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What impact do specialist and advanced-level nurses have on people living with heart failure compared to physician-led care? A literature review

ABSTRACT

Background

The inclusion of specialist nurses in multi-disciplinary teams is the current gold standard for care of people with heart failure (HF) in the United Kingdom; however, they remain underutilised in practice. Though existing systematic reviews favourably compare advanced nursing roles to physician-led care, none have focused solely on HF.

Aim

To investigate the impact of specialist and advanced nurse-led care on the clinical outcomes, quality of life and satisfaction of people with HF compared to physician-led care.

Methods

Literature review and narrative synthesis.

Results

This review included twelve studies and categorised their measured outcomes into five domains: These were mortality; hospital admissions and length of stay; HF diagnosis and management; quality of life and patient satisfaction; and finally, self-assessment and self-care. Five studies appraised as medium or low risk of bias suggest the impact of specialist and advanced-level nurses on people with HF to be broadly equivalent to physicians regarding mortality, hospital admissions and length of stay, while superior in terms of self-assessment and self-care behaviours.

Conclusions

There were too few studies of sufficient methodological quality to draw definitive conclusions. However, no evidence was found to suggest that nurse-led services are any less effective or safe than physician-led services.

Key points for policy, practice and/or research:

- Specialist and advanced-level nursing services that include structured self-care education and support are beneficial for people with HF.
- Further research is needed to confirm these findings, particularly regarding the impact of these roles on mortality and readmission rates amongst newly diagnosed patients.
- Effective educational partnerships between nurse and patient involve tailoring material to individual circumstance and actively problem-solving real world challenges.
- The patient experiences of people with HF who receive specialist and advanced-level nursing care are currently under-researched.

Key words
Advanced nursing practice, heart failure, clinical outcomes, quality of life, literature review

Introduction

The Advanced Nurse Practitioner (ANP) role was introduced into the United Kingdom (UK) in the 1980s as part of a wider strategy to relieve the workload of junior doctors (McGee, 2009). For many years its competencies lacked formal recognition, its scope of practice was uncertain and staff in advanced nursing roles had variable levels of education and skills (Bryson, 2016). In 2017 a formalised ANP credentialing process was established by the Royal College of Nursing, which included an Advanced Level Nursing Practice register. Registered ANPs are required to demonstrate the four pillars of advanced practice: effective management and leadership; expert teaching and mentorship; involvement in research development; and, autonomous clinical judgement (RCN, 2018). While the ANP role represents a generalist career development pathway, Clinical Nurse Specialists (CNS) apply advanced nursing knowledge and skills within specific fields of practice.

A group that may benefit from specialist and advanced-level nursing are people with Heart Failure (HF). HF is diagnosed when a reduction in cardiac output occurs in light of structural and/or cardiovascular abnormalities, falling to a level low enough for symptoms to arise. Symptoms are numerous, though fatigue, oedema and dyspnoea are commonly noted. People living with HF also experience depression and anxiety with prevalence estimates of 10-60% and 11-45% respectively (Yohannes et al., 2010). Depression strongly predicts physical/social disability and mortality, whilst self-care behaviour is intrinsically linked to self-efficacy and motivation, particularly for maintaining structured physical exercise (Klompstra et al., 2018). Psychological care and support is therefore of paramount importance for people living with HF; as is the promotion of self-efficacy to adopt healthy behaviours.

The inclusion of specialist HF nurses within multi-disciplinary teams is the gold standard incorporated into NICE Guidance for chronic HF (National Institute of Health and Care Excellence, 2018). However, advanced-level and specialist nurses remain under-utilised and a public perception of nursing as subordinate to medicine has endured (Casey et al., 2017). Criticisms surrounding these roles include blurred boundaries with medical colleagues, a

lack of consensus regarding their cost efficacy, and inconsistent regulation and scopes of practice, both nationally and internationally (Maten-Speksnijder et al., 2013; Maier, 2015).

Results from systematic reviews into the effectiveness of ANPs compare favourably against physician-led care, reporting positive impacts on patient satisfaction, health status, functional status, reductions in the number of unexpected hospital admissions and reduced length of stay (Newhouse et al., 2011; Stanik-Hutt et al., 2013). However, these reviews dealt with multiple specialisms and were not HF specific. Therefore, this literature review considers the impact of advanced-level and specialist nurse-led care among people living with HF compared to physician-led care.

Methodology

A Population, Intervention, Comparison Outcome analysis (PICO: Table 1) was undertaken to construct an answerable research question (Aveyard and Sharp, 2017).

Insert Table 1 about here

Search strategy

The Cochrane Library of Systematic Reviews was initially searched using the terms 'nurse AND heart failure'. Fifteen hits were returned though none directly answered the research question. Four databases were then searched from 2008 to January 2020: The British Nursing Index (BNI); CINAHL; MEDLINE; and EMBASE. The 2008 start date was chosen in light of the aforementioned systematic reviews (Newhouse et al., 2011; Stanik-Hutt et al., 2013), as each study searched for cross specialism research up until 2008 and 2009 respectively.

Table 2 depicts utilised search terms, Boolean operators and truncation commands (*). The same strategy was also used to search for conference abstracts via BIOSIS Citation Index and for unpublished theses using OpenGrey, alongside the British Library's E-Theses Online Service (EthOS). Forward citation tracking from included articles was also undertaken. Studies were included if they reported randomised controlled trials (RCTs) or quasi-experimental research that compared physician-led care with specialist or advanced-level

nursing, where participants were aged 18 years or above while living with HF, and were peer reviewed articles published in English. Non-comparative studies and those in which the ANP contribution was not specified or measured were excluded.

Insert Table 2 about here

Data Extraction and Synthesis

Tabulation and grouping techniques guided data extraction and synthesis. A template was used to extract key methodological detail for each paper including the research aim, design, sample, intervention and key findings. Because the included studies featured heterogeneous methods, interventions and outcomes, a meta-analysis could not be conducted. As such, this review coded the outcomes captured in each study and categorised them into five groupings, with evidence then reported for each outcome domain. A further synthesis across themes allowed for a meaningful and valid narrative of evidence to answer the review question. Data were extracted and study outcomes categorised by the first author (XX), with verification done by the second author (XX). Any additions or disagreements were discussed and agreed.

Quality Appraisal

The quality of included studies was appraised using the Consolidated Standards of Reporting Trials (CONSORT) statement checklist (Schulz et al., 2010). Quality appraisal was undertaken by the first author (XX) and verified by the second author (XX) with any discrepancies agreed through discussion. No articles were excluded based on their quality appraisal, however, findings from studies that exhibited fewer methodological concerns identified by the CONSORT statement were considered to hold more weight.

Results

Description of studies

The search strategy returned a total of 19,932 records, from which 12 studies were included in the review after title screening and application of inclusion/exclusion criteria (Figure 1).

Insert Figure 1 about here

Study characteristics are presented in Table 3. The 12 studies were published between 2008 and 2019 and involved a total of 3,887 participants from nine countries: Australia, Brazil and USA (two studies each), Germany, Netherlands, Saudi Arabia, Spain, Thailand, UK (one study each). Six were RCTs (de Souza et al., 2014; Driscoll et al., 2014; Jaarsma et al., 2008; Köberich et al., 2015; Mulligan 2008; Ortiz-Bautista et al., 2018) and six were quasi-experiments (Bdeir et al., 2015; David et al., 2015; Driscoll et al., 2011; Lowery et al., 2012; Rhiantong et al., 2019; Sauer et al., 2010).

A majority of studies (n=8) examined specialist and advanced-level nursing functions such as titration of β-blocker medications alone (Driscoll et al., 2011; Driscoll et al., 2014) or in combination with other medications (Ortiz-Bautista et al., 2018; Lowery et al., 2012), co-ordinated discharge and transitional care (David et al., 2015; Rhiantong et al., 2019), patient telephone follow-up (Bdeir et al., 2015; Jaarsma et al., 2008; Köberich et al., 2015; Lowery et al., 2012), and patient education (Bdeir et al., 2015; David et al., 2015; de Souza et al., 2014; Köberich et al., 2015; Lowery et al., 2012; Ortiz-Bautista et al., 2018). Four studies also examined the effectiveness of home visits (de Souza et al., 2014; Driscoll et al., 2011; Driscoll et al., 2014; Jaarsma et al., 2008), and one study tested nursing diagnoses of HF severity (Sauer et al., 2010).

Insert Table 3 about here

Quality of studies

Full reporting of the CONSORT statement checklist for each study is available as supplementary online information (Appendix A). Intention-to-treat (ITT) analyses were not performed in six studies (Bdeir et al., 2015; David et al., 2015; Driscoll et al., 2011; Driscoll et

al., 2014; Lowery et al., 2012; Rhiantong et al., 2019). Among these studies were high drop-out rates (e.g. Bdeir et al., 2015 [29%]; Rhiantong et al., 2019 [30-40%]), significant differences between intervention and control group baseline characteristics (e.g. Driscoll et al., 2011; Lowery et al., 2012), and absent effect sizes or CONSORT flow diagrams (e.g. Drsicoll et al., 2014; David et al., 2015). In addition, Ortiz-Bautista et al., (2018) undertook ITT analysis but did not blind participants, fell 43% short of its power calculation sample size and did not provide a CONSORT flow diagram. These seven studies were classified as high risk of bias.

Among the five other studies, two RCTs conducted ITT analyses of single-blinded data and reported participant flow diagrams, but failed to report effect sizes and fell short of power calculation sample sizes (Köberich et al., 2015 [3.5% short]; Mulligan, 2008 [33% short]). Additionally, one robust quasi-experiment involved only a single nurse, limiting the generalisability of its findings (Sauer et al., 2010). These three studies were classified as medium risk of bias. The remaining two RCTs (de Souza et al., 2014; Jaarsma et al., 2008) were methodologically sound as appraised by the CONSORT statement. Single-blinding, sufficient power, clear outcome definitions/measurement, ITT analyses and participant flow diagrams characterised these studies, which were both classified as low risk of bias.

Study outcomes

Study outcomes were categorised into five overarching domains (Table 4): mortality; hospital admissions and length of stay; HF diagnosis and management; quality of life and patient satisfaction; self-assessment and self-care.

Insert Table 4 about here

Mortality

Most studies found no significant differences in mortality rates between intervention and control groups. This was true of studies with low risk of bias (e.g. Jaarsma et al., 2008), medium risk (e.g. Mulligan, 2008) and high risk (e.g. Ortiz-Bautista et al., 2018). Two exceptions (Bdeir et al., 2015; Lowery et al., 2012) found significant reductions in all-cause

mortality for nurse-led disease management programmes (DMPs), but had high subject attrition and significant baseline differences between participant groups.

Hospital admissions and length of stay

Most studies found no significant differences in readmission rates between intervention and control groups. This was true of studies with a low (e.g. de Souza et al., 2014), medium (e.g. Mulligan, 2008) and high risk of bias (e.g. Driscoll et al., 2011). Two exceptions (Ortiz-Bautista et al., 2018; David et al., 2015), found significant differences in readmission rates favouring their nurse-led DMP and cardiac nurse practitioners respectively. However, David et al. (2015) relied on participants' acceptance of nurse-led care for allocation and Ortiz-Bautista et al. (2018) did not report participant movement through the trial, while including participants already receiving prior long-term titration.

One RCT with low risk of bias indicated that length of hospital stay (LoS) was significantly reduced by a nurse-led DMP when offered alongside standard care (Jaarsma et al., 2008, median LoS Intervention=8 days, Control=12 days *P*=0.01). Less robust evidence provides a mixed picture: Rhiantong et al. (2019) similarly reported significant reductions in LoS, this time from a nurse-led continuing care programme (95% CI -3.49 to -0.91, *P*=0.001), while David et al. (2015) and Mulligan (2008) found no significant LoS reductions from care delivered by cardiac nurse practitioners and a nurse-led self-management programme. However, Mulligan (2008) conducted a sub-group analysis of newly diagnosed patients which found significantly fewer readmissions for HF (Fisher's Exact Test, *P*=0.01) or HF events (combined death or readmission, χ^2 [df=1]=6.307, *P*=0.01) among the intervention group. Newly diagnosed patients who received the intervention also had a shorter LoS (Mann-Whitney Z Score =-2.545, *P*=0.01).

HF diagnosis and management

A robust quasi-experiment considered the accuracy of nursing diagnoses of HF severity (Sauer et al., 2010). Significant correlations with cardiologist-led findings (Spearman's Rank Correlation Co-efficient [SRCC]= 0.86, *P*<0.001) and Natriuretic Peptide (Nurse SRCC=0.45,

P<0.0001; Cardiologist SRCC=0.51, *P*<0.0001) suggested that specialist nurses were sufficiently accurate after adequate training. However, New York Heart Association Classification agreement was minimal (Kappa=0.316), and the study's generalisability is limited by its use of a single nurse. A RCT appraised as low risk of bias (de Souza et al., 2014) also reported significantly better use of diuretics following nurse-led home visits and telephone follow-up (intervention group 97.4% vs control 88.8%, *P*=0.01).

Evidence with high risk of bias indicates that specialist HF nurse-led titration of cardiac medications results in significantly more patients reaching their therapeutic dose of β-blockers compared to physician-led titration (Driscoll et al., 2011; Driscoll et al., 2014; Lowery et al., 2012). However, Ortiz-Bautista et al. (2018) found no significant difference in nurse-led titrations. Given the limited methodological strength of the evidence, little can be said for certain about the relative performance of nurse and physician-led titrations.

Quality of life and patient satisfaction

Evidence for improvements in QoL between intervention and control groups was equivocal. Two studies of medium and high risk of bias respectively reported significant improvements from a nurse-led HP education session (Köberich et al., 2015, Intervention Overall Score Difference = +8.99 *P*=0.001) and from a DMP (Ortiz-Bautista et al., 2018, Intervention=10.9, Control=2.29, *P*=0.04). However, these findings were countered by studies of equivalent methodological strength that found no significant improvements (Mulligan, 2008; Driscoll et al., 2014).

Two studies with medium risk of bias assessed patient mood with differing results. Mulligan (2008) found no significant improvements while Driscoll et al. (2014) reported significant improvements after six months following nurse-led titration of cardiac medicines (Cardiac Depression Scale mean differences Intervention -1.8 ± 11.98 vs Control 17.85 ± 18.44 *P*=0.006). Though a significant improvement in patient satisfaction was reported from nurse-led continuing care by Rhiantong et al. (2019), a high drop-out rate (30-40%) and absence of ITT analysis makes it difficult to generalise findings with any confidence. The evidence therefore presents a mixed picture; at best there is weak evidence to suggest that advanced nurse-led interventions may improve patients' QoL.

Self-assessment and self-care

Two RCTs with low and medium risks of bias reported statistically significant improvements in self-care following nurse-led education, home visits and telephone follow-up (de Souza et al., 2014, HF Self-Care Scale score differences: Intervention −12±9 vs Control -4±9 $P<0.001$; Köberich et al., 2015, European HF Self-Care Behaviour Scale $F[1,108]=4.174$, $P=0.043$). Two studies of medium quality also reported significant improvements in symptom monitoring and reporting compared to their respective control groups, including increased weighing behaviour, reporting weight changes and keeping to fluid guidelines at six weeks (Köberich et al., 2015; Mulligan, 2008). Weaker evidence from Rhiantong et al. (2019) also suggested significant improvements in functional status. However, three-month data in the Köberich et al. (2015) study were collected when delivering follow-up telephone support and may be susceptible to socially desirable responses. Nevertheless, the evidence consistently suggests that specialist nurse-led patient education and follow-up is associated with improvements in patients' self-assessment and self-care.

Discussion

Table 5 provides a high-level summary of review evidence weighted for risk of bias against outcome domains. All seven studies appraised as high risk of bias were quasi-experiments, which tend to report larger treatment effects than randomised trials (Kunz et al., 2007); while two of the seven studies also failed to reach target sample sizes, suggesting inadequate statistical power to detect differences. Even then, single-studies alone provided opposing results for the same domain (e.g. QoL) and there was a broad equivalence of positive and negative results across outcome domains. These are murky waters from which to craft any clear conclusions.

Insert Table 5 about here

There are patterns in Table 5 across the remaining five studies. The consistent finding that nurse-led care resulted in no greater mortality, readmissions or length of stay than

physician-led care when appropriately trained and supported by senior cardiologist. This is important given the reasonable fears of people living with HF and the enduring public perception of nursing as subordinate to medicine (Casey et al., 2017). The safety of nurse-led services, as measured by the accuracy of clinical congestion assessments, was also reported (Sauer et al., 2010).

A multi-specialism Cochrane review has found weak evidence for an association between the substitution of primary care doctors with advanced-level nurses, and equal or better rates of mortality and readmissions (Laurant et al. 2018): This perhaps indicates that there may be too few quality HF focused studies included within this review to capture these differences (n=2). There may also be significant matching effects between specific interventions or patient characteristics; as the sub-group analysis by Mulligan (2008) of newly diagnosed patients found significantly fewer readmissions, combined deaths and readmissions, and reduced LoS following a nurse-led HF self-management intervention.

Few HF diagnosis and management outcomes were reported in the five medium and low risk studies, with an exception being an increased use of furosemide found from a study in which specialist HF nurses did not have prescribing rights (de Souza et al., 2014); less can be deduced from this result than from the output that generated it. Other studies examined the prescription of cardiac medicines and reported positive results, but all were conducted under supervision from senior cardiologists prescribing on the nurses' behalf (e.g. Driscoll et al., 2011; Driscoll et al., 2014; Lowery et al., 2012). This contrasts with British nursing practice, where 70% of specialist HF nurses have independent prescribing rights (Pumping Marvellous Foundation, 2018). In this respect, these findings are not representative of contemporary specialist HF nursing practice in Britain.

Only two of the five medium and low risk studies considered QoL (Mulligan, 2008; Köberich et al., 2015). The former tested a nurse-led HF self-management intervention (no significant difference from control) and the latter a nurse-led HF patient education intervention (significant QoL benefit). The two interventions were similar in content; with symptom/behaviour monitoring, problem-solving, education and support to change, however, they differed in delivery and research method. Mulligan (2008) provided two hospital-based sessions, a home visit within one week of discharge, one telephone call the following week and follow-up data captured 6-8 weeks after discharge. In contrast,

Köberich et al. (2015) provided one hospital-based session and four telephone calls over a three month period after discharge, at which point follow-up data were collected. Participants in the Köberich et al. (2015) study received more professional input over a longer period, while the collection of follow-up data after three months may have allowed time for QoL benefits to accrue after self-management strategies were taught and successfully implemented.

Three of the five medium and low risk studies captured outcome data on self-care behaviours, with each reporting significant positive results. Like Mulligan (2008) and Köberich et al. (2015), de Souza et al. (2014) tested a nurse-led education and self-care intervention of four home visits and four follow-up phone calls over a four-month period, with outcome data captured at month six. de Souza et al. (2014) may also have found improved QoL in their patients similar to Köberich et al. (2015), given their extended follow-up, but that variable was not measured. However, the authors did provide an indication of effect size, with intervention patients improving by 12 points compared to the control group's 4 point improvement on the 12-item European HF Self-Care Behaviour Scale, which scores from 12 to 60 (Feijó et al., 2012). This equates to a 16.6% improvement for intervention compared to an 8.3% improvement for control, meaning that the nurse-led intervention was twice as effective in facilitating self-care behaviour as GP-led care.

Limitations and risk of bias

This review's search strategy yielded 19,352 results from BNI; meaning that potentially relevant literature may have been overlooked during manual screening. The inclusion of literature from different countries also introduced variations in the context and scope of advanced-level nursing practice that could not be fully accounted for; while the poor methodological quality of most included studies made it difficult to draw decisive, generalisable conclusions. Whilst there are legitimate arguments to suggest a relationship between advanced nursing practice and particular outcomes such as self-care and QoL, they are based on just two or three studies.

Risk of bias was managed by appraising the quality of studies and using their weightings throughout the presentation and discussion of results. There remains the risk that studies

with positive results are more likely to be published than those with neutral or negative results, which impacts on the pooled summaries contained within literature reviews (Catalogue of Biases, 2017). Given the broad equivalence of positive and negative findings summarised in Table 5 however, this risk does not seem significant.

Further research

The evidence base is patchy and more high-quality research is required. Interventions that promote self-care show particular promise and warrant further attention; as does investigation into their effects on mortality and readmissions amongst newly diagnosed patients. This review suggests that the intervention must be maintained for a minimum of three months, with outcome data captured after that point. A QoL measurement would usefully augment the assessment of self-care behaviour.

Further sub-group analyses by time since diagnosis, age, health status and intervention may also reveal important relationships that allow more effective matching of resources to patient need. A striking observation from the twelve studies is that patient satisfaction was only reported in one (Rhiantong et al., 2019). Little can therefore be gleaned from these studies of the patient experience; without which it is not possible to fully understand the impact of advanced and specialist nurse-led interventions.

Conclusion

There were too few studies of sufficient quality for this review to draw definitive conclusions or practice recommendations. However, the review question can be answered with evidence from five studies: Compared to physicians, the impact that specialist and advanced-level nurses have on people living with HF is superior in terms of self-assessment and self-care behaviours, while broadly equivalent in terms of mortality, hospital admissions and length of stay. Though tentative, this summary is professionally appealing. The educational interventions that facilitated improved self-care behaviours involved nurses tailoring material to individual circumstance and actively problem-solving patients' real-world challenges; interventions that were done 'with' patients rather than 'to' them. This

educational partnership is a marker of studies in this review and therefore of specialist and advanced-level nursing practice. It also chimes with patient expectations; as the need for holistic care and to feel valued as an individual, not an illness or group of symptoms, stand as most important for people living with HF (Sampaio et al., 2018).

Ethics statement

Ethical approval was not required for this secondary review of published, primary research data.

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Table 1 PICO analysis and research question

Population	Intervention	Comparison	Outcome
People living with Heart Failure.	Advanced-level nurses and specialist nurses	Physician-led care	Improved clinical outcomes, quality of life and patient satisfaction

What impact do specialist and advanced-level nurses have on the clinical outcomes, quality of life and patient satisfaction of people living with heart failure, compared to physician-led care?

Table 2 Search terms

Population		Intervention		Comparison		Outcome
Heart Failure		Advanced nurs*		Doctor*		Clinical Outcome*
OR		OR		OR		OR
HF		ANP		Doctor-led		Patient Outcome*
OR		OR		OR		OR
CHF		Nurse Specialist*		Physician*		Quality of Life
OR	AND	OR	AND	OR	AND	OR
Cardiac Failure		CNS		Physician-led		QoL
OR		OR		OR		OR
HFrEF		Nurse Practitioner*		Physician led		Patient Satisfaction
OR		OR		OR		
HFpEF		NP		Cardiologist*		
		OR		OR		
		Nurse Consultant*		Medic*		

Figure 1 PRISMA flow diagram (Moher et al., 2009)

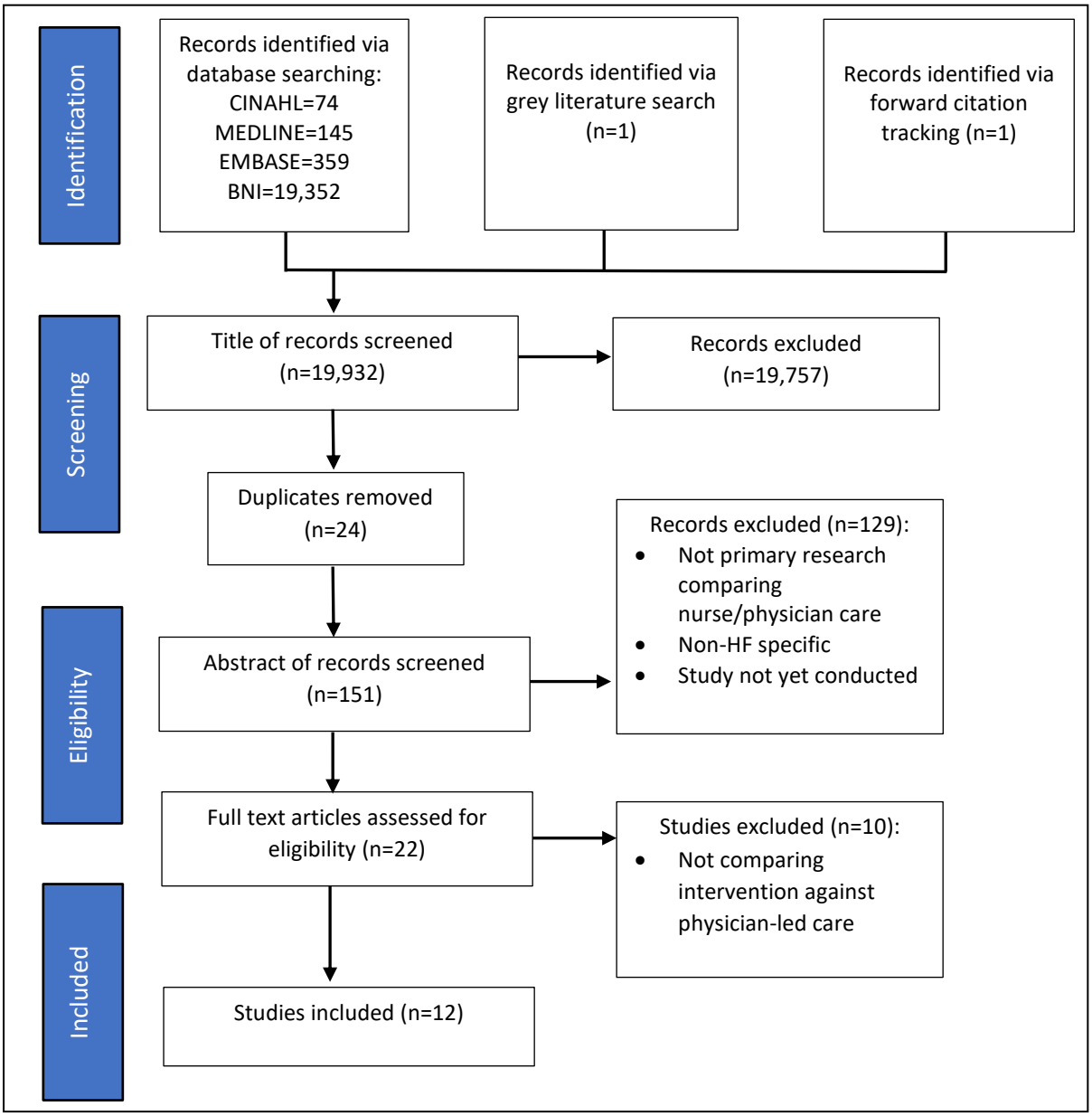

Table 3 Characteristics of included studies (n=12)

Author, year, country	Aim/purpose	Design, sample and follow-up (FU)	Intervention and control	Key findings
Bdeir et al., (2015) *** Saudi Arabia	To evaluate the impact of a specialist nurse-led Heart Failure Programme (HFP) on all-cause mortality (A-CM)	• Single-centre quasi-exp. • N=413 (I=199, C=214) **** • Retrospective	• I=specialist nurse-led HF clinic and pre-hospital discharge consultation with cardiologist support • C=cardiologist-led HF clinic	• Intervention associated with a 2.5-fold reduction in A-CM (hazard ratio=0.4; *P*=0.008)
David et al., (2015) *** USA	To assess service use outcomes of cardiovascular ICU patients cared for by cardiac nurse practitioners	• Single-centre quasi-exp. • N=185 (I=109, C=76) • Retrospective	• I=specialist nurse-led HF in-patient support and post-discharge clinic with "standard care" • C=cardiologist-led HF clinic ("standard care")	• ≈47.8% reduction in 30-day readmissions for Intervention (Intervention ratio=13.8%, Control ratio=28.9%; *P*=0.01). • No significant difference in length of stay (LoS) or time of discharge
de Souza et al., (2014) * Brazil	To evaluate the impact of specialist HF nurse-led home visits and phone follow-up on service use, A-CM, HF knowledge and self-care	• Multi-centre RCT • N=252 (I=123, C=129) • Six-month FU	• I=specialist nurse-led home visits and phone follow-up (with cardiologist support to amend prescriptions) • C=GP-led care	• No significant differences in readmissions or all-cause mortality • Significant differences in HF knowledge (HF Knowledge Scale score differences: Intervention 15.8±21% vs Control 0.94±17% *P*<0.001), self-care (HF Self-Care Scale score differences: Intervention −12±9 vs Control -4±9 *P*<0.001), and significantly more people used furosemide in intervention group (97.4%) vs control (88.8%) (*P*=0.01)
Driscoll et al., (2011) *** Australia	To examine the effect of specialist nurse-led titration of β -blocker medication on level of dosage after six months, A-CM and service use	• Multi-centre quasi-exp. • N=484 (I=229, C=255) • Six-month FU	• I=specialist nurse-led titration with cardiologist support. Nurses did not have prescribing rights • C=GP or cardiologist-led titration	• Significantly more intervention group patients reached maximum therapeutic β –blocker dosage (Intervention ratio=48%, Control ratio=36%; *P*=0.05) • Significantly fewer intervention group patients died (6 vs 21, *P*=0.007). However, grouping did not significantly predict mortality. • No significant differences in readmission rates

Driscoll et al., (2014) *** Australia	To examine the effect of specialist nurse-led titration of β -blocker medication on level of dosage after six months, time taken to reach maximal dosage, A-CM, QoL and service use.	• Single-centre RCT • N=25 (I=13, C=12) • Six-month FU	• I=specialist nurse-led titration in addition to "standard care". Nurses did not have prescribing rights • C=cardiologist-led titration ("standard care")	• Significantly more intervention group patients reached maximum therapeutic β –blocker dosage (Intervention ratio=91%, Control ratio = 31%; *P*=0.001). Optimal dose was also reached in half the time 90+/-14 vs 166+/-8 days (p<0.0005) • Significantly less worsening of depression for intervention patients (Cardiac Depression Scale mean differences: Intervention -1.8 ± 11.98 vs Control 17.85 ± 18.44 *P*=0.006) but no significant differences in QoL, admissions or A-CM
Jaarsma et al., (2008) * Netherlands	To examine the effects of moderate and intensive HF disease management programmes (DMP) on A-CM and service use	• Multi-centre RCT • N=1023 • (Basic I=340, Intensive I=344, C=339) • 18-month FU	• Basic I=nurse-led HF programme (in-patient, clinic and phone contact) with "standard care" • Intensive I=as above with home visits • C=cardiologist-led care ("standard care")	• No significant differences in all-cause mortality • Slightly more hospital admissions in Intensive I patients than control (134 vs 120); Incidence Rate Ratio=1.07 (*P*=0.62) • Median duration of hospital admissions was Basic I=8 days, Intensive I=9.5 days, and C=12 days. LoS was significantly different between Basic I and C (*P*=0.01)
Köberich et al., (2015) ** Germany	To evaluate the effects of a nurse-led HF education session on self-care behaviour, care dependency and QoL	• Single-centre RCT • N-110 (I=58, C=52) • Three-month FU	• I=specialist nurse-led in-patient education, phone follow-up and self-monitoring with "standard care" • C=physician-led care ("standard care")	• Greater improvements in intervention group self-care behaviour (European HF Self-Care Behaviour Scale F[1,108]=4.174, *P*=0.043), daily weighing (F[1,108]=14.1, *P*<0.001) and reporting weight changes (F[1,108]=4.2, *P*=0.044) compared to control • Greater improvement in intervention group QoL (Intervention Overall Score Difference=+8.99 *P*=0.001)
Lowery et al., (2012) *** USA	To evaluate the impact of a nurse practitioner-led DMP on service use, prescription changes and mortality	• Multi-centre quasi-exp. • N=969 (I=458, C=511) • One and two year FU	• I=nurse practitioner-led HF DMP with cardiologist support. NPs had prescribing rights • C=physician-led care (GP/Cardiologist)	• No significant differences in readmissions or LoS • Year 1: β –blocker (χ^2=6.029, *P*=0.014) and spironolactone (χ^2=5.534, *P*=0.019) prescribed significantly more in intervention group. Year 2: spironolactone (χ^2=7.689, *P*=0.026) and digoxin (χ^2=4.966, *P*=0.006) prescribed significantly more in intervention group • Significantly lower mortality in Intervention group than Control (Hazard ratio after two years=0.55 *P*<0.01)

Mulligan, (2008) ** UK	To evaluate the impact of a clinical nurse specialist (CNS)-led self-management intervention on service use, self-care, A-CM, mood and QoL	• Single-centre RCT • N=165 (I=85, C=80) • Six to eight week, 90 day and 12-month FU	• I=CNS-led self-management intervention with cardiologist support and "standard care" • C=cardiologist-led care	• No differences in admissions, LoS, mortality, mood or QoL • Intervention group significantly more likely to check weight at 6 weeks (χ^2 [df=1]=56.51, p<0.001) and 12 months (χ^2 [df=1]=17.67, p<0.001) and keep to fluid guidelines at 6 weeks (χ^2 [df=1]=6.80, p=0.009) • Newly diagnosed intervention patients (n=90) were less likely than controls to be readmitted for HF (Fisher's, *P*=0.01) or have a HF event (combined death or readmission, χ^2 [df=1]=6.307, *P*=0.01), and had a shorter LoS (Z=-2.545, *P*=0.01)
Ortiz-Bautista et al., (2018) *** Spain	To evaluate the impact of a specialist nurse-led DMP on service use, A-CM, medicines titration and QoL	• Single-centre RCT • N=127 (I=87, C=40) • Two-year FU	• I=specialist nurse-led HF DMP with "standard care" • C=cardiologist-led care ("standard care")	• No significant differences in A-CM or proportion of patients prescribed cardiac medicines • Intervention group had significantly lower readmission rates (Intervention = 18%, Control = 35%, *P*=0.04) and significantly better reported QoL (Intervention=10.9, Control=2.29, *P*=0.04)
Rhiantong et al., (2019) *** Thailand	To evaluate the impact of a continuing care programme led by advanced practice nurses (APN) on service use, functional status, QoL and patient satisfaction	• Single-centre quasi-exp. • N=71 (I=42, C=29) • Three-month FU	• I=APN-led discharge planning, transitional care and home monitoring with "standard care" • C=care without APN-led service ("standard care")	• No significant differences in readmissions although LoS was significantly lower in the intervention group (95% CI -3.49 to -0.91, *P*=0.001). • No significant differences in body weight changes at discharge or 3 months follow-up although functional status was significantly improved in the intervention group at 3 months (Odds Ratio=0.36; *P*=0.007). • Intervention group had significantly improved satisfaction (95% CI 2.01 to 7.09, *P*=0.001) and QoL (95% CI -14.45 to -3.43, *P*=0.001)
Sauer et al., (2010) ** Brazil	To compare specialist HF nurses' clinical assessments of congestion with those of cardiologists and correlate results with NT-ProBNP levels.	• Single-centre quasi-exp. • N=63 (26 assessments by both nurse and cardiologist)	• IA=specialist nurse diagnosis of HF severity • IB=cardiologist diagnosis • C=NT-ProBNP (Natriuretic Peptide monitoring)	• Significant correlations between nurse and cardiologist assessments (Spearman's Rank Correlation Co-efficient = 0.86, *P*<0.001) and with NT-ProBNP levels (Nurse SRCC=0.45, *P*<0.0001; Cardiologist SRCC=0.51, *P*<0.0001)

Key: *Low risk of bias, **Medium risk of bias, ***High risk of bias, ****I=intervention group, C=control group

Table 4 Outcome domains

Study Author and Date	Outcomes Measured	Theme Mapping				
		Mortality	Hospital Admissions and Length Of Stay	HF Diagnosis and Management	Quality Of Life and Patient Satisfaction	Self-Assessment and Self-Care
Bdeir et al. (2015)	All-cause mortality (A-CM)	X				
David et al. (2015)	Length of stay (LoS), Time of discharge, Readmissions		X			
de Souza *et al.* (2014)	A-CM, Hospital use, Prescriptions, HF knowledge, Self-care	X	X	X		X
Driscoll et al. (2011)	A-CM, Readmissions, Titration	X	X	X		
Driscoll et al. (2014)	A-CM, Readmissions, Titration, Quality of life (QoL), Mood	X	X	X	X	
Jaarsma et al. (2008)	A-CM, LoS, Readmissions	X	X			
Köberich et al. (2015)	QoL, Self-care				X	X
Lowery et al. (2012)	A-CM, Readmissions, Outpatient visits, Bed days, Titration	X	X	X		
Mulligan (2008)	A-CM, Readmissions, QoL, Mood, Self-care	X	X		X	X
Ortiz-Bautista et al. (2018)	A-CM, Time to first readmission, Titration, QoL	X	X	X	X	
Rhiantong et al. (2019)	LoS, Time to first readmission, Functional status, QoL, Satisfaction		X	X	X	
Sauer et al. (2010)	Diagnostic accuracy			X		

Table 5 Strength of evidence by outcome domain

Mortality	Hospital Admissions and Length Of Stay	HF Diagnosis and Management	Quality Of Life and Patient Satisfaction	Self-Assessment and Self-Care
Low Risk of Bias (n=2 studies)				
(2)	Readmissions (1) Length of stay (1)	Medicines use (1)		(1)
Medium Risk of Bias (n=3 studies)				
(1)	Readmissions (1) Length of stay (1)	Nurse/cardiologist assessment correlations (1)	QoL (1) QoL (1) Mood (1)	(2)
Sub-group analysis (newly diagnosed)				
(combined death or readmission)	Readmissions Length of stay			
High Risk of Bias (n=7 studies)				
(3)	Readmissions (4)	Medicines use (1)	QoL (1)	
(2)	Readmissions (2)	Medicines use (3)	QoL (1)	
	Length of stay (2)	Weight change (1)	Mood (1)	
	Length of stay (1)	Functional status (1)	Satisfaction (1)	

Key: No significant differences Significant differences (n) number of studies that report the finding