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Review

Quality of life assessment in heart failure interventions: a 10-year (1996–2005) review

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The increasing prevalence and poor prognosis associated with heart failure have prompted research to focus on improving quality of life (QoL) for heart failure patients. Research from 1996–2005 was systematically reviewed to identify randomized controlled trials that assessed QoL in heart failure. In 120 studies, 44 were medication trials; 19 surgical/procedural interventions; and 57 patient care/service delivery interventions. Studies were summarized in terms of aim, population, QoL measures used and QoL findings. Studies used 47 different measures of QoL-generic, health-related, condition-specific, domain-specific and utility measures. Most used a single QoL measure. In 87%, a condition specific QoL measure was used, with the Minnesota Living with Heart Failure Questionnaire the favoured assessment tool. The range of QoL measures in use poses challenges for development of cumulative knowledge. Although comparability across studies is important, this must be informed by the responsiveness of the instrument selected. As carried out in other cardiac groups, comparative evaluations of instrument responsiveness are needed in heart failure. *Eur J Cardiovasc Prev Rehabil* 00:000–000 © 2007 The European Society of Cardiology

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Introduction

Heart failure is associated with both high levels of mortality and high healthcare costs. For instance, it consumes an estimated 2–2.5% of the total health budget in the United Kingdom [1]. Given the poor prognosis of heart failure and the increasing complexity of management regimens, much recent emphasis has focused on maintaining or improving quality of life (QoL) for heart failure patients. Early studies showed that heart failure was associated with poorer QoL than other common chronic conditions such as diabetes and chronic lung disease [2]. Exponential growth has been seen in QoL research in heart failure over the past decade. This overall body of work has been reviewed on previous occasions, most recently in 1999 [3] with a 2006 review of nursing interventions in heart failure [4]. These reviews have outlined a range of descriptive cross-sectional and interventional studies. Owing to the many recent developments in therapeutic options, including patient care and service management approaches, and pharmacological and device innovations, many of the more recent QoL studies are randomized interventions. As randomized studies provide the most conclusive evidence, a review of such studies can help clarify and consolidate patterns of QoL findings from this active research area.

Defining QoL is a complex process that has been well documented elsewhere [5]. A basic assumption was that QoL assessment must be carried out by the patient him/herself, as studies have demonstrated that patient assessment does not correlate with physician assessment [6]. Otherwise, QoL definition and/or operationalization by study authors was accepted.

This paper thus reviewed randomized controlled trials which assessed QoL in heart failure interventions, either as a primary or secondary end point. The objective was to describe the aim of each study, the sampling and

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assessment time frames, the specific instruments used to assess QoL and the study's key QoL findings.

Methods

The review involved systematic searches of the following databases from January 1996 to December 2005: *MEDLINE*, *PsychINFO*, and *CINAHL*. *OVID* in process and other nonindexed citations for the period were also searched.

The search terms used were 'quality of life', 'heart failure', 'measure/measurement' and 'assess/assessment' combined in different ways to yield maximum results. Truncated terms were used as appropriate for each database. All terms were used as text words (i.e. words appearing in the title or abstract, key words or a database entry).

Inclusion/exclusion criteria

Papers were included in the review if the study was designed as a randomized controlled trial of heart failure patients; QoL was specifically stated to be a primary or secondary outcome; a self-report measure of QoL was used; and the study was published in English.

Results

A total of 233 studies were identified using the specified search terms. Of these, 120 met the defined selection criteria. Details of the QoL measures used in the studies are provided in Table 1. Measures were categorized according to whether their focus was generic (general QoL), health-related (health-related QoL), condition-specific (aspects of QoL relevant to particular health problems), domain-specific (particular component of QoL) or utility (the value of health or other interventions in terms of a combination of increased QoL and length of life) [5].

Eight studies used a generic QoL measure. The most frequently used measure was Cantril's 'Ladder of Life' (three studies) [27,60,61]. Health-related measures were used in 46 studies. In the majority (52%), the measure of choice was the 36-item Short-form Health Survey (SF-36) or some subscale(s) of the SF-36 (24 studies) [61–65,10,66–82]. In six studies, this was the only QoL measure used. The next most commonly used measure was the Sickness Impact Profile or a derivative (eight studies) [63,83,8,84–88].

One hundred and five (87%) studies used a condition-specific measure of QoL, with the majority favouring the Minnesota Living with Heart Failure Questionnaire (MLHF). This measure was used in 83 (69%) of all studies [61–64,66,68,71,74,78–82,85,88–115,34,116–155]. In 57 (47%) of studies, it was the only measure used. The next most commonly used condition-specific measures were the Chronic Heart Failure Questionnaire (six studies) [75,83,156–159] and the Quality of Life Index (four studies) [67,96,137,151].

Table 1 QoL measures used in randomized controlled studies of heart failure 1996–2005

Category	Measure	*N* of studies
Generic	Ladder of Life [7]	3
	Self-assessment of General Well-Being (SAGWB) [8]	2
	Scale of Life Satisfaction [9]	1
	0–100 Global QoL scale [10]	1
	Psychological General Well-Being Index (PGWB) [11]	1
Health-related	36-Item Short-Form Health Survey (SF-36) [12,13]	24
	Sickness Impact Profile (SIP) (also called Functional Limitations Profile) [14]	8
	Profile of Mood States (POMS) [15]	3
	Nottingham Health Profile (NHP) [16,17]	2
	Dartmouth COOP Functional Health Assessment Charts (COOP Charts) [18]	1
	The Psychological Adjustment to Illness Scale (PAIS) [19]	1
	Multidimensional Functional Assessment Questionnaire (OARS) [20]	1
	The Functional Status Questionnaire [21]	2
	Items to assess impact of illness on leisure and regular activities [22]	1
	Patients Global Assessment of Change in Quality of Life (PGACQoL) [23]	1
	General Health Questionnaire [24]	1
	Health status index derived from SIP scores [22]	1
Condition-specific	Minnesota Living With Heart Failure Questionnaire (MLHF) [25]	83
	Chronic Heart Failure Questionnaire (CHQ) [26]	6
	Signs and symptoms of heart failure questionnaire(s)/scale(s) [27–29]	3
	Quality of Life Index (QLI) [30]	4
	Kansas City Cardiomyopathy Questionnaire (KCCQ) [31]	1
	QoL profile for chronic diseases (PLC) [32]	1
	Heart Failure Functional Status Inventory [33]	1
	Specific Symptoms Scale [34,35]	1
	European Organisation for Research on Treatment of Cancer QLQ C-30 (EORTC QLQ-C30) [36]	1
	Subjective Symptoms Assessment Profile (SSA-P) [37]	1
	Customized – 16 items [38]	1
	Customized – breathlessness, fatigue, well-bring [39]	1
Domain-specific	Sense of Coherence Scale (SOC) [40]	3
	Yale Dyspnea–Fatigue Index [41]	1
	Hospital Anxiety and Depression Questionnaire (HADS) [42]	3
	Centre for Epidemiological Studies Depression Scale (CES–D) [43]	2
	Heart Patients Psychological Questionnaire (HPPQ) [44]	2
	Epworth Sleepiness Scale [45]	1
	Heart Failure Self-Efficacy Scale [46]	1
	Guyatt Respiratory Scale [47]	1
	The Transitional Dyspnea Index/Mahler Dyspnea–Fatigue Index [48]	2
	Philadelphia Geriatric Morale Score [49]	1
	Zung Self-rated Depression Scale [50]	1
	Geriatric Depression Scale [51,52]	1
	The Functional Assessment of Chronic Illness Therapy – Spiritual Well-being [53,54]	1
	Specific Activities Scale [55]	2
	Karolinska Scale (modified) [56]	1
	State Anxiety Inventory [57]	1
	State Anger Inventory [58]	1
Utility	EuroQoL quality of life measure (EQ–5D) [59]	6

A range of domain-specific measures was also used, the most frequently used was the Sense of Coherence scale (three studies) [84–86] and the Hospital Anxiety and Depression Scale (three studies) [83,151,160]. The EuroQoL quality of life measure, which combines information on the absolute and relative value of aspects of QoL, was the only utility-based measure of QoL used in the studies reviewed. It was used in combination with other measures in four studies [148,152,158,161] and alone in two studies [162,163].

Most studies used a single measure of QoL (76 studies; 63%) (see Appendix A* for a detailed breakdown of the combinations). Use of a single condition-specific measure was the favoured approach to QoL measurement, with the MLHF being used most frequently (76% of single measure studies). Where multiple measures were used, the most common combination consisted of a health-related measure and either a condition-specific or a domain-specific measure or both (23/43 studies). None of the studies encompassed measures from all five categories examined.

In addition to be being categorized according to the measure(s) used, studies were categorized according to type of trial – pharmacological, surgical/procedural and patient care and service management interventions.

Pharmacological trials

Of the 120 studies reviewed, 44 were medication trials (see Table 2). Almost three quarters (80%) of the 44 pharmacological trials used the MLHF. In most (29/32) it was the sole measure of QoL. A single measure of QoL was used in 32 trials.

Of the 44 pharmacological trials, 27 evaluated the effects of a medication compared with a placebo or usual care. Ten trials reported a QoL benefit of medication over placebo [72,90,92,93,96,99,100,124,155,162]. A partial effect was reported in two studies [61,113]. Fifteen reported no significant differences between medication and placebo [39,63,78,89,101,106,107,111,129,133,139, 141,146,149,165]. Four studies were terminated early, two because of a trend towards increased mortality in the treatment arm [112,158], one because of significantly increased survival in the treatment arm [125] and one for reasons not outlined [147].

A number of trials compared the impact of two or more medications on outcomes including QoL. In a comparison of torsemide and furosemide [98], QoL was significantly better in the torsemide group at one of three assessment points.

Candesartan was found to improve QoL significantly more than verapamil or placebo [103] and inotrope infusions (milrinone or dobutamine) improved QoL significantly when compared with placebo [102].

Studies comparing cilazapril and captopril [22], metoprolol and carvedilol [131], enalapril and losartan [140], captopril and spirapril [167] and captopril and lisinopril [28] found no difference in QoL scores between groups. Two studies [88,163] compared losartan and captopril and both found significant improvement in QoL within but not between groups. Treatment guided by plasma aminoterminal brain natriuretic peptide offered no QoL benefits over treatment guided by standard care [94,120].

Konstam and colleagues [164] examined QoL data from the SOLVD trial which compared enalapril with a placebo. Baseline assessment of QoL predicted mortality and heart failure-related hospitalizations in patients randomized to enalapril and placebo treatment.

Surgical/procedural trials

Of 120 studies reviewed, 19 were surgical/procedural trials (see Table 3). As with the pharmacological trials, the favoured measure of QoL was the MLHF, used in 78% of surgical/procedural trials (15/19). Most studies used a single measure of QoL (13/19).

Of the 19 interventions, 10 reported a positive impact of the procedure (or at least one procedure of those assessed) on the QoL score(s) of participants [10,64,75,76,91,97,104,105,115,122,123]. Two studies [97,105] were follow-ups on previously beneficial studies to assess whether benefits initially observed were sustained at 12 months. Two studies reported a partial impact on QoL (i.e. a positive impact at some but not all assessment time points) [116,122], whereas four reported no measurable change in QoL [95,108,109,159]. One study [10] evaluated the impact of three different physiologic sensors in permanent pacemakers on cardiovascular events and QoL, and found that patients who received one of the sensor types (blended) had significantly poorer SF-36 physical function scale scores than the other two groups.

Brignole and colleagues [168] completed a trial which involved two phases. In phase one, right ventricular and left ventricular pacing were compared. No significant difference between group QoL scores was found, although there was significant improvement within the two groups on all QoL measures from baseline to end point. In phase two, right ventricular and biventricular pacing were compared. Again there was significant improvement within the groups on all QoL measures from baseline to end point. A between group difference

*See supplementary data.

Table 2 Pharmacological ($N=44$)

Study	Aim of study	N[a]	NYHA class	Method/intervention	Time-Frame (weeks)[b]	QoL indicator	QoL findings[c]
Goldstein *et al.* [141]	To assess the tolerability, safety, and effect on left ventricular ejection fraction of metoprolol	60	III–IV	Metoprolol or placebo	26	MLHF	No significant difference in QoL
Hjalmarson *et al.* [139]	To assess the effects of metoprolol on mortality, hospitalization, symptoms, and QoL in patients with heart failure (subset from MERIT-HF Trial)	741	II–IV	Metoprolol or placebo	52	MLHF	No significant difference in QoL scores
RESOLVD Investigators [129]	To assess the effects of metoprolol	426	II–IV	Metoprolol or placebo	24	MLHF	Metoprolol did not affect QoL
Sanderson *et al.* [131]	To compare the long-term clinical efficacy of metoprolol versus carvedilol	51	II–IV	Metoprolol or carvedilol	12	MLHF	Both medications significantly improved symptoms ($P<0.001$). No significant difference in QoL scores
Agostoni *et al.* [155]	To assess the effects of β-blockers on ventilation	15	II–III	Carvedilol or placebo	26 (3 mths on each regimen)	MLHF	Carvedilol improved quality-of-life scores ($P<0.05$)
Bristow *et al.* [149]	To assess the efficacy and safety of carvedilol	345	II–IV	Carvedilol low, medium or high dose or placebo	26	MLHF	No significant changes in QoL scores between groups
Cohn *et al.* [147]	To assess the safety and efficacy of carvedilol	131	II–IV	Carvedilol or placebo	26	MLHF	Study terminated early. QoL had improved similarly in both groups
Colucci *et al.* [145]	To assess if carvedilol inhibits clinical progression in patients with mildly symptomatic heart failure owing to left ventricular systolic dysfunction	366	II–IV	Carvedilol or placebo	52	MLHF	No significant changes in QoL scores between groups
Packer *et al.* [133]	To assess the effects of carvedilol (The PRECISE Trial)	278	II–IV	Carvedilol or placebo	26	MLHF	Carvedilol therapy had little effect on indirect measures of patient benefit including quality-of-life scores
Konstam *et al.* [164]	To assess the independent relation of QoL to mortality and congestive heart failure-related hospitalizations in patients randomized to enalapril or placebo [Studies of Left Ventricular Dysfunction (SOLVD) Trial]	2465	I–IV	Enalapril or placebo	158 (mean follow-up)	The Functional Status Questionnaire; POMS; SF-36	Baseline assessment of QoL predicted mortality and heart failure-related hospitalizations in symptomatic and asymptomatic patients randomized to enalapril and placebo treatment. But other domains were stronger predictors
Guazzi *et al.* [140]	To assess losartan and enalapril in isolation or in combination	25	II–III	Enalapril + placebo, losartan + placebo, enalapril + losartan or the same preparations in a reverse order or placebo + placebo	8	MLHF	No significant difference in QoL between groups
van den Broek *et al.* [127]	To assess if duration of action of spirapril compared with captopril affects clinical efficacy	20	II–III	Captopril or spirapril	12	MLHF	No significant improvement in QoL between groups
Cowley *et al.* [88]	To compare QoL measures following losartan or captopril in elderly symptomatic heart failure patients	203	II–IV	Losartan or captopril	48	MLHF; SIP	Significant improvements in QoL from baseline for both groups ($P \leq 0.001$). Nonsignificant trend favouring losartan vs. captopril for composite QoL endpoint
Konstam *et al.* [163]	To compare the effect of losartan with captopril on mortality, morbidity and functional status of patients [ELITE II study] (QoL substudy)	1856	II–IV	Losartan or captopril	52	EQ-5D Visual Analogue Scale	QoL improved in both groups ($P<0.001$) but did not differ between groups over time
Bulpitt *et al.* [22]	To compare QoL effects of cilazapril or captopril in patients with mild to moderate heart failure	367	II–IV	Cilazapril or captopril daily for 24 weeks, or placebo for 12 weeks followed by cilazapril for 12 weeks	24	SIP; POMS; Dyspnea-Fatigue Index; a health status index derived from SIP scores; items to assess impact of ill-	Nonsignificant trend towards improved QoL on ACE inhibitors vs. placebo

Study	Aim of study	N[a]	NYHA class	Method/intervention	Time-Frame (weeks)[b]	QoL indicator	QoL findings[c]
						health on regular and leisure activities	
Morisco *et al.* [28]	To compare the efficacy, safety, and tolerability of lisinopril with captopril in elderly patients	251	II–III	Lisinopril or captopril	12	Signs and symptoms of heart failure	Similar improvement in both groups
Larsen *et al.* [165]	To assess adaptive changes in acute haemodynamic response to inhibitors of angiotensin-converting enzyme	135	II–III	Cilazapril 0.5 mg, 1.0 mg or 2.5 mg or placebo	12	Questionnaire based on symptoms state, general well-being and daily activities	The QoL assessment remained unchanged or improved in the majority of patients
Watson *et al.* [89]	To assess the effect of coenzyme Q on echocardiographic and haemodynamic indexes of left ventricular ejection fraction and on QoL in patients with chronic left ventricular systolic dysfunction	30	NS	Coenzyme Q or placebo	12	MLHF	No significant difference in QoL with coenzyme Q
Cohn *et al.* [113]	To assess the effect of vesnarinone on mortality and morbidity in severe heart failure	833	III–IV	Vesnarinone 30 mg or 60 mg or placebo	26	MLHF	Significantly greater increase in QoL in 60-mg vesnarinone group vs. placebo group at 8 weeks ($P<0.001$) and at 16 weeks ($P=0.003$).Similar but not significant trends in QoL in the 30-mg vesnarinone group
Dorszewski *et al.* [112]	To assess the effects of urapidil combined therapy on QoL, exercise tolerance and haemodynamic parameters	36	III–IV	Urapidil or placebo	12	MLHF	Study terminated early. A trend towards increased mortality in urapidil group was observed
Hutcheon *et al.* [78]	To assess the effects of perindopril on 6-min walking distance and QoL in very old patients with left ventricular systolic dysfunction	66	I–IV	Perindopril or placebo	10	MLHF; SF-36	No significant improvement in QoL
Keith *et al.* [107]	To assess whether vitamin E supplementation modifies oxidative stress in patients with advanced heart failure.	56	III–IV	Vitamin E or placebo	12	MLHF	No significant difference in QoL between groups.
Lader *et al.* [61]	To assess the effect of digoxin therapy on QoL [QoL substudy of the Digitalis Investigation Group (DIG) trial]	589	I–IV	Digoxin or placebo	52	SF-36; Ladder of Life; CES-D; State Anxiety Inventory; State Anger Inventory; MLHF	Perceived health was improved in digoxin group at 4 months ($P=0.0057$). No significant differences at 52 weeks
Levine *et al.* [106]	To assess the effect of mibefradil on morbidity and mortality congestive heart failure	327	II–IV	Mibefradil or placebo	52	MLHF	QoL virtually unchanged in both groups
Lubsen *et al.* [101]	To assess the effect of pimobenda on exercise capacity (PICO trial)	317	II–III	Pimobendan or placebo	24	MLHF	No significant effects over time or difference in QoL across groups
Mancini *et al.* [99]	To assess the effect of erythropoietin (EPO) on exercise performance in anaemic heart failure patients.	26	III–IV	EPO or placebo	12	MLHF	QoL decreased in control group and increased in the treatment group
Majani *et al.* [100]	To assess the effect of valsartan on QoL - Valsartan Heart Failure Trial (Val-HeFT)	3010	IV	Valsartan or placebo	156	MLHF	Significant effect of Valsartan on overall MLHF score ($P=0.005$). Placebo group slowed as the trial progressed
Newby *et al.* [166]	To assess the effect of candoxatril on exercise capacity, clinical status and QoL in patients receiving angiotensin-converting enzyme inhibition	110	I–III	Candoxatril or placebo	12	Questionnaire assessing breathlessness, fatigue and well-being	No significant changes in QoL scores between groups
Omran *et al.* [72]	To compare the effectiveness of oral D-ribose supplementation on cardiac haemodynamics and QoL in patients with chronic coronary artery disease and heart failure	15	II–III	D-ribose or placebo	7	SF-36	D-ribose demonstrated a significant improvement in QoL ($P \leq 0.01$)

Study	Aim of study	*N*[a]	NYHA class	Method/intervention	Time-Frame (weeks)[b]	QoL indicator	QoL findings[c]
Udelson *et al.* [63]	To assess the effect of amlodipine as adjunctive therapy	437	II–IV	Amlodipine or placebo	12	MLHF; SF-36; SIP (subscale)	Amlodipine did not affect QoL
Webster *et al.* [93]	To investigate whether sildenafil is safe and effective for erectile dysfunction	35	II–III	Sildenafil or placebo	12	MLHF	MLHF index improved with sildenafil ($P=0.02$)
Zeng, Zeng and Li [90]	To assess the efficacy and safety of berberine	156	II–IV	Berberine or placebo	8 (treatment) 104 (mean follow-up)	Dyspnea-Fatigue Index; MLHF	Significant difference in the aggregate score on the index and MLHF after 8 weeks of treatment ($P<0.02$)
Elkayam *et al.* [111]	To assess the effect of organic nitrates in patients treated with angiotensin-converting enzyme inhibitiors	29	II–III	Transdermal nitroglycerin or placebo	12	MLHF	No significant differences changes in QoL
Lee *et al.* [124]	To assess the effect of perhexiline	56	II–III	Perhexiline or placebo	8	MLHF	Significantly improved MLHF scores with Perhexiline ($P=0.04$). No change in control MLHF scores
Little *et al.* [103]	To compare candesartan and verapamil	21 7	III–IV	Candesartan, verapamil or placebo	6	MLHF	Significant improvement in QoL with candesartan ($P<0.05$) but not with verapamil
Witte et al [162]	To access the effect of micronutrient supplementation on QoL and left ventricular function in elderly patients	30	NS	Micronutrient supplement or placebo	39	EQ-5D	Significant effect of micronutrients on QoL ($P<0.05$), decrease in QoL of placebo patients ($P=0.23$)
Lopez-Candales *et al.* [102]	To assess the safety and efficacy of outpatient inotrope infusions in intractable heart failure	29	III–IV	Intravenous milrinone, dobutamine or placebo	12	MLHF	Significant improvement in QoL ($P<0.00001$) with inotrope infusions
Noe *et al.* [98]	To assess the effect of torsemide and furosemide	240	II–III	Torsemide or furosemide	26	MLHF	QoL significantly better for torsemide group at month 4 ($P=0.017$), but not at month 2 ($P=0.059$) or month 6 ($P=0.269$)
Taylor *et al.* [125]	To assess the effect of fixed-dose combination isosorbide dinitrate-hydralazine (ISND-HYD) in an African-American population with advanced heart failure	1050	III–IV	Fixed-dose ISDN-HYD or placebo		MLHF	Terminated early as a result of significantly increased survival in the treatment arm ($P=0.02$)
Califf *et al.* [158]	To assess the effect of epoprostenol [The Flolan International Randomized Survival Trial (FIRST)]	471	III–IV	Epoprostenol infusion or usual care	Terminated early	Signs and symptoms questionnaire; EQ-5D; CHQ; NHP	Study terminated early. Strong trend toward decreased survival on epoprostenol
Yancy *et al.* [92]	To assess the safety and feasibility of serial infusions of nesiritide (from the FUSION I trial)	210	III–IV	Weekly infusions of nesiritide or usual care	12	MLHF	Significant improvement in QoL between groups at 4, 8 and 12 weeks
Prasun *et al.* [96]	To assess the effect of a patient-directed flexible diuretic protocol	66	II–IV	Flexible diuretic titration (DT) or usual care	12	MLHF; QLI	Significant increase in DT total QOL score ($P=0.001$) only
Troughton *et al.* [94]	To assess the treatment of heart failure guided by plasma aminoterminal brain natriuretic peptide (*N*-BNP) concentrations	69	II–IV	Treatment guided by either plasma N-BNP concentration or standard care	26–41.2 (follow-up)	MLHF	No significant difference in QoL
Beck–da–Silva [120]	To compare brain natriuretic peptide (BNP) guided therapy and expert clinical assessment	41	II–IV	Bisoprolol increased according to BNP levels or according to clinical assessment	13	MLHF	QoL improved in both groups. Non-significant trend towards greater improvement in the BNP group

CES-D, Centre for Epidemiological Studies Depression Scale; CHQ, Chronic Heart Failure Questionnaire; EQ-5D, EuroQoL Quality of Life measure; MLHF, Minnesota Living with Heart Failure Questionnaire; NHP, Nottingham Health Profile; PGWB, Psychological General Well-Being Index; POMS, Profile of Mood States; QLI, Quality of Life Index; SF-36, Medical Outcomes 36-Item Short-Form General Health Survey; SIP, Sickness Impact Profile. [a]Reported as presented in paper (in some cases this is number recruited, in some the number completing the study). [b]Reported as presented in paper (in some cases run-in period is included). [c]*P* values provided where reported.

Table 3 Surgical/procedural (*N*=19)

Study	Aim of study	*N*[a]	NYHA Class	Method/intervention	Time-Frame (weeks)[b]	QoL indicator	QoL findings[d]
Auricchio *et al.* [122]	To assess the clinical efficacy of single-site left ventricular pacing and determine the impact of baseline conduction delay severity on the magnitude of benefit	86	II–IV	Long QRS or short QRS compared during a 3-month period of active pacing and a 3-month period of inactive pacing	52	MLHF	Significant improvement in QoL in long QRS group ($P=0.004$)
Auricchio *et al.* [121]	To compare the short-term and long-term effects of atrial synchronous preexcitation of one or both ventricles	41	III–IV	4 weeks of treatment with biventricular or univentricular stimulation, followed by 4 weeks without treatment, and then 4 weeks of treatment with the opposite stimulation.	26	MLHF	Significant QoL improvement after treatment ($P<0.001$). No change after following no training period. Nonsignificant increase in QoL after second treatment period
Brignole *et al.* [168]	To compare right ventricular (RV) vs. left ventricular (LV) pacing and RV vs. biventricular (BiV) pacing	56	I–III	3-month crossover comparison between RV and LV and between RV and BiV	12	MLHF; Specific Symptoms Scale; modified Karolinska Scale	RV and LV: no difference between groups, significant improvement in both groups on all measures from baseline to end point RV and BiV: significant difference between groups on Karolinska scores only, significant improvement in both groups on all measures from baseline to end point
Cazeau *et al.* [115]	To assess the effect of multisite biventricular pacing in heart failure with intraventricular conduction delay	67	III	3-month period of inactive pacing and a 3-month period of active pacing	30	MLHF	QoL score improved significantly with active pacing ($P<0.001$)
Lamas *et al.* [76]	To compare dual-chamber and single-chamber pacing	2010	I+	Dual-chamber pacing or ventricular pacing	260	SF-36; Specific Activity Scale	Significant improvement from baseline to 48 months on both SF-36 summary scores. No in specific activity scale scores
Linde *et al.* [105]	To assess the impact of biventricular pacing on QoL [MUltisite STimulation In Cardiomyopathy (MUSTIC) Trial]	131	III	Comparison of biventricular pacing and inactive pacing (patients in sinus rhythm) or biventricular pacing and right univentricular inhibited pacing (VVIR)	52	MLHF	Improved QoL with biventricular pacing
Linde *et al.* [104]	To assess whether the benefits of BiV pacing observed during the crossover phase of the MUSTIC trial were sustained over 12 months	131	III		52	MLHF	Significant improvement in QoL in SR group ($P=0.0001$) and AF group ($P=0.002$)
Aranda *et al.* [123]	To assess whether patients who have conduction abnormalities other than left bundle-branch block (LBBB) respond favourably to cardiac resynchronization therapy (CRT) [MultiCentre InSync Randomized Clinical Evaluation (MIRACLE)]	394	III–IV	LBBB or right bundle-branch block (RBBB) or interventricular conduction delay (IVCD)	26	MLHF	Significant improvement QoL with CRT for patients with IVCD only ($P=0.038$)
Higgins *et al.* [108]	To assess the safety and effectiveness of CRT combined with an implantable cardiac defibrillator (ICD)	490	II–IV	CRT/ICD or control	Up to 26	MLHF	No significant improvement in QoL
Young *et al.* [91]	To assess the efficacy and safety of combined CRT and ICD therapy in patients with congestive heart failure on optimal therapy (MIRACLE)	369	III–IV	ICD activated, CRT on or ICD activated, CRT off (control)	26	MLHF	Significant improvement in QoL with CRT ($P=0.02$)

Study	Aim of study	*N*[a]	NYHA Class	Method/intervention	Time-Frame (weeks)[b]	QoL indicator	QoL findings[d]
Calvert et al [148]	To assess the QoL of patients from the CArdiac REsynchronicsation in Heart Failure (CARE-HF) STUDY	813	III–IV	Cardiac resynchronization or control (check)	QoL assessed at 13 & will be assed at 78	MLHF; EQ-5D	Results demonstrated an association between EQ-5D and MLHF scores
Mansfield *et al.* [75]	To compare the effect of obstructive sleep apnea (OSA) treatment with nocturnal continuous positive airway pressure (CPAP)	55	II–IV	CPAP or control	12	CHQ; SF-36; Epworth Sleepiness Scale	Significant improvement in four SF-36 subscales; three domains of the CHQ and Epworth Sleepiness Scale score in with CPAP compared with control
Bradley *et al.* [159]	To evaluate the effects of continuous positive airway pressure (CPAP) in patients with central sleep apnea and heart failure	258	II–IV	CPAP or control	QoL Assessments at 12, 26 and 104	CHQ	No significant difference in QoL between groups
Park *et al.* [97]	To assess the effect of a left ventricular assist device (LVAD) on survival and QoL and to determine outcome improvement [extended follow-up of The Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure (REMATCH) Trial]	129	IV	LVAD therapy or optimal medical management (OMM)	52 & 104 follow-up	MLHF	MLHF scores were significantly better for LVAD ($P=0.007$)
Stevenson *et al.* [64]	To assess outcomes in patients undergoing inotropic infusions assigned to LVAD or optimal medical management (OMM) [REMATCH]	129	IV	LVAD or OMM	52	MLHF; SF-36 (physical function and emotional role subscales)	After LVAD, QoL scores for survivors improved
Torre-Amione, *et al.* [95]	To assess the effect of an immune modulation therapy	75	III–IV	Immune modulation therapy or placebo	26	MLHF	Nonsignificant trend toward improvement in QoL with treatment
Shukla *et al.* [10]	To compare the impact of three different physiologic sensors in permanent pacemakers on cardiovascular events and QoL [The Mode Selection Trial (MOST)]	1245	III–IV	Pacemaker with accelerometer, piezoelectric crystals or blended sensors	208	SF-36; Specific activities scale; 0–100 global QoL scale	Significantly poorer physical function with blended sensors ($P<0.01$)
Gilligan *et al.* [109]	To assess whether 'optimal' AV delay results in a symptomatic and functional benefit greater than that provided by the device's normal AV delay	17	II–III	'Optimum' AV delay or control	12	MLHF	No significant improvement in QoL
Binanay *et al.* [169]	To assess the effect of pulmonary artery catheterization [ESCAPE trial]	433	NS	Therapy guided by clinical assessment and Pulmonary artery catheters (PACs) or clinical assessment alone	26	MLHF	MLHF scores improved in both groups at 1 month, greater improvement with PAC. At 6 months clinical assessment scores improved to match PAC scores.

CHQ, Chronic Heart Failure Questionnaire; MLHF, Minnesota Living with Heart Failure Questionnaire; NYHA, New York Heart Association; SF-36, Medical Outcomes 36-Item Short-Form General Health Survey. [a]Reported as presented in paper (in some cases this is number recruited, in some the number completing the study). [b]Reported as presented in paper (in some cases run-in period is included). [c]*P* values provided where reported.

Table 4 Patient Care and Service Management Interventions ($N=57$)

Study	Aim of study	*N*	NYHA class	Method/intervention	Time-frame (weeks)[a]	QoL indicator	QoL findings[b]
Exercise/cardiac rehabilitation interventions							
Belardinelli *et al.* [119]	To assess the effect on functional capacity, QoL, and clinical outcome of exercise training (ET)	99	II–IV	Exercise or control	61	MLHF	Significant improvement in MLHF at 2 months with training ($P=0.001$). Improvement remained stable after 12 months and during follow-up
Beniaminovitz *et al.* [117]	To compare the effects of exercise training and relaxation techniques in patients with moderate to severe heart failure	29	NS	Isolated lower-limb training or learned guided imagery relaxation technique (control)	12	MLHF; Guyatt Respiratory Scale; The Transitional Dyspnea Index	Significant improvement in all QoL scores with training (all $P<0.05$)
Gary *et al.* [110]	To compare the effect of education only with education and exercise in older women with diastolic heart failure	32	II–III	Home-based, low-to-moderate intensity exercise and education programme or education only programme (control)	12	MLHF; Geriatric Depression Scale	Significant improvement in QoL in intervention and control groups ($P=0.002$; $P=00.24$, respectively). Significantly greater improvement with intervention compared with control
Giannuzzi *et al.* [29]	To assess the effect of exercise training on LV remodelling in chronic heart failure [The Exercise in Left Ventricular Dysfunction and Chronic Heart Failure (ELVD-CHF) Trial]	90	II–III	Training or control	26	Modified likert symptom questionnaires	Significant improvement in QoL with training ($P<0.01$) compared with control
Gottlieb *et al.* [81]	To assess the effect of exercise training on peak performance and QoL in elderly patients	33	II–III	Exercise or control	26	MLHF; SF-36; Functional Status Questionnaire; CES-D	No significant improvement in QoL
Johnson *et al.* [170]	To assess the effect of a domiciliary inspiratory muscle training on exercise tolerance and QoL	18	II–III	Training group or control group	8	16-item questionnaire	No significant improvement in QoL
Keteyian *et al.* [138]	To assess the effect of exercise training on chronotropic incompetence	51 men	II–III	Exercise training or control	24	MLHF	No significant improvement in QoL.
Koukouvou *et al.* [137]	To assess the physiological and psychosocial effects of exercise training	26 men	II–III	Exercise or control	26	MLHF; QLI; Scale of Life Satisfaction	Trained patients demonstrated a significant improvement in QoL
Nuhr *et al.* [135]	To assess the effect of chronic low-frequency electrical stimulation (CLFS) of thigh muscles on muscle performance and QoL	32	II–IV	CLFS or control	10	MLHF (German)	Significant improvement in QoL in the CLFS group compared with control ($P<0.001$)
Oka *et al.* [156]	To assess the effect of a home-based combined walking and resistance exercise program on symptoms and QOL	40 women	II–III	Exercise programme or usual care	12	CHQ	Exercisers reported improvement in fatigue ($P=0.02$), emotional functioning ($P=0.01$) and sense of mastery ($P=0.04$)
Owen and Croucher [134]	To assess the effect of an exercise programme on older heart failure patients	22	I–IV	Exercise or control	12	MLHF	No significant improvement in MLHF scores
Parnell *et al.* [132]	To assess the effect of an exercise training programme on arterial mechanical properties, LV performance and QoL	21	II–III	Training or control	8	MLHF	Significantly improved QoL following the exercise training programme ($P=0.01$)
Pozehl *et al.* [71]	To assess the adjunctive effect of an exercise training intervention vs. standard pharmacologic therapy	23	II–IV	Exercise or usual care	12	SF-36; POMS; MLHF	Significantly higher role function ($P<0.05$), role emotional ($P<0.001$) and mental functioning ($P<0.01$) and significantly better scores on POMS confusion/bewilderment subscale with training. No significant difference in MLHF
Quittan *et al.* [69]	To assess the effect of a programme of neuromuscular stimulation of thigh muscles on strength and cross-sec-	42	II–1V	Stimulation or control group	8	SF-36	Significantly improvement on SF-36 physical functioning, emotional role and social functioning subscales (all

Study	Aim of study	*N*	NYHA class	Method/intervention	Time-frame (weeks)[a]	QoL indicator	QoL findings[b]
	tional area in patients with refractory heart failure listed for transplantation						$P<0.05$). No change in QoL in controls
Quittan *et al.* [70]	To assess the effect of an exercise programme on QoL in patients with severe chronic heart failure	27	II–III	Training or control	12	SF-36 (German)	QoL improved significantly in the domains of vitality ($P=0.0001$), physical role fulfilment ($P=0.001$), physical ($P=0.02$) and social ($P=0.0002$) functioning with training
Tyni-Lenne *et al.* [84]	To compare the effect of endurance training with knee extensor muscles on exercise tolerance and QoL	21 men	II–III	Two leg training, one leg training or control	8	SIP; SOC	Training improved overall QoL ($P<0.05$). Compared with the control group, the improvement was more pronounced in the two-leg training group (P 0.02–0.005) as compared with the one-leg training group (NS). No change in SOC scores
Tyni-Lenne *et al.* [85]	To compare exercise training on a cycle ergometer; aerobic knee-extensor training and usual care in previously trained patients	24	II–III	Cycle ergometer or knee-extensor training or control	8	MLHF; SIP; SOC	Significant improvement in MLHF scores ($P<0.05$) only after knee-extensor training. Three of the four assessed SIP scales also showed a nonsignificant trend toward improvement after training. SOC remained stable.
Tyni-Lenne *et al.* [86]	To assess the effect of skeletal muscle endurance training in women with chronic congestive heart failure secondary to either ischemic or idiopathic dilated cardiomyopathy	16 women	II–III	Crossover trial with 8 weeks of knee extensor training and 8 weeks of nontraining.	16 (excluding run-in)	SIP; SOC	Improvement on overall ($P<0.01$) and psychosocial ($P<0.03$) QoL with training. No change in SOC
van den Berg-Emons *et al.* [128]	To assess if aerobic training leads to a more active lifestyle and improved QoL	34	II–III	Training or control group	12	MLHF (Dutch)	Slight but not significant improvement in QoL in the training group
Wielenga *et al.* [8]	To assess the effect of exercise training on QoL	67	II–III	Training or control	12	SIP; SAGWB; HPPQ	Significantly lower scores on Feelings of Being Disabled (HPPQ subscale) in the training group compared with control ($P=0.042$). Significantly higher SAGWB scores after training ($P<0.0000$) were observed after training
Wielenga *et al.* [171]	To assess the safety and efficacy of physical training [result of the Chronic Heart Failure and Graded Exercise study (CHANGE)]	80	II–III	Endurance (levels A, B and C) training or control	12	SAGWB; HPPQ	Nonsignificant difference between changes in scores on 'feelings of being disabled' subscale in the groups ($P=0.06$). Within the training group, the difference between levels was significant in relation to this subscale ($P<0.01$). Patient overall assessment of general well-being was significantly improved in both groups ($P<0.0001$). Improvement in patients assessment of QoL in both groups ($P<0.0001$)
Willenheimer *et al.* [172]	To assess if post-training effects on physical function and QoL are sustained	54	NS	Exercise programme or control	43	PGACQoL	No significant improvement in QoL
Witham *et al.* [83]	To assess the effect of a seated exercise programme on physical function and health status in frail patients with heart failure	82	II–III	Gentle, seated exercise program or usual care	26	CHQ; HADS; Philadelphia Geriatric Morale Score; the modified Functional Limitations Profile (UK version of SIP)	No significant improvement in QoL
Belardinelli *et al.* [118]	To assess the effect of exercise training on sexual dysfunction in patients with heart failure	59	II–III	Exercise or control	8	MLHF	QoL improvised significantly with training, compared with control ($P<0.001$)

Study	Aim of study	*N*	NYHA class	Method/intervention	Time-frame (weeks)[a]	QoL indicator	QoL findings[b]
Austin *et al.* [152]	To assess the impact of a cardiac rehabilitation programme	200	II–III	Cardiac rehabilitation programme or usual care	24	MLHF; EQ-5D	Significant improvement in MLHF and EuroQoL between groups ($P<0.001$)
Klocek *et al.* [173]	To assess the effect of physical training on oxygen consumption and QoL	42	II–III	Constant workload or progressive/increasing workload or control	26	PGWB; SSA-P	Significant improvement in PGWB scores in the intervention groups ($P<0.01$). Significant Improvement in 4/6 (constant workload), 5/6 (progressive workload) and 2/6 SSA-P dimensions.
Collins *et al.* [82]	To assess the effect of a cardiac rehabilitation programme	31 men	I–III	Moderate intensity supervised aerobic exercise program or control	12	MLHF; SF-36	Significant improvement in perceived physical function ($P=0.025$) after exercise. No significant difference in MLHF scores between groups
Service delivery interventions							
Artinian *et al.* [154]	To assess the effect of a self-care and medication compliance device, linked to a web-based monitoring system	18	II–III	Compliance device and usual care or usual care	12	MLHF	Significantly more improvement in QoL after monitoring ($P=0.006$)
Atienza *et al.* [153]	To assess the effect of a discharge and outpatient management programme for hospitalized patients	338	III–IV	Comprehensive discharge planning and close follow-up or usual care	52	MLHF	QoL improved in both groups but improvement was significantly greater for intervention compared with control ($P=0.01$)
Ducharme *et al.* [174]	To assess the effect of a multidisciplinary heart failure clinic	230	II–IV	Follow-up at multidisciplinary specialized out-patient clinic or usual care	26	MLHF	Significant improvement in emotional and physical QoL scores in the intervention group compared to control ($P<0.001$)
Ojeda *et al.* [126]	To assess whether the benefits of a discharge planning intervention were sustained 12 months after the end of the study	153	II–IV	Discharge planning or usual care	52 weeks after study end	MLHF	QoL benefits reported at end of study not present at follow-up
Benatar *et al.* [151]	To compare the effect of care delivered by home nurse visit (HNV) and nurse telemanagement (NTM)	216	III–IV	HNV or NTM	12	MLHF; QLI-Cardiac version; HADS; Heart Failure Self-efficacy Scale	Significant improvement in QoL and self-efficacy in both groups ($P<0.01$). Non significant trend toward more QoL improvement with NTM compared with HNV
Bouvy *et al.* [150]	To assess the effect of a pharmacist-led intervention on medication adherence in patients with heart failure	152	I–IV	Intervention or usual care	26	MLHF; COOP WONCA CHARTS	Disease-specific QoL improved in both groups. Non significant trend towards more improvement with usual care. Generic QoL improved with usual care and worsened with intervention
De Lusignan *et al.* [157]	To assess the effect of home telemonitoring	20	I–IV	Telemedicine or control	52 (initially 13 mths)	General Health Questionnaire; CHQ	No significant differences in QoL
Sadik *et al.* [68]	To assess the effect of a pharmacist-led pharmaceutical care programme	208	I–IV	Structured pharmaceutical care programme or usual care	Assessment every 13 weeks for 52 weeks	MLHF; SF-36	Significantly improved MLHF and some SF-36 subscale scores with intervention compared to control ($P<0.05$)
Feldman *et al.* [143]	To assess the effect of a home health intervention designed to standardize nursing care, strengthen nurses' support for patient self-management and yield better CHF patient outcomes.	371	NS	Evidence-based nursing protocol, patient self-care guide and training to improve nurses' teaching and support skills or control	13	MLHF	No significant differences in QoL
Feldman *et al.* [161]	To compare the impact and cost-effectiveness of two information-based provider reminder interventions designed to improve self-care management and outcomes	628	NS	E-mail to the patient's nurse highlighting 6 HF-specific clinical recommendations (basic) or initial nurse reminder with additional clinician and patient resources (augmented) or usual care	6.4	KCCQ; EQ-5D	Improved QoL (KCCQ) with both interventions compared to usual care ($P \leq 0.05$). Basic intervention also yielded a higher EuroQoL score relative to usual care ($P \leq 0.05$).

Study	Aim of study	*N*	NYHA class	Method/intervention	Time-frame (weeks)[a]	QoL indicator	QoL findings[b]
GESICA Investigators [175]	To assess the effect of a centralized telephone intervention on death or hospital admission rates	1518	I–IV	Counselling and monitoring by nurses through frequent telephone follow-up or usual care	26 (min)	MLHF	Significantly better QoL after intervention ($P=0.001$)
Harrison *et al.* [79]	To assess the effect of transitional care on QoL, rates of readmission and emergency room use for hospitalized patients			Intervention focused on the transition from hospital-to-home and supportive care for self-management 2 weeks after hospital discharge	12	MLHF; SF-36	Significantly better MLHF scores at 6 wks ($P=0.002$) and 12 wks ($P=0.001$) after discharge with transitional care. No between group differences on SF-36 scores
Jaarsma *et al.* [27]	To assess the effect of a supportive educational nursing intervention on self-care abilities, self-care behavior, and QoL of patients with advanced HF	179	III–IV	Systematic education and nursing support in hospital and at home or usual care	39	Heart Failure Functional Status Inventory; Symptom questionnaire; PAIS; Ladder of life	No significant improvement in QoL
LaFramboise *et al.* [77]	To compare a heart failure disease management programme through an in-home telehealth communication device (Health Buddy) with traditional home management strategies	90	NS	Same educational content delivered differently to each group-telephonic, home visit, health buddy and home visit/health buddy groups.	8.5	SF-36	No significant differences in QoL
Martensson *et al.* [74]	To assess the effect of a nurse-led intervention to improve self-management	153	III-IV	Patient and family education and monthly telephone follow-up or control	52	MLHF; SF-36; Zung self rated depression scale	Significant improvement at 3 mths in SF-36 role function with intervention ($P=0.008$). This improvement did not persist at 12 mths. No other improvements, control group QoL deteriorated significantly on a number of SF-36 dimensions. Significant difference in moderate and severe depression from baseline to 3 mths ($P=0.023$) with patients in the intervention group having significantly less depression. AT 12 mth follow-up there was no difference between groups.
Mejhert *et al.* [176]	To assess the effect of a nurse based outpatient management programme for elderly patients	208	II–IV	Follow-up within the management programme or usual follow-up	78	NHP	No significant improvement in QoL.
Naylor *et al.* [136]	To assess the effect of a transitional care intervention delivered by advanced practice nurses (APNs) to older hospitalized heart failure patients	239	NS	APN-directed discharge planning and home follow-up protocol or control	52	MLHF	Short-term improvements in overall QoL (12 weeks, $P<0.05$), physical dimension of QoL (2 weeks, $P<0.01$; 12 weeks, $P<0.05$) and patient satisfaction (2 and 6 weeks, $P<0.001$) with intervention only
Noel *et al.* [98]	To assess the effect of home telehealth on healthcare costs and QoL for elderly high resource users with complex comorbidities	104	NS	Home telehealth or control	52	OARS Multidimensional Functional Assessment (cognitive status, functional level, patient satisfaction and self-rated health)	The intervention group showed improved cognitive status at 12 months ($P<0.028$). Patient satisfaction scores improved significantly in the control group at 3 months ($P<0.001$) and 6 months ($P<0.004$) compared with the interventions group ($P<0.0001$)
Oddone *et al.* [73]	To assess the effect of enhanced access to primary care on diagnostic evaluation, pharmacologic management and health outcomes in hospitalized patients	443	I–IV	Enhanced access to primary care or usual care	26	SF-36	No significant differences in QoL. Hospital readmissions increased with intervention.
Philbin *et al.* [60]	To assess the effect of a regional, multi-hospital, collaborative quality improvement intervention on care and outcomes	1504	Mean 3.3	Hospital Quality improvement intervention or usual care	26	Ladder of Life	No significant improvement in QoL

Study	Aim of study	*N*	NYHA class	Method/intervention	Time-frame (weeks)[a]	QoL indicator	QoL findings[b]
Scott *et al.* [67]	To assess the effect of mutual goal setting and supportive-educative nursing interventions on mental health and QoL	88	NS	Supportive/educative intervention or mutual goal setting intervention or control	26	QLI; SF-36 (MHI-5 subscale only)	Significant improvement in QoL with both interventions ($P=0.006$; $P=0.000$). Significantly higher QoL scores in goal setting intervention group ($P=0.01$). No change in control group
Sethares and Elliott [130]	To assess the effect of a tailored message intervention on heart failure readmission rates, QoL, and health beliefs	70	NS	Tailored message during hospitalization, one week and 1 month after discharge or control	5	MLHF	No significant difference in QoL
Gwadry–Sridhar *et al.* [80]	To assess the effect of an educational intervention in hospitalized heart failure patients	134	NS	In hospital educational intervention delivered by a multidisciplinary team or usual care	QoL assessed every 13 for 52	MLHF; SF-36	QoL improved in both groups over time. The only between group difference favoured the intervention (MLHF scores) ($P=0.04$)
Shively *et al.* [66]	To assess the effect of behavioural management	116	I–III	Behavioural management program or usual care	69	MLHF; SF-36	Significantly improved MLHF physical dimension scores over time compared with intervention ($P=0.009$)
Smith *et al.* [65]	To assess the effect of disease management on QoL	1069	I–IV	Disease management or augmented disease management or control	78 (follow-up)	SF-36	No effect of disease management observed across any of the SF-36 components
Varma *et al.* [62]	To assess the effect of a structured pharmaceutical care programme for elderly patients on disease control, QoL, and use of healthcare facilities	83	I–IV	Education from a pharmacist or usual care	52	MLHF; SF-36	Significantly better MLHF scores at 9 months ($P=0.04$) (not baseline, 3, 6 or 12 months) with education. Significantly better physical function scores at 9 ($P=0.009$) and 12 months ($P=0.03$); vitality at 12 months ($P=0.04$); social functioning at 12 months ($P=0.015$) and mental health at 9 and 12 months (both $P=0.014$) with education
Paes [160]	To assess the effect of a palliative care clinic on QoL	13	III–IV	Palliative care intervention or usual care	22	EORTC QLQ-C30 (European Organisation for Research on Treatment of Cancer QLQ C-30); HADS	Nonsignificant improvement in intervention group in HADS and QoL scores
Relaxation-based interventions							
Chang *et al.* [177]	To assess the effect of a relaxation response (RR) intervention on the QoL and exercise capacity	95	II–III	Weekly RR group and home practice or weekly cardiac education (EDU) or usual care	15–19 week follow-up	MLHF; The Functional Assessment of Chronic Illness Therapy – Spiritual Well-Being	The RR group had significantly better QoL change scores in peace-spiritual scales than did the UC group ($P=0.02$). No significant difference was observed between the EDU and UC groups. Insignificant trend towards improved d in emotional QoL with RR. No significant intervention effect on physical QoL
Curiati *et al.* [145]	To assess the effect of meditation on sympathetic activation and QoL in an elderly group	19	I–II	Meditation or control	12 weeks (after 2 mths)	MLHF	Improved QoL with meditation ($P=0.02$) compared to control
Michalsen *et al.* [178]	To assess the effect of hydrotherapy	15	II–III	Intensive home-based hydrotherapy or restriction crossover	6	Quality of life profile for chronic diseases	Significant improvement in 3 of 6 QoL dimensions and significant reduction in heart-failure related symptoms with hydrotherapy ($P \leq 0.05$)

AGWB, Self-Assessment of General Well-Being; CES-D, Centre for Epidemiological Studies Depression Scale; CHQ, Chronic Heart Failure Questionnaire; COOP WONCA Charts, Dartmouth COOP Functional Health Assessment Charts/WONCA; EORTC QLQ-C30, European Organisation for Research on Treatment of Cancer QLQ C-30; EQ-5D, EuroQoL Quality of Life measure; HADS, Hospital Anxiety and Depression Questionnaire; HPPQ, Heart Patients Psychological Questionnaire; KCCQ, Kansas City Cardiomyopathy Questionnaire; MLHF, Minnesota Living with Heart Failure Questionnaire; NHP, Nottingham Health Profile; OARS, OARS Multidimensional Functional Assessment (cognitive status, functional level, patient satisfaction and self-rated health); PAIS, Psychological Adjustment to Illness Scale; PGACQoL, Patients Global Assessment of Change in Quality-of-Life; QLI, Quality of Life Index; SF-36, Medical Outcomes 36-Item Short-Form General Health Survey; SIP, Sickness Impact Profile; SOC, Sense of Coherence Scale; SSA-P, Subjective Symptoms Assessment Profile.
[a]Reported as presented in paper (in some cases run-in period is included). [b]*P* values provided where reported.

was found in Karolinska scores only, favouring biventricular pacing.

Finally Calvert and colleagues [148], using data from the ongoing CARE-HR study, found an association between EQ-5D and MLHF scores.

Patient care and service management interventions

The remaining 57 studies concerned patient care and service management interventions (see Table 4). Again, the most frequently used measure of QoL was the MLHF, which was used in 56% of studies (32/57). Twenty-seven studies involved cardiac rehabilitation programmes or exercise/muscle stimulation interventions. The majority (20/27 studies) reported a positive impact of an intervention on one or more dimensions of QoL when compared with usual care [8,69–71,82,84–86,110,118,119,132,135,137,152,156,171,173,29]. Seven reported no significant QoL effect of the intervention/programme [38,81,83,128,134,138,172].

Service delivery interventions, including discharge and outpatient management programmes and education-based interventions were evaluated in 27 studies. Twelve studies reported a positive impact of one or more interventions on one or more dimensions of QoL when compared with usual care. These interventions were based on multidisciplinary approaches to patient treatment [144], transitional care [79,136], discharge and outpatient management [153], behavioural management [66], information provision (basic and augmented levels), nurse-led education [74], in-hospital education [80], pharmacist-led education [62,68], compliance monitoring [154] and telephone counselling and monitoring [142].

In comparing two methods of care delivery (nurse telemanagement and home nurse visit), Benatar *et al.* [151] found that QoL improved with both methods, with a trend towards better improvement in the nurse telemanagement group. A comparison of an education intervention, a mutual goal setting intervention and a control, found improvement in QoL in both intervention groups, with the improvement being significantly greater for the mutual goal setting intervention [67].

Nine of the interventions reported no significant QoL effect [27,60,65,77,130,143,157,160,176]. Ojeda and colleagues [126] completed a 12-month follow-up of a study reporting beneficial effects of a discharge intervention and found that the benefits were not present at follow-up. Three studies noted mixed results. Bouvy and colleagues [150] evaluated a pharmacist-led intervention on medication adherence and reported that although condition-specific QoL improved in both the usual care and intervention groups, generic QoL improved with usual care and worsened with intervention. Oddone and colleagues [73] evaluated the effect of increased access to primary care than in usual care and found no significant differences in QoL between groups. An increase in hospital admission, however, was seen with the intervention. Finally, in a study assessing the effect of a home telehealth intervention, the intervention group showed improved cognitive status on the OARS Multidimensional Functional Assessment, whereas patient satisfaction scores improved significantly more in the control group compared with the intervention group [179].

This category also included three relaxation-based interventions. A positive impact on one or more dimensions of QoL was reported for a meditation intervention [145,161], a hydrotherapy intervention [178] and a relaxation response programme [177].

Discussion

Much recent research on heart failure has focused on maintaining or improving QoL. This review identified 120 randomized controlled trails that assessed QoL in this patient group – 44 medication trials, 19 surgical interventions and 57 patient and service management interventions. A wide range of generic, health-related, condition-specific, domain-specific and utility assessment tools were used.

The majority of studies used a single measure of QoL. This approach was particularly favoured in medication trials and surgical interventions. In patient management and service delivery interventions, there was an even split between the number of studies using one or multiple QoL measures.

Excluding the studies terminated early, and the study that looked at the predictive value of QoL scores, the majority of medication trials reported no significant between-group differences in QoL. In contrast, the majority of surgical interventions reported a positive effect on QoL. The majority of patient care and service management interventions also reported positive effects of the intervention on QoL.

The studies reviewed used a total of 47 self-report tools to assess QoL. The large range of measures available presents challenges to the selection of the most appropriate, reliable and valid instrument for a particular context [180,181]. One criterion for instrument selection is comparability. The MLHF is currently the clear choice based on this criterion given its widespread use. Responsiveness, however, is also important. The selection of a measurement instrument can play an important role in finding out whether and to what extent differences between randomized groups are evident. Detailed comparative studies of measures are warranted in existing

or planned heart failure studies in which more than one QoL instruments may be used.

In conclusion, QoL is now a widely used outcome measure in randomized trials of heart failure interventions. Interventions focusing on surgical procedures or patient care/service management interventions appear to deliver a greater benefit regarding QoL than those focusing on pharmacological interventions. The latter, however, mostly involve comparisons across medication categories rather than placebo/intervention comparisons. Greater agreement on key QoL outcome measures would enable cross-intervention-type comparisons and a greater understanding of the documented improvements in QoL for patients.

Supplementary data

Supplementary data are available at *The HJR Journal* Online (■ ■ ■).

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Appendix A

Complete profile of measures used in randomized controlled studies of heart failure 1996–2005

	Generic	Health-related	Condition-specific	Domain-specific	Utility
1	Ladder of Life				
6		SF-36			
1		PGACQoL			
1		NHP			
1		OARS			
1		The Functional Status Questionnaire			
		POMS			
		SF-36			
57			MLHF		
2			CHQ		
2			Signs and symptoms of heart failure questionnaire(s)/scale(s)		
1			PLC		
1			Customized 16 item questionnaire		
1			Customized – general well-being, daily activities, symptoms		
1			Customized – breathlessness, fatigue, well-being		
1			MLHF		
			QLI		
1					EQ-5D
1	Ladder of Life	SF-36	MLHF	CES-D	
				State Anxiety Questionnaire	
				State Anger Questionnaire	
1	Ladder of Life	PAIS	Signs and symptoms of heart failure questionnaire(s)/scale(s)		
			Heart Failure Functional Status Inventory		
1	SAGWB	SIP		HPPQ	
1	0-100 Global QoL Scale	SF-36		Specific Activities Scale	
1	Scale of Life Satisfaction		MLHF		

	Generic	Health-related	Condition-specific	Domain-specific	Utility
			QLI		
1	PGWB		SSA-P		
1	SAGWB			HPPQ	
1		SIP (subscale) SF-36	MLHF		
1		SIP	CHQ	HADS Philadelphia Geriatric Morale	
1		SIP	MLHF	SOC	
1		SF-36	MLHF	Zung Self-Rated Depression Scale	
1		SF-36 Functional Status Questionnaire	MLHF	CES-D	
1		NHP	CHQ Signs and symptoms of heart failure questionnaire(s)/ scale(s)		EQ-5D
8		SF-36	MLHF		
1		SIP	MLHF		
1		COOP Charts	MLHF		
1		SF-36	QLI		
1		General Health Questionnaire	CHQ		
1		SF-36 POMS	MLHF		
1		SF-36	CHQ	Epworth Sleepiness Scale	
2		SIP		SOC	
1		SIP POMS Health Status Index Items to assess impact of Illness on leisure and regular activities		Dyspnea–Fatigue Index	
1		SF-36		Specific Activities Scale	
1			MLHF Specific Symptoms Questionnaire	Karolinska Scale	
1			MLHF	Dyspnea–Fatigue Index	
1			Signs and symptoms of heart failure questionnaire(s)/ scale(s)	Dyspnea–Fatigue Index	
1			MLHF	The Functional Assessment of Chronic Illness Therapy – Spiritual Well-Being	
1			MLHF	Geriatric Depression Scale	
1			MLHF	Guyatt Respiratory Scale The Transitional Dyspnea Index	
1			MLHF QLI	HADS Heart Failure Self-Efficacy Scale	
1			EORTC QLQ-C30	HADS	
2			MLHF		EQ-5D
1			KCCQ		EQ-5D

CES-D, Centre for Epidemiological Studies Depression Scale; CHQ, Chronic Heart Failure Questionnaire; EORTC QLQ-C30, European Organisation for Research on Treatment of Cancer QLQ C-30; EQ-5D, EuroQoL Quality of Life measure; HADS, Hospital Anxiety and Depression Questionnaire; HPPQ, Heart Patients Psychological Questionnaire; KCCQ, Kansas City Cardiomyopathy Questionnaire; MLHF, Minnesota Living with Heart Failure Questionnaire; NHP, Nottingham Health Profile; OARS, OARS Multidimensional Functional Assessment (cognitive status, functional level, patient satisfaction and self-rated health); PAIS, Psychological Adjustment to Illness Scale; PGACQoL, Patients Global Assessment of Change in Quality-of-Life; QLI, Quality of Life Index; SF-36, Medical Outcomes 36-Item Short-Form General Health Survey; SIP, Sickness Impact Profile; SOC, Sense of Coherence Scale; SSA-P, Subjective Symptoms Assessment Profile.

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