ESC HEART FAILURE
ESC Heart Failure 2021; **8**: 802–818
Published online 6 January 2021 in Wiley Online Library (wileyonlinelibrary.com) **DOI:** 10.1002/ehf2.13152

REVIEW

Impact of primary care involvement and setting on multidisciplinary heart failure management: a systematic review and meta-analysis

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Abstract

Multidisciplinary disease management programmes (DMPs) are a cornerstone of modern guideline-recommended care for heart failure (HF). Few programmes are community initiated or involve primary care professionals, despite the importance of home-based care for HF. We compared the outcomes of different multidisciplinary HF DMPs in relation to their recruitment setting and involvement of primary care health professionals. We conducted a systematic review and meta-analysis of randomized controlled trials published in MEDLINE, Embase, and Cochrane between 2000 and 2020 using Cochrane Collaboration methodology. Our meta-analysis included 19 randomized controlled trials (7577 patients), classified according to recruitment setting and involvement of primary care professionals. Thirteen studies recruited in the hospital (*n* = 5243 patients) and six in the community (*n* = 2334 patients). Only six studies involved primary care professionals (*n* = 3427 patients), with two of these recruited in the community (*n* = 225 patients). Multidisciplinary HF DMPs that recruited in the community had no significant effect on all-cause and HF readmissions nor on mortality, irrespective of primary care involvement. Studies that recruited in the hospital demonstrated a significant reduction in mortality (relative risk 0.87, 95% confidence interval [CI] [0.76, 0.98]), HF readmissions (0.70, 95% CI [0.54, 0.89]), and all-cause readmissions (0.72, 95% CI [0.60, 0.87]). However, the difference in effect size between recruitment setting and involvement of primary care was not significant in a meta-regression analysis. Multidisciplinary HF DMPs that recruit in the community have no significant effect on mortality or hospital readmissions, unlike DMPs that recruit in the hospital, although the difference in effect size was not significant in a meta-regression analysis. Only six multidisciplinary studies involved primary care professionals. Given demographic evolutions and the importance of integrated home-based care for patients with HF, future multidisciplinary HF DMPs should consider integrating primary care professionals and evaluating the effectiveness of this model.

Keywords care setting; community care; disease management; heart failure; multidisciplinary; primary care; transitional care

Received: 8 July 2020; Revised: 13 November 2020; Accepted: 19 November 2020
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Introduction

Heart failure (HF) is an important and growing public health problem that affects millions of patients worldwide and has enormous impact on patients' quality of life (QoL) and global health expenditures.[1] Disease management, a process of co-ordinating care of patients with a specific chronic condition across different health care settings, has been proposed for decades as a model for optimizing the complex care for this predominantly older and multimorbid patient population.[2,3] Disease management programmes (DMPs) exemplify this health care paradigm but require significant resources, a prerequisite that is impeding real-world implementation.

Research has therefore concentrated on identifying the most efficient type of interventions. Several systematic reviews have demonstrated that multidisciplinary disease management reduces all-cause hospital admissions and

mortality.[4–8] The current HF guidelines of the European Society of Cardiology reflect these findings, recommending multidisciplinary HF DMPs with the highest level of evidence.[9]

However, the effect of two variables that seem decisive and might impact outcomes is unclear. First is the composition of the multidisciplinary team. Although a cardiologist and cardiac nurse should be actively involved,[7] there has been little research into the effect of involvement of primary care professionals (PCPs), even though they are responsible for a significant share of cardiac and non-cardiac chronic care delivery in this patient group.[10] Second is the setting of recruitment. Few DMPs are community initiated,[11] reflecting the choice of most DMPs to focus on patients hospitalized for HF. This high-risk strategy intends to maximize programme efficiency by focusing on a patient group at high risk of readmission but possibly disregards a substantial part of the HF population in the community.

The objective of this review is therefore to compare the outcomes of different multidisciplinary HF DMPs in relation to their recruitment setting and involvement of primary care health professionals.

Methods

This study adheres to the Cochrane Collaboration methodology and the PRISMA statement Supporting Information.[12,13] We registered this study with PROSPERO (registration number CRD42019137637).

Data sources and search strategy

We searched PubMed, Embase, and CENTRAL from 1 January 2001 to 31 December 2019 to identify applicable studies. We used a search strategy combining MeSH and text terms that encompassed HF, multidisciplinary DMPs, and primary care using Boolean 'AND' operators, listed in Supporting Information, *Data S1*.

Study selection

We included randomized controlled trials that had the following characteristics:

- population: patients with a HF diagnosis
- intervention: multidisciplinary HF DMP
- comparator: usual care
- outcomes: all-cause mortality, all-cause and HF readmissions, patient-reported outcomes, and costs

We defined a multidisciplinary HF DMP as a programme in which the patient had a contact (in person or by telephone) with at least two different health disciplines as part of the intervention. Case management studies where a single case manager-co-ordinated care and patients therefore did not necessarily have a contact with different health disciplines were excluded. Because disease management is defined by co-ordination of care across different health care echelons,[2] we excluded studies that failed to manage patients across different settings. We excluded studies that had less than 6 months of follow-up.

We classified primary care involvement as active involvement of the patients' own primary care team [general practitioner (GP), home nurse, home pharmacist, or physiotherapist] rather than involvement of external professionals such as GPs with a special interest in HF or home visits from a specialist nurse employed by the hospital.

The first reviewer (WR) independently screened the titles and abstracts from the search results based on the pre-specified inclusion criteria and divided the resulting articles into three categories (definitely excluded, included, and in doubt). A second reviewer (MS) checked all studies in the last two categories. Disagreements were resolved by consensus or by a third reviewer (BV). We retrieved full texts of all included articles and all articles in doubt. Two reviewers (WR and MS) read the articles and checked the inclusion criteria. A third person (BV) considered studies on which there was a lack of agreement, and a final decision was made after discussion. A log was kept of the excluded articles that were not conference abstracts, with the reasons for exclusion (Supporting Information, *Data S2*).

Assessment for study quality and risk of bias

Two authors (WR and MS) independently assessed the quality and risk of bias of all included studies using the criteria defined by the *Cochrane Handbook for Systematic Reviews of Interventions*[13]:

a random sequence generation (selection bias)
b allocation concealment (selection bias)
c blinding of participants, investigators, and outcome assessors (performance bias)
d incomplete outcome data (attrition bias)
e selective outcome reporting (reporting bias)
f other potential sources of bias

Based on these criteria, we judged studies to have a low, high, or unclear risk of bias for each category.

We evaluated the overall quality of the evidence supporting the outcomes using the Grading of Recommendations Assessment, Development and Evaluation approach.[14] Only moderate-quality to high-quality studies were included to ensure the validity of the included results.

DOI: 10.1002/ehf2.13152

Assessment of heterogeneity

We anticipated a high degree of heterogeneity due to differences in study interventions, patient populations, and definitions of usual care. We visually inspected forest plots to investigate and potentially explain heterogeneity. We calculated heterogeneity using the I^2 and χ^2 tests. We followed the *Cochrane Handbook for Systematic Reviews of Interventions* for the interpretation of I^2.[13]

When interpreting the I^2 value, we used the *P* value from the χ^2 test where a value of 0.10 or less was considered significant.

Data extraction

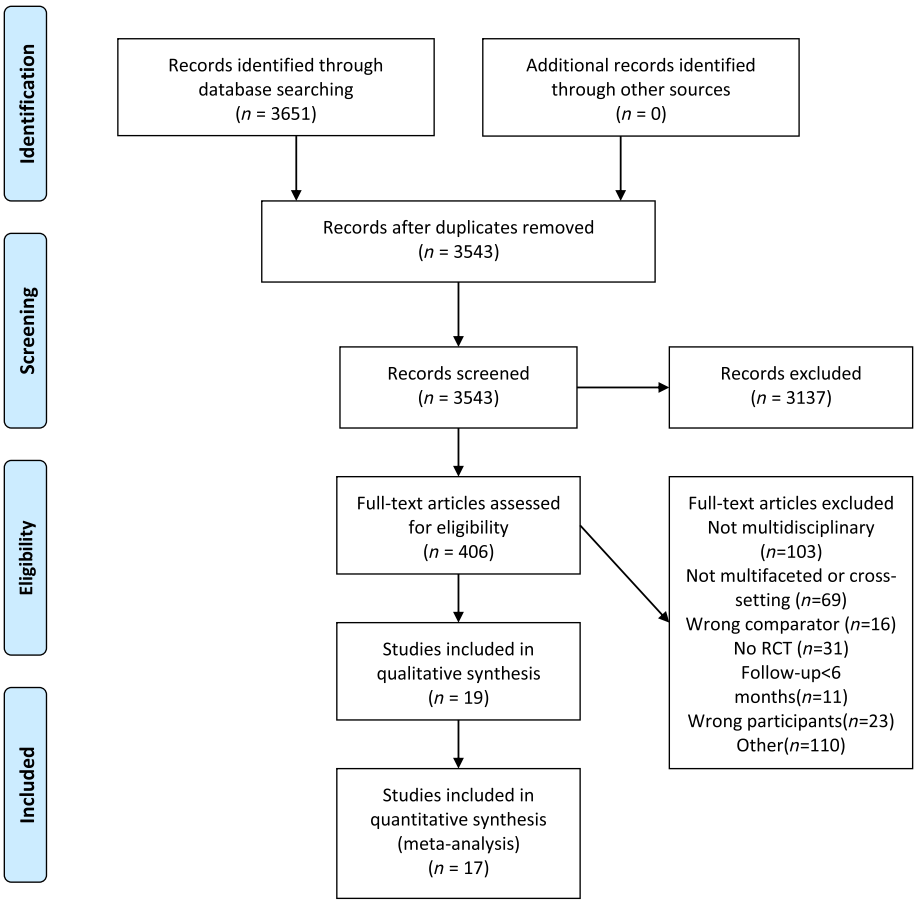
We extracted information from the available studies concerning patient characteristics and recruitment setting, intervention characteristics and outcomes, and possible biases. We contacted study authors to request additional information when studies did not report outcomes or presented them in a format unsuitable for inclusion in a meta-analysis.

Clinical outcomes

The following are the clinical outcomes:

- all-cause readmissions
- HF readmissions (where studies report these separately from all cardiac-related readmissions). We interpreted readmissions as the number of patients experiencing a second admission, rather than the total number of hospitalizations or hospitalization rates.
- all-cause mortality
- patient-reported outcome measures (PROMs):

Figure 1 Flowchart describing study selection and excluded studies. DMP, disease management programme; HF, heart failure; RCT, randomized controlled trial. The number between parentheses reflects the number of articles reporting on the respective trials.



○ health-related QoL as quantified by disease-specific questionnaires such as the Minnesota Living with Heart Failure (MLHFQ) and Kansas City Cardiomyopathy Questionnaires (KCCQ) or generic QoL instruments[15,16]
○ self-care as measured by the European Heart Failure Self-care Behaviour Scale[17]
○ anxiety and depression
○ ancillary outcomes such as quality of chronic care and care transition and discharge preparedness

Data analysis

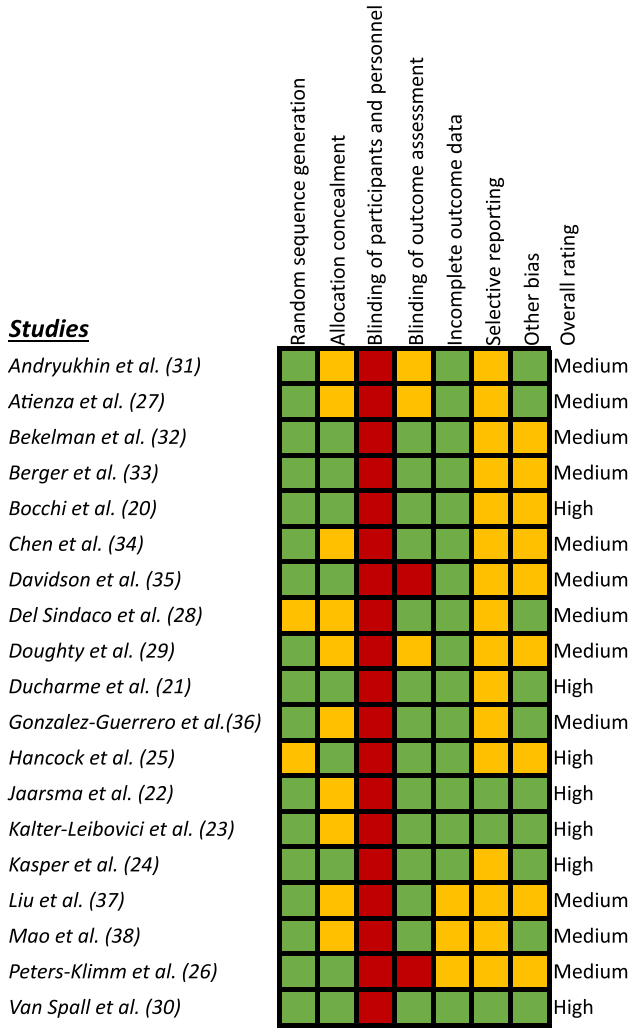
All trials of sufficient quality that reported appropriate data and compared interventions with usual care were included in the meta-analyses. We conducted a stratified meta-analysis based on four non-overlapping subgroups classified according to primary care involvement and primary recruitment setting. We reported data on mortality and HF and all-cause readmissions as relative risks with 95% confidence intervals (CIs). We pooled effects on QoL as changes from baseline where possible.[18] We combined MLHFQ and KCCQ scores in our pooling, because both scales have the same clinically meaningful difference (a change of 5) and similar weighting.[19] We inflected KCCQ scores to account for the inverse value distribution compared with the MLHQ (higher values indicate clinical improvement in contrast to worsening with the MLHFQ). We carried out meta-analyses with inverse variance weighting and random effects in RevMan version 5.3 (Cochrane Collaboration, Oxford, UK). We conducted a meta-regression analysis using binary categorical covariates to quantify an association of effect size differences for the two variables of interest in our review: involvement of primary care providers (PCP vs. no PCP) and setting (community vs. hospital) separately in R version 3.6.3. We compared baseline characteristics using random effects for age and left ventricular ejection fraction. We estimatedcrude event rates for all-cause readmissions, HF readmissions, and deaths by dividing total events by the total follow-up in years. We constructed funnel plots to assess for possible publication bias.

Results

Study selection

We identified 3651 records yielding 406 potentially eligible studies. Twenty-five studies met the original inclusion criteria. We excluded six low-quality articles after quality appraisal to ensure validity. We included 19 studies in our review, originating from both hemispheres (*Figure 1*). Six studies were high quality.[5,20–24] We graded the remaining 13 studies as medium quality (*Figure 2*). We requested additional data on clinical and patient-reported outcomes for six articles.

Figure 2 Risk of bias appraisal. Green = low risk of bias. Orange = unclear risk of bias. Red = high risk of bias.



Interventions and study characteristics

We classified the interventions into four subgroups (PCP/community, PCP/hospital, no PCP/community, and no PCP/hospital) according to their involvement of PCPs and recruitment setting. The interventions are summarized in *Table 1*.

Primary care professional/community

Two studies recruited in the community and closely involved PCPs[25,26] in a case management model. Hancock *et al*. studied multidisciplinary follow-up by specialist nurses and cardiologists in long-term care facilities.[25] PCP involvement

Table 1 Characteristics of the studies included

Author	Year (country)	*n*	Only HFrEF?	Mean (SD) age (years)	Intervention summary	Participating disciplines	Follow-up
PCP/community							
Hancock *et al.*[25]	2012 (UK)	28	Yes	83.7 (6.9)	HF service in long-term care facilities, consisting of initial visit by cardiologist who initiated plan of treatment and follow-up visits by HF nurse specialists	Cardiologist, HF nurse specialist, GP with special interest in HF, GP	6 months
Peters-Klimm *et al.*[26]	2010 (Germany)	197	Yes	69.6 (9.9)	Support of doctor assistants in GP practices. Combination of home visits, telephone monitoring, recall–reminder systems, and GP feedback	GP, doctor assistant (registered nurse)	12 months
PCP/hospital							
Atienza *et al.*[27]	2004 (Spain)	338	No	68 (median)	HF clinic in the hospital with outpatient follow-up every 3 months and scheduled visit and education with the GP 2 weeks after discharge. Facilitated telephone monitor with 24 h mobile phone contact number.	Cardiologist, cardiac nurse, GP	509 days (median)
Del Sindaco *et al.*[28]	2007 (Italy)	173	No	77.3 (5.8)	Discharge planning, education, and therapy optimization in HF clinic after discharge. Periodical nurse's phone calls. Assessment of adherence to treatment, evaluation of adverse effects, and comorbidities by GP.	Geronto-cardiologist, HF nurse specialists, GP	24 months
Doughty *et al.*[29]	2002 (New Zealand)	197	No	73.0 (10.8)	Integrated HF management programme with post-discharge review at HF clinic, phone call post-discharge to GP, and follow-up plan with six weekly visits alternating between GP and HF clinic. Telephone access to study team for GPs and patients. Education sessions in group.	Cardiologist, nurse, GP	12 months
Van Spall *et al.*[30]	2019 (Canada)	2494	No	77.7 (12.1)	Transitional care programme with hospital nurse navigator at time of discharge, multidisciplinary referrals as needed, structured patient-centred discharge summary with symptom-driven action plan for the patient and GP. Post-discharge GP follow-up within 1 week of discharge and referrals to post-discharge nurse-led home visits and HF clinic care for high-risk patients	HF nurse specialist, GP	12–24 months
No PCP/community							
Andryukhin *et al.*[31]	2010 (Russia)	85	No, only HFpEF	67 (median)	Educational group sessions and individual weekly consultations by a nurse for 6 months. Exercise training consisting of four weekly sessions of 30 min under the supervision of a physiotherapist	Nurse, physiotherapist	12 months
Bocchi *et al.*[20]	2008 (Brazil)	350	No	50.7 (16.8)	Multidisciplinary education classes in group, first at weekly and then at 6-month intervals. Telephone monitoring by a nurse trained in HF management, focused on reinforcing education	Cardiologist, nurse, pharmacist, social worker, dietitian, dentist, psychologist	2.47 years (mean)
Bekelman *et al.*[32]	2018 (USA)	314	No	65.5 (11.4)	Symptom check by nurse specialist with six follow-ups by telephone with symptom follow-up and motivational interviewing to improve health behaviours. Structured psychosocial care by a social care worker. Patient review by multidisciplinary panel consisting of cardiologist, palliative care physician, and primary care physician and weekly discussion with nurse and social worker	Nurse, social worker, primary care physician, cardiologist, palliative care physician	6 months

(*Continues*)

DOI: 10.1002/ehf2.13152

Table 1 (continued)

Author	Year (country)	*n*	Only HFrEF?	Mean (SD) age (years)	Intervention summary	Participating disciplines	Follow-up
Kalter-Leibovici *et al.*[23]	2017 (Israel)	1360	No	70.8 (11.3)	Nurse case management with regular remote contact between visits to HF centres. Telemonitoring of patient biometric data. Six monthly visits at HF centre and cardiologist evaluation. Counselling by dietitians and social workers as needed.	Cardiologist, nurse, social worker/dietitian	2.7 years (median)
No PCP/hospital							
Berger *et al.*[33]	2010 (Austria)	186	Yes	72 (12)	Home visits and telephone contact by nurse. Pre-scheduled consultations with cardiologist 10 days and 2 months after discharge. Tailored medication plan.	Cardiologist, HF nurse specialist	12 months
Chen *et al.*[34]	2019 (China)	62	No	61.7 (14.4)	Individualized discharge education with cardiologist. Tailored exercise training. Consultation with dietitian or psychiatrist when necessary. Home visit by coach nurse after discharge and telephone follow-up by cardiologist.	Cardiologist, coach nurse, dietitian, psychiatrist	6 months
Davidson *et al.*[35]	2010 (Australia)	105	No	71.6 (I)/73.9 (C)	Weekly exercise programme and weekly group-based educational sessions by nurses, pharmacists, physiotherapists, occupational therapists, and dietitians. Attendance at nurse-co-ordinated cardiac rehabilitation clinic with assessment by physiotherapist, nurse co-ordinator and occupational therapist with physical and psychosocial assessment and therapist. Implementation of strategies to promote self-management and treatment adherence.	Nurse, pharmacist, physiotherapist, dietitian, occupational therapist	6 months
Ducharme *et al.*[21]	2005 (Canada)	230	N/A	69 (10)	Multidisciplinary HF clinic with phone follow-up by nurses. Clinic provided rapid access to cardiologists, clinician nurses, dietitians, and pharmacists. Nurse telephone follow-up after discharge. Education at the clinic.	Cardiologist, nurse, dietitian, hospital pharmacist	6 months
González-Guerrero *et al.*[36]	2014 (Spain)	120	No	85 (6)	Multidisciplinary assessment and treatment in geriatric day care hospital. Education, telephone follow-up after discharge by nurse and geriatrician.	Geriatrician, nurse, social worker	12 months
Jaarsma *et al.*[22]	2008 (Netherlands)	683	No	71 (11.5)	Intensive intervention consisting of HF nurse education, telephone follow-up after discharge, regular follow-up by cardiologist, as well as home visits by the HF nurse, telephone follow-up, and multidisciplinary assessment by team consisting of physiotherapist, dietitian, and social worker	Cardiologist, HF nurse specialist, physiotherapist, dietitian, social worker	18 months
Kasper *et al.*[24]	2002 (USA)	200	Yes	61.9 (14.4)	Tailored treatment plan by cardiologist and consultation at 6 months. Telephone follow-up by nurse co-ordinator. Monthly HF nurse follow-up in clinic. Regular updates to primary care physicians (66% internal medicine physician, 29% cardiologist).	Cardiologist, HF nurse specialist, nurse co-ordinator, general internal physicians	6 months
Liu *et al.*[37]	2012 (Taiwan)	106	Yes	61 (12)	Intramural patient care by HF team consisting of three cardiologists specialized in HF care, one psychologist, one dietitian, and two case managers with 10 years of experience in HF care. Post-discharge follow-up by consultations with cardiologist and case manager and telephone follow-up.	Cardiologist, nurse case manager, psychologist, dietary assistant	6 months

(*Continues*)

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Table 1 (continued)

Author	Year (country)	*n*	Only HFrEF?	Mean (SD) age (years)	Intervention summary	Participating disciplines	Follow-up
Mao *et al*.[38]	2015 (Taiwan)	349	No	60.3 (13.2)	Intramural care by HF team consisting of two cardiologists specializing in HF care, psychologist, pharmacist, two nurse case managers. Post-discharge follow-up by consultations with cardiologist and case manager and telephone follow-up.	Cardiologist, nurse case manager, dietitian, pharmacist, psychologist	24 months

GP, general practitioner; HF, heart failure; HFpEF, heart failure with preserved ejection fraction;PCP, primary care professional; SD, standard deviation.

consisted of extensive notifications by the study team to GPs, drug prescription management through the associated general practice, and input from a GP HF specialist for advice about ongoing care. Peters-Klimm *et al*. studied complex structured case management by a trained doctor's assistant in GP practices with feedback to employing GPs.[26]

Primary care professional/hospital

Four studies recruited in the hospital and involved PCPs.[27–30] PCP involvement in all four studies consisted of a standardized contact within 1 to 6 weeks after discharge with the GP to assess treatment adherence and evaluate adverse effects and comorbidities. Three studies were multidisciplinary HF clinics.[27–29] One study was a hybrid of multidisciplinary case management and clinic follow-up.[30]

No primary care professional/community

Four studies recruited in the community but did not involve PCPs.[20,23,31,32] One of these also recruited in the hospital (n = 521/1360, 38%).[23] Three studies offered case management[20,23,32] with remote follow-up via telephone by specialist nurses. All studies offered individual or group-based education. Only one study offered multidisciplinary education by various health disciplines.[20] One study conducted telemonitoring of patient biometric data.[23] One study had an exercise training component.[31] One study implemented patient review by a multidisciplinary panel.[32]

No primary care professional/hospital

Nine studies recruited in the hospital and did not involve PCPs.[21,22,24,33–38] Seven studies were multidisciplinary HF clinics.[21,22,24,34,36–38] One study had case management by a specialist nurse and cardiologist.[33] One study offered multidisciplinary cardiac rehabilitation.[35] All studies offered individual or group-based education. All except one[35] conducted telephone follow-up of patients after discharge. Three studies had hospital-initiated home visits by a specialist nurse.[22,33,34]

Outcomes

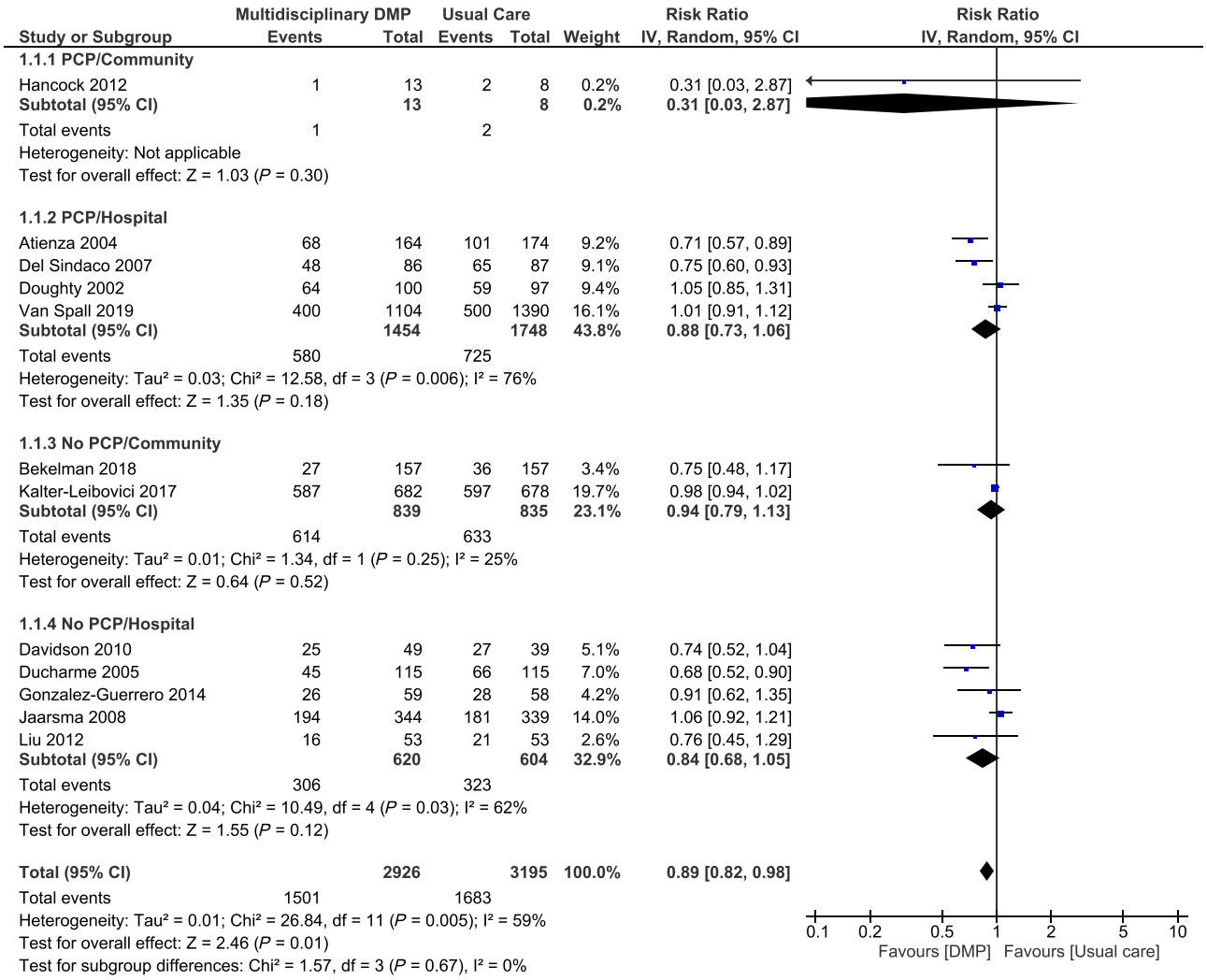
Effect on all-cause readmission

Twelve studies reported all-cause readmission (*Figure 3*). Meta-analysis showed a significant reduction in all-cause readmissionfor multidisciplinary interventions compared with usual care (relative risk 0.89, 95% CI [0.82, 0.98]). Moderate to substantial heterogeneity was present (I^2 = 59%, P = 0.005).

Effect on heart failure readmission

Ten studies reported data on HF readmission (*Figure 4*). Meta-analysis showed a significant decrease in HF readmissions for multidisciplinary interventions compared with usual care (relative risk 0.76, 95% CI [0.62, 0.93]).

Figure 3 Effectiveness of multidisciplinary heart failure DMPs in reducing all-cause hospital admission. Results of the meta-analysis are depicted in the forest plot. CI, confidence interval; DMP, disease management programme; PCP, primary care professional. Total = total number of patients in the study arm.



Substantial heterogeneity was present (I^2 = 66%, P = 0.002). Stratified meta-analysis by subgroup showed a significant reduction in HF readmissions for the PCP/hospital group (relative risk 0.61, 95% CI [0.46, 0.79]). There was no significant risk reduction for other subgroups.

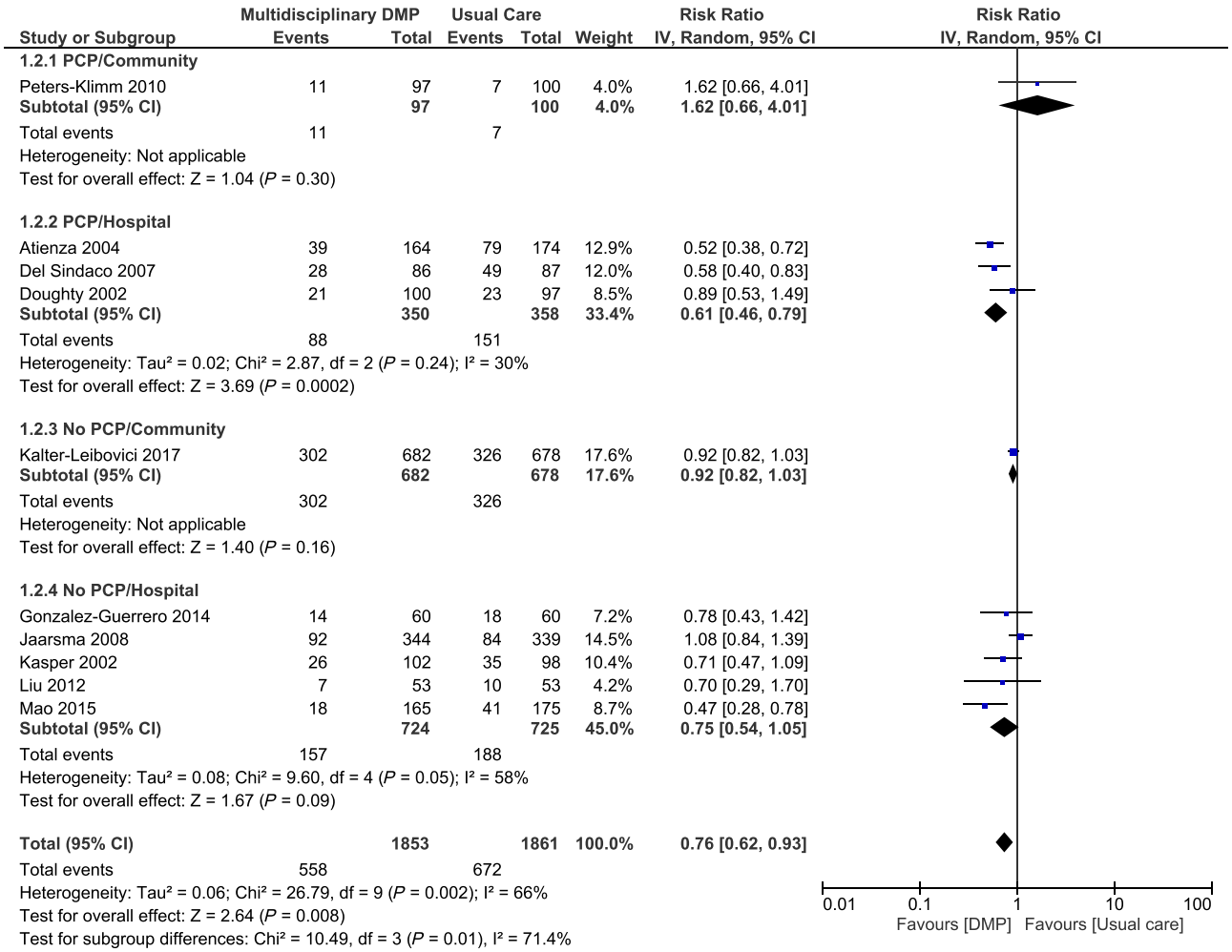
Effect on all-cause mortality

Sixteen studies reported data on all-cause mortality (*Figure 5*). Meta-analysis showed a significant decrease in all-cause mortality for multidisciplinary interventions compared with usual care (relative risk 0.79, 95% CI [0.68, 0.91]). Moderate heterogeneity was present (I^2 = 40%, P = 0.05). Stratified meta-analysis by subgroup showed a significant decrease for the no PCP/hospital subgroup (relative risk 0.63, 95% CI [0.50, 0.80]). There was no significant risk reduction for other subgroups.

Meta-regression analyses

We conducted no meta-regression analysis for the four subgroups because there were less than three studies for each subgroup. Meta-regression analyses on recruitment setting or primary care involvement showed no significant association of either variable with effect size differences for all-cause readmissions and mortality and HF readmissions (*Table 2* and *Figure 6*). To assess the possible impact of different population characteristics in the community and hospital settings, we compared disease severity at baseline (*Table 3*) and crude event rates using L'Abbé plots (*Figure 7*). We also

Figure 4 Effectiveness of multidisciplinary heart failure (HF) DMPs in reducing HF hospital admission. Results of the meta-analysis are depicted in the forest plot. CI, confidence interval; DMP, disease management programme; PCP, primary care professional. Total = total number of patients in the study arm.



conducted a sensitivity analysis to assess the effect on pooled subgroup effects without two larger studies that contributed substantially to their respective subgroup population and I^2 heterogeneity (Supporting Information, *Data S4* and *S5*).[23,30]

Effect on patient-reported outcome measures

Table 4 shows various PROMs. We did not conduct a formal meta-analysis on PROMs according to recruitment setting and involvement of PCP because most studies used different PROM questionnaires and failed to report either regression-weighted change from baseline or the number of participants who completed the outcome measures. We therefore report significant improvements in patient-reported outcomes descriptively.

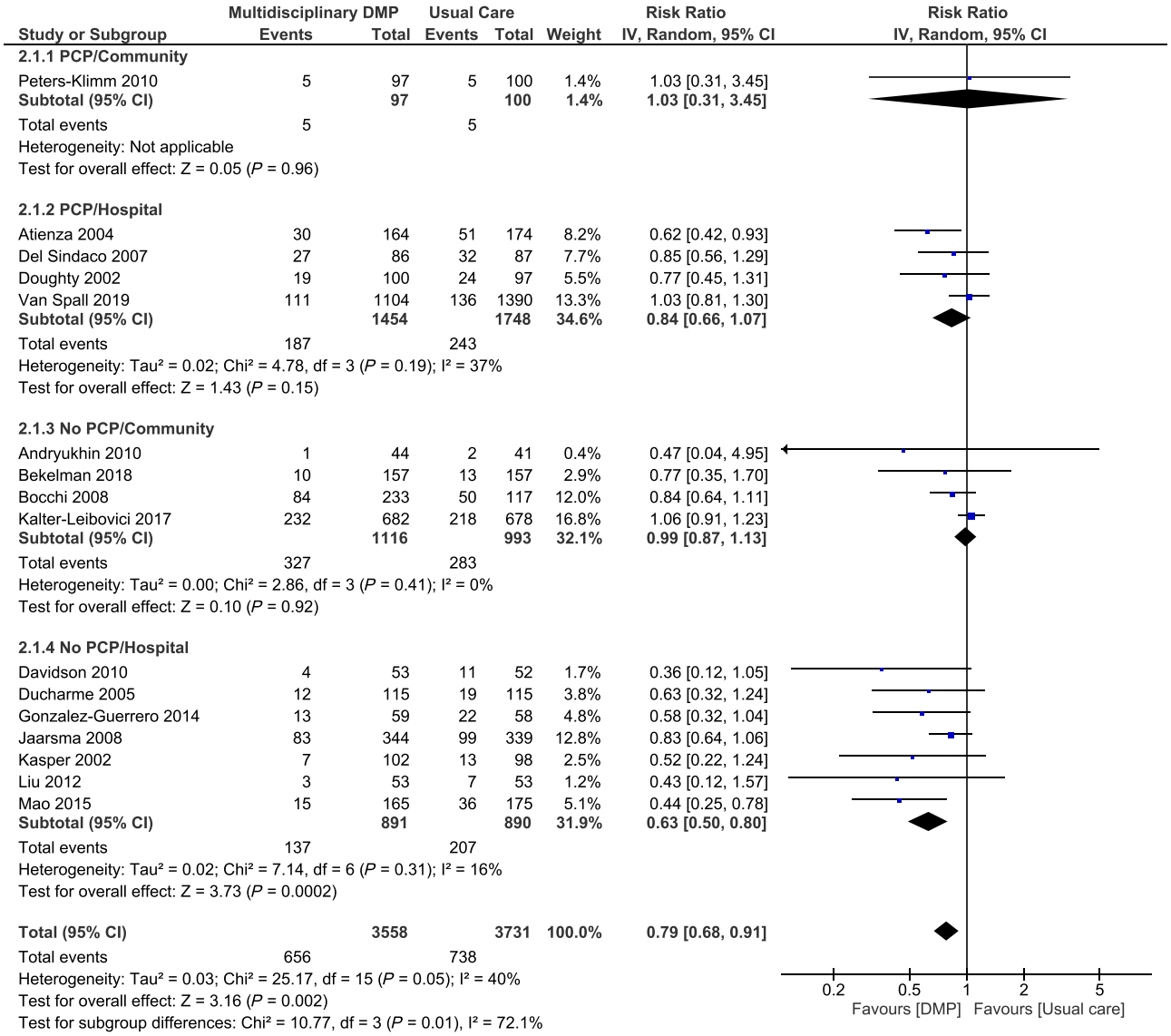
Quality of life Of the two studies that recruited in the community and involved PCPs, none reported significantly improved QoL in the multidisciplinary care group compared with usual care (n = 225).[25,26]

Of the four studies that recruited in the hospital and involved PCPs, three (n = 708) reported significantly improved HF-specific QoL in the multidisciplinary care group compared with usual care (MLHFQ).[27–29] One study (n = 2494) found no significant improvement on generic QoL (EuroQol 5 dimensional).[30]

Of the four studies that recruited in the community without PCP involvement, two (n = 1710) reported significantly improved generic and HF-specific QoL in the multidisciplinary care group compared with usual care (MLHFQ and Short Form Health Survey).[20,23] Two studies (n = 399) reported no improvement in either MLHFQ[31] or KCCQ score.[32]

Of the nine studies that recruited in the hospital without PCP involvement, five studies reported QoL. Four (n = 612) reported significantly improved HF-specific QoL in the multidisciplinary care group compared with usual care

Figure 5 Effectiveness of multidisciplinary heart failure DMPs in reducing all-cause deaths. Results of the meta-analysis are depicted in the forest plot. CI, confidence interval; DMP, disease management programme; PCP, primary care professional.



(MLHFQ).[21,24,34,36] One study (n = 105) found no significant improvement in MLHFQ scores.

Anxiety and depression Studies with PCP participation did not report anxiety or depression. Three out of four studies in the no PCP/community group reported anxiety and depression scores (Hospital Anxiety and Depression Scale and Patient Health Questionnaire-9).[23,31,32] All studies (n = 1759) noted significant improvements in the multidisciplinary care group compared with usual care. Of the nine studies in the no PCP/hospital group, one (n = 62) reported anxiety and depression (Patient Health Questionnaire-9) and found significant improvement in the multidisciplinary care group compared with usual care.

Self-care Only two studies reported on patients' self-care using the European Heart Failure Self-care Behaviour Scale. One study (n = 197) in the PCP/community[26] and one study (n = 62) in the no PCP/hospital group[34] reported significant improvement in the multidisciplinary care group compared with usual care.

Chronic care and transition of care Two studies with PCP participation collected outcomes on chronic care and transition of care. Peters-Klimm *et al*. recruited in the community (n = 197) and reported quality of chronic care using the self-administered extended Patient Assessment of Chronic Illness Care-5A instrument and found significant improvement in the intervention arm.[26] Van Spall *et al*. recruited in the

Table 2 Random effects subgroup and mixed effects meta-regression analysis by recruitment setting and primary care involvement

Outcome	Group	Number of studies (k)	Relative risk (CI)	*P* value	Intercept (CI)	*P* value	Test of moderators (QM)	*P* value
All-cause readmission		12						
	Community	3	0.94 [0.78, 1.12]	0.47	−0.10 [−0.35, 0.15]	0.45	0.11	0.75
	Hospital	9	0.87 [0.76, 0.98]	0.03*	−0.05 [−0.33, 0.23]	0.75		
	No PCP	7	0.90 [0.80, 1.01]	0.08	−0.20 [−0.43, 0.03]	0.08	0.96	0.32
	PCP	5	0.87 [0.72, 1.05]	0.15	−0.19 [−0.57, 0.19]	0.32		
HF readmission		10						
	Community	2	1.01 [0.67, 1.54]	0.95	0.04 [−0.44, 0.51]	0.89	2.11	0.15
	Hospital	8	0.70 [0.54, 0.89]	0.004*	−0.40 [−0.93, 0.14]	0.15		
	No PCP	6	0.83 [0.67, 1.02]	0.07	−0.20 [−0.43, 0.03]	0.08	0.96	0.33
	PCP	4	0.70 [0.49, 1.00]	0.051	−0.19 [−0.57, 0.19]	0.33		
All-cause mortality		16						
	Community	5	0.99 [0.87, 1.13]	0.92	−0.05 [−0.27, 0.17]	0.65	3.31	0.07
	Hospital	11	0.72 [0.60, 0.87]	0.0004*	−0.25 [−0.52, 0.02]	0.07		
	No PCP	11	0.73 [0.59, 0.90]	0.004*	−0.29 [−0.49, 0.10]	0.0035**	0.51	0.48
	PCP	5	0.86 [0.70, 1.05]	0.14	0.12 [−0.21, 0.45]	0.48		

CI, confidence interval; HF, heart failure; PCP, primary care professional.
A single asterisk indicates a significant effect on relative risk. The double asterisk indicates a significant predictor in the mixed effects meta-regression model. The test of moderators examines the association between variables and effect size differences.

hospital (n = 2494) and selected patient discharge preparedness (11-item B-PREPARED questionnaire) and quality of transition of care (three-item Care Transitions Measure questionnaire) as secondary outcomes based on a patient survey.[30] Both outcomes improved significantly in the intervention group compared with usual care.

Funnel plots

Funnel plots (Supporting Information, *Data S3*) suggested little evidence of publication bias.

Discussion

This is the first systematic review to compare the outcomes of different multidisciplinary HF DMPs in relation to their recruitment setting and involvement of primary care health professionals. Multidisciplinary HF DMPs that recruited in the community had no significant effect on all-cause and HF readmissions nor on mortality, irrespective of primary care involvement. Studies that recruited in the hospital significantly decreased HF and all-cause readmissions, as well as mortality. A majority of multidisciplinary HF DMPs did not involve PCPs (n = 13/19). In our meta-regression analysis, we found no significant effect size difference between recruitment setting or primary care involvement for all-cause readmissions, HF readmissions, or all-cause mortality, a result that should be interpreted cautiously because the number of studies recruiting in the community and involving primary care providers was limited (6/19 studies in each group).

Our systematic review provides important new insights on two important variables of multidisciplinary HF DMPs.

First, with respect to recruitment setting, we found that most included multidisciplinary DMPs recruited patients in the hospital after a first HF hospitalization (13/19 studies). This is likely driven by practical considerations such as easier recruitment and follow-up in a hospital environment (a structural problem in research on chronic illness)[39] as well as an effort to maximize programme efficiency by focusing on a patient group at high risk of readmission. Our results suggest the benefit of such a high-risk strategy, as multidisciplinary HF DMPs recruiting in the hospital significantly reduced risk of death, HF readmission, and all-cause readmission. In comparison, studies conducted in the community had smaller effects (closer to relative risk = 1) for all three outcomes (*Figure 6*), although this finding was not statistically significant. Community-initiated multidisciplinary HF DMPs had no significant effects on all-cause readmissions, HF readmissions, or mortality, consistent with a previous review that focused on community-based HF case management rather than multidisciplinary approaches.[11] However, it should be noted that the lack of significance could be due to the relatively small number of community-initiated HF DMPs (6/19 studies, n = 2334 patients) and by problems in patient selection, because patients had generally lower event rates as well as lower disease severity at baseline. Only two of the community-initiated DMPs used risk stratification to select patients most likely to benefit from the intervention,[23,32] one of which had to relax inclusion criteria during the study to increase the eligible study population.[32] It is possible that the lack of effectiveness seen in community-initiated DMPs could therefore be attributed not only to their relatively small number but also to their recruitment strategy. This hypothesis is supported by the benefits of risk stratification previously

Figure 6 Bubble diagram of random effects meta-regression analysis by recruitment setting (A) and primary care involvement (B). Treatment effects are displayed on the *y*-axis as log-risk ratios. The regression line is plotted in black. HF, heart failure; PCP, primary care professional.

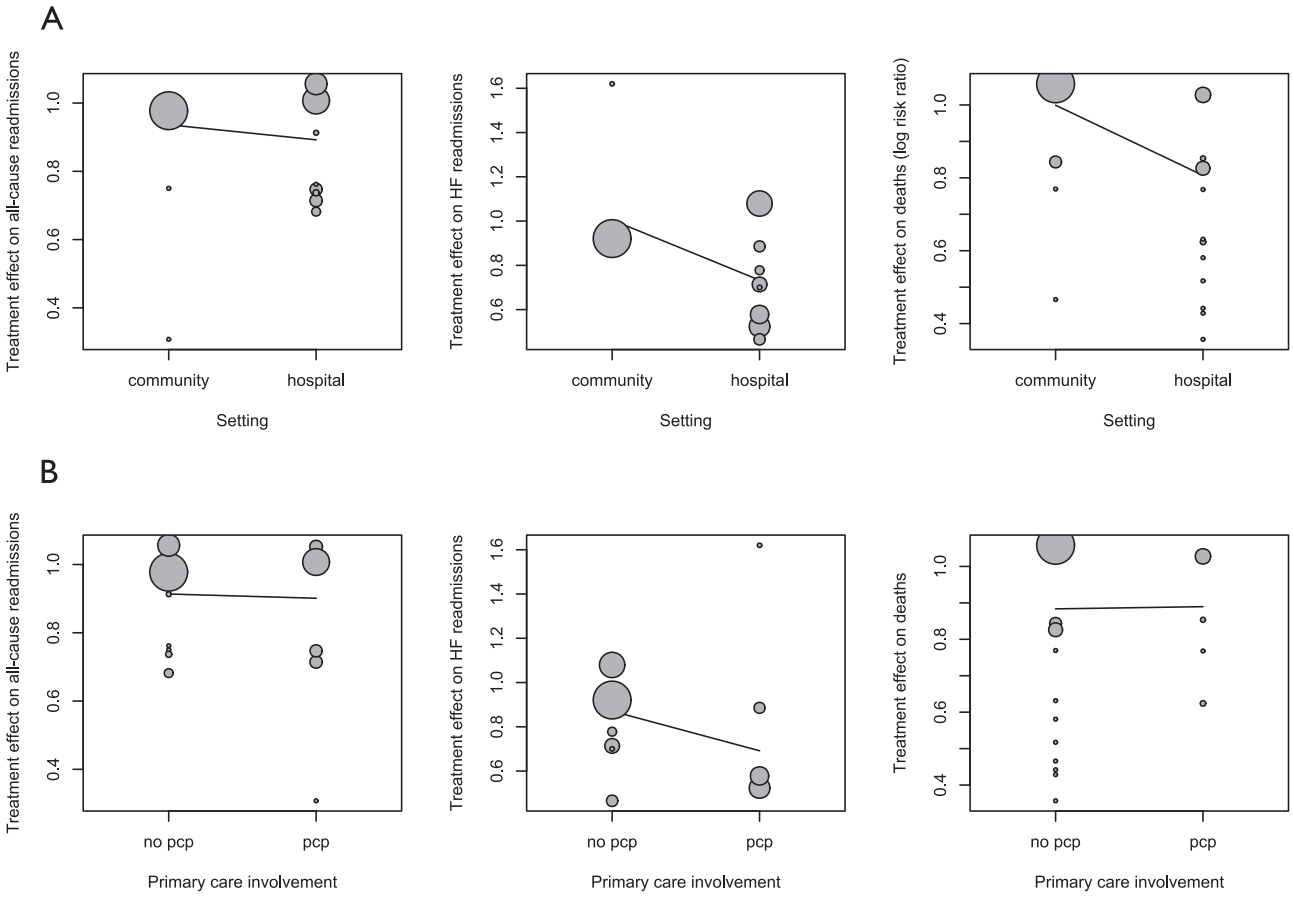
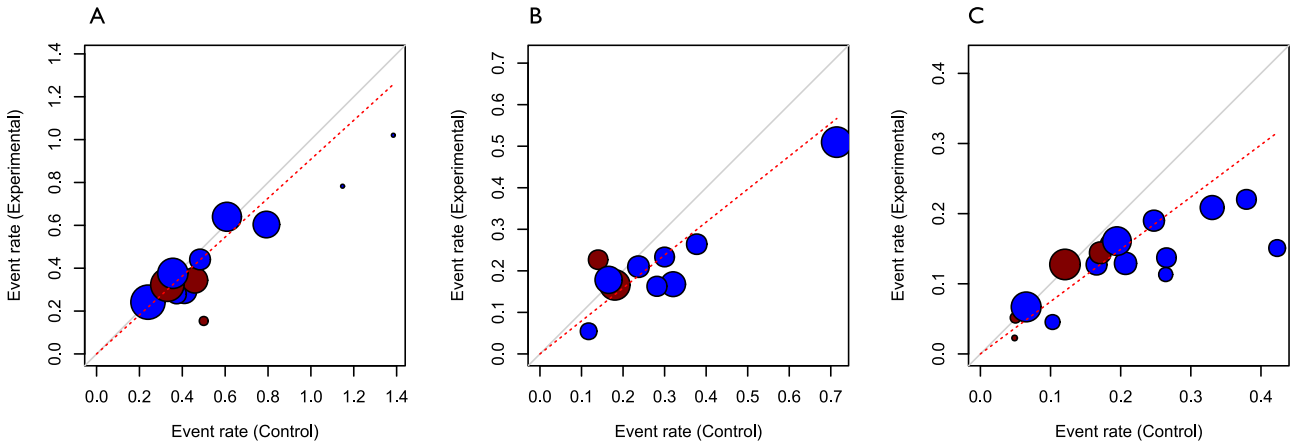


Table 3 A comparison of characteristics at baseline of the populations of two recruitment settings

Setting	Community	Hospital	Majority community
Total participants	974	5271	1360
Age (95% CI)	67.4 [54.1, 80.6]	70.1 [65.2, 74.9]	70.8 [69.4, 70.6]
LVEF (95% CI)	36.8 [35.8, 37.8]	36.3 [30.1, 42.4]	/
Male	668/974 (68.6%)	2941/5271 (55.8%)	986/1360 (72.5%)
HFrEF	687/974 (71%)	467/492 (95%)	1096/1360 (81%)
Hypertension	350/861 (41%)	1593/2777 (57%)	1010/1360 (74%)
Diabetes	299/861 (34.7%)	2907/5271 (55.2%)	693/1360 (51.0%)
COPD	172/861 (20.0%)	910/4162 (21.9%)	227/1360 (16.7%)
AF	213/861 (24.74%)	2016/4562 (44.2%)	333/1360 (24.5%)
MI	256/861 (29.7%)	1424/4616 (30.8%)	859/1360 (63.2%)
ICD	74/861 (8.6%)	/	228/1360 (16.8%)
Depression	152/511 (29.8%)	35/148 (23.6%)	/
NYHA1	123/974 (12.6%)	43/2443 (1.8%)	9/1360 (0.7%)
NYHA2	411/974 (42%)	781/2443 (32%)	197/1360 (14%)
NYHA3	348/974 (36%)	1354/2443 (55%)	1071/1360 (79%)
NYHA4	89/974 (9.1%)	352/2443 (14.4%)	80/1360 (5.9%)
Beta-blocker	708/974 (73%)	1260/2580 (49%)	1136/1360 (84%)
ACEi	809/974 (83.1%)	2217/2777 (79.8%)	1137/1360 (83.6%)
MRA	352/861 (40.9%)	324/950 (34.1%)	519/1360 (38.2%)
Diuretics	506/660 (76.7%)	2174/2499 (87.0%)	1242/1360 (91.3%)

ACEi, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; CI, confidence interval; COPD, chronic obstructive pulmonary disease; HFrEF, heart failure with reduced ejection fraction; ICD, implantable cardioverter-defibrillator; LVEF, left ventricular ejection fraction; MI, myocardial infarction; MRA, mineralocorticoid receptor antagonist; NYHA, New York Heart Association.

Figure 7 L'Abbé plots comparing event rates for all-cause readmission (A), heart failure readmission (B), and deaths (C). Studies recruiting in the community are coloured red, and studies recruiting in the hospital are coloured blue.



seen in multidisciplinary HF clinics.[40,41] With respect to recruitment setting, one could conclude that including patients at higher risk for events probably maximizes the effect of any HF DMP.

Second, with respect to involvement of PCPs, the results of our meta-analysis are inconclusive because of the high match of studies between the hospital and non-PCP subgroups (n = 7/11) as well as the limited number of studies involving primary care (n = 6/19). This last result is perhaps the most striking of our review: less than half of multidisciplinary HF DMPs involve PCPs. This contrasts with observational evidence that early collaborative care improves outcomes for patients after a HF admission.[42] In addition, several observational studies in Spain, Sweden, and France demonstrated a reduction in HF readmissions by as much as 20% by implementing integrated multidisciplinary care with strong collaboration between the hospital and primary care.[43–45] This systematic review shows that despite the recommendation of the European Society of Cardiology guideline that a multidisciplinary DMP implies close collaboration between cardiologist, specialist HF nurse, and GP,[9] this is not the most studied model in multidisciplinary HF randomized controlled trials.

This finding has implications for policymakers and researchers. It seems obvious to involve PCPs in multidisciplinary HF DMPs, given demographic evolutions in the HF patient population. The prevalence of HF has risen by almost 25% in the last decade, and in the community, approximately 50% of patients with clinical HF have a preserved ejection fraction (HFpEF).[1,46] The overwhelming majority of patients with HF, regardless of ejection fraction, have multiple chronic comorbidities, and nearly 50% of patients with HFpEF present with five or more major comorbidities,[1] fuelling the call for recognition of HFpEF as a true geriatric syndrome.[47] HF management for this growing older population in the community should be tailored to patients' needs and comorbidities. PCPs and GPs especially are ideally placed to deliver care for this geriatric population based on a holistic understanding of patients' personal histories, comorbidities, and preferences.[10] However, despite calls for increased primary care support, funding for HF in primary care remains limited.[48] This is especially striking because home-based care in HF is effective and reduces health care costs[49–51] and PCPs such as GPs or home nurses already conduct home visits in elderly patients.[52] The design of future HF DMPs should emulate these findings. Resources for specialized HF health care personnel in the community should target integration within existing primary care networks and the implementation of protocol-driven care.

We recognize the limitations of our study. First, multidisciplinarity in a DMP is easy to sense but hard to define. We defined a multidisciplinary DMP as a multifaceted intervention in which contact between a patient and at least two health care disciplines was part of the study protocol. Unlike previous reviews,[8,53] we therefore chose not to include studies where a single case manager co-ordinated multidisciplinary care[54,55] because this implies collaboration of one case manager with different health care professionals rather than real interdisciplinary communication. Second, we pooled several interventions according to their recruitment setting and primary care involvement possibly introducing substantial heterogeneity,[56] as suggested by the calculated I^2 values. We acknowledge that judgements about clinical heterogeneity will ultimately always be qualitative.[57] Third, we conducted a meta-regression without the generally recommended 10 studies for each covariate.[58] However, for categorical variables, four studies per subgroup have been suggested as a lower bound, although considered insufficient

Table 4 Patient-reported outcome measures

Study	*n*	HF QoL	Generic QoL	Anxiety/depression	Self-care	Other	Results
PCP/community	225						
Hancock *et al.*[25]	28	NR	EQ-5D, EQ-VAS	NR	NR	MMSE	No significant improvement in QoL or cognitive score.
Peters-Klimm *et al.*[26]	197	KCCQ	SF-36	NR	EHFScBS	PACIC (chronic care quality)	Significant improvement in self-care and chronic care scores. Non-significant improvement in generic and disease-specific QoL.
PCP/hospital	3202						
Atienza *et al.*[27]	338	MLHFQ	NR	NR	NR	NR	Significant improvement in QoL in intervention group compared with control
Del Sindaco *et al.*[28]	173	MLHFQ	NR	NR	NR	NR	Significant improvement in QoL in intervention group compared with control
Doughty *et al.*[29]	197	MLHFQ	NR	NR	NR	NR	Significant improvement of physical functioning in intervention group compared with control.
Van Spall *et al.*[30]	2494	NR	EQ-5D-5L	NR	NR	CTM-3 (transitional care), B-PREPARED (discharge preparedness)	Significant improvement in CTM-3 and B-PREPARED scores. No significant difference in mean QALY between intervention and control groups.
No PCP/community	2109						
Andryukhin *et al.*[31]	85	MLHFQ	NR	HADS	NR	NR	Significant improvement in QoL, anxiety and depression between intervention and control group.
Bocchi *et al.*[20]	350	MLHFQ	NR	NR	NR	Sequential adherence index	Significant improvements in QoL and sequential adherence scores in intervention group compared with control group.
Bekelman *et al.*[32]	314	KCCQ	NR	PHQ-9, GAD-7	NR	GSDS (symptoms), PROMIS (fatigue), PEG-3 (pain intensity)	No significant improvement in primary outcome of HF QoL. Secondary outcomes of depression and fatigue significantly improved in intervention group compared with control group.
Kalter-Leibovici *et al.*[23]	1360	NR	SF-36	PHQ-9	NR	NR	Significant improvement in QoL and depression scores in intervention group compared with usual care group.
No PCP/hospital	2041						
Berger *et al.*[33]	186	NR	NR	NR	NR	NR	
Chen *et al.*[34]	62	MLHFQ	NR	PHQ-9	EHFScBS	NR	Significant improvement in QoL, depressive symptoms and self-care behaviours.
Davidson *et al.*[35]	105	MLHFQ, HFNAQ	NR	NR	NR	NR	No significant improvement in QoL at end-of follow-up.
Ducharme *et al.*[21]	230	MLHFQ	NR	NR	NR	NR	Significant improvement in QoL in intervention group compared with the control group.
González-Guerrero *et al.*[36]	120	MLHFQ	NR	NR	NR	NR	Significant improvement in QoL in intervention group compared with the control group.
Jaarsma *et al.*[22]	683	NR	NR	NR	NR	NR	
Kasper *et al.*[24]	200	MLHFQ	NR	NR	NR	NR	Significant improvement in QoL in intervention group compared with control group
Liu *et al.*[37]	106	NR	NR	NR	NR	NR	
Mao *et al.*[38]	349	NR	NR	NR	NR	NR	

CTM-3, three-item Care Transitions Measure; EHFScBS, European Heart Failure Self-Care Behaviour Scale; EQ-5D, EuroQol 5 dimensional; EQ-VAS, EuroQol Visual Analogue Scale; GAD7, Generalized Anxiety Disorder-7; HADS, Hospital Anxiety and Depression Scale; HF, heart failure; HFNAQ, Heart Failure Needs Assessment Questionnaire; KCCQ, Kansas City Cardiomyopathy Questionnaire; MLHFQ, Minnesota Living with Heart Failure Questionnaire; MMSE, mini-mental state examination; NR, not reported; PACIC, Patient Assessment of Chronic Illness Care; PCP, primary care practitioner; PEG-3, Pain, Enjoyment, General Activity; PHQ-9, Patient Health Questionnaire-9; PROMIS, patient-reported outcome measurement index score; QALY, quality-adjusted life-year; QoL, quality of life; SF-36, Short Form Health Survey.
PROMs with significant improvement in intervention group compared with control group are coloured green.

for significant findings.[59] The results of our meta-regression should therefore be interpreted carefully.

Conclusion

Multidisciplinary HF DMPs that recruit in the community have no significant effect on mortality or hospital readmissions, unlike DMPs that recruit in the hospital, although the difference in effect size was not significant in a meta-regression analysis. Including patients at highest risk for events probably maximizes the effect of any DMP. Only six multidisciplinary studies involved PCPs. Considering demographic evolutions and the importance of integrated home-based care for patients with HF, future multidisciplinary HF DMPs should consider integrating PCPs and evaluating the effectiveness of this model.

Acknowledgements

We thank Rob Doughty for providing further data from his trial.

Conflict of interest

None declared.

Funding

S. Janssens is holder of a named chair in Cardiology at the University of Leuven financed by Astra-Zeneca.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Data S1. Supporting Information
Data S2. Supporting Information
Data S3. Supporting Information
Data S4. Supporting Information
Data S5. Supporting Information
Data S6. Supporting Information

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