong hybrid evaluation-implementation study designs in a realistic setting, logic models or program theories describing the expected impact of the planned intervention, a common understanding of how integrated care models affect the system, service, patients, and providers, as well as clearly defined proximal and distal outcomes, and timeframes, in which they are measured.

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The authors declare that there is no conflict of interest.

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