Heart Failure Disease Management Incorporating Telemedicine: A Critical Review

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Abstract

- Objectives: To summarize and critically review research regarding heart failure disease management (HFDM) programs incorporating telemedicine and to outline critical research gaps and approaches for addressing them.

- Methods: We searched MEDLINE and other databases for randomized controlled trials (RCTs) and systematic reviews published between 1966 and November 2004 comparing HFDM programs incorporating telemedicine with usual care. Broad definitions of disease management and telemedicine were employed to guide decisions regarding article inclusion.

- Results: We retrieved 5 prior systematic reviews on this topic, each employing different definitions of disease management and telemedicine, and 33 RCTs. Thirty of the RCTs were included in at least 1 of these reviews, and we found 3 additional RCTs not included in any of them. Considered together, the findings of the 33 RCTs suggest that, when targeted to recently hospitalized patients with moderate to severe heart failure, a variety of HFDM interventions incorporating telemedicine significantly reduced hospitalizations and emergency visits. Fewer studies examined the impact of HFDM programs on mortality, care costs, and quality of life, and their findings varied. Several RCTs targeted patients with less severe disease and/or enrolled in health systems with preexisting proactive approaches to chronic disease care and found no significant improvement in any outcomes.

- Conclusions: HFDM programs incorporating telemedicine can reduce acute care utilization by severely affected patients, but their impact on other outcomes is unproven. Less symptomatic patients and those cared for in well-organized health systems do not appear to benefit from HFDM. Many questions regarding HFDM remain, such as which program elements are most effective. We propose a HFDM taxonomy to help organize future research on this topic.

More than 5 million Americans have heart failure [1], a condition associated with a substantially increased risk of mortality [2–7]. Heart failure is also a very costly condition. In 2004, the estimated direct and indirect costs of heart failure in the United States totaled $25.8 billion [1]. The high cost of caring for patients with heart failure can be primarily attributed to frequent hospital admissions for acute exacerbation [8]. Hospital discharges for heart failure rose from 377,000 in 1979 to 995,000 in 2001, a 164% increase [1]. Readmission to a hospital for any reason occurs in 20% to 50% of patients with heart failure within 6 months following an index admission [9–13], and 16% to 25% of these rehospitalizations are due primarily to heart failure [5,9,12].

Despite the well-known potential for various medical therapies to reduce heart failure mortality and morbidity in the setting of randomized controlled trials (RCTs), there is little evidence that the prognosis of heart failure in the general population has improved over the past 30 years [14]. Thus, novel health care delivery methods have been explored as potential ways of translating the clinical benefits of therapies demonstrated in RCTs into the general heart failure population. One such new approach to caring for patients with heart failure is disease management. While various definitions exist, in essence disease management is a “systematic, population-based approach to identify persons at risk, intervene with specific programs of care, and measure clinical and other outcomes”[15]. Improved quality of care has been one goal of disease management programs, but short-term chronic care cost containment has been an even more prominent focus [16]. Although the elements of disease management programs have varied greatly, various programs have included consultation with specialist physicians; frequent outpatient monitoring conducted by nurses; multidisciplinary assessment and intervention from social workers, physical therapists, and psychologists; and patient and family education and self-management support, often reinforced via home visits during a post-hospitalization “transitional period.” Many programs
have also included aggressive hospital discharge planning and recommendations to primary care providers for optimizing management of chronic conditions.

Heart failure has been a frequent target of disease management programs as local health systems and health plans have sought to reduce unplanned hospitalizations for exacerbations. Several RCTs have demonstrated that, compared with usual care, disease management programs targeted to patients recently admitted to the hospital for heart failure (and thereby at high risk for further admissions) can improve heart failure care quality, reduce hospitalizations, and perhaps even prolong survival [17]. Yet despite these encouraging findings, many unanswered questions remain concerning heart failure disease management (HFDM) programs. One particularly important question concerns the potential role of telemedicine in such programs. The American Telemedicine Association defines telemedicine as “the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or health care provider and for the purpose of improving patient care” [18]. Thus, telemedicine includes but is not limited to patient care provided via “real time” electronic communication media, including standard telephones as well as videophone devices with integrated peripheral devices such as pulse oximeters, cardiorespiratory monitors, electronic stethoscopes, and care provided via asynchronous communication methods, such as electronic mail and automated messaging pagers.

The Institute of Medicine’s 2001 report Crossing the Quality Chasm stated that “[information technology] must play a central role in the redesign of the health care system,” particularly if the quality of care provided to patients with chronic conditions like heart failure is to be improved [19]. Electronic health care is increasingly available in the home by videoconferencing, e-mail, internet, or telephone, either in real-time or via store-and-forward methods, and has great potential clinical and economic value, especially for the chronically ill [20]. For these reasons, inclusion of such telemedicine modalities into HFDM programs has increased greatly in the past 10 years. A fundamental assumption underlying use of telemedicine to care for heart failure patients is that electronic communication will allow frequent nurse monitoring of and contact with patients at lower cost than has been possible with traditional in-person home care, with no decrement or perhaps improvement in care quality.

The main purpose of this paper is to critically review the research literature concerning the use of telemedicine in HFDM to determine whether this assumption has been supported. We initially planned to do a systematic review of RCTs in this area. However, in reviewing retrieved papers, we found that nearly all had already been included in one or more previously published systematic reviews on this topic. Thus, we decided to (1) summarize and critically review previous systematic reviews on this topic; (2) present findings of any additional RCTs that had not been included in previous systematic reviews; and (3) outline a set of unresolved issues concerning HFDM incorporating telemedicine and some possible approaches to addressing them.

Methods

We searched for articles published in English between 1966 and November 2004 reporting the results of RCTs of disease management programs that included at least some patients with congestive heart failure, reported results for patients with heart failure separately from those with other diseases, and incorporated at least one telemedicine element. We also sought systematic reviews (nonquantitative and meta-analyses) in which at least some of the studies included met these criteria.

Reports of nonrandomized prospective studies and observational studies were excluded, as were reports that focused exclusively on nonclinical outcomes such as feasibility or provider perceptions. We desired to be inclusive and so employed the broad definitions of the terms disease management and telemedicine listed in the Introduction in determining whether or not to include retrieved articles.

Search Strategy, Intervention Classification, and Quality Assessment

We searched the MEDLINE, PsychINFO, CINAHL, and Cochrane electronic databases. During preliminary searches, we noted that relevant articles were inconsistently indexed using a wide variety of medical subject (MeSH) headings. We compiled a listing of headings and employed them in various combinations in researching each database to help ensure identification of all relevant studies. MeSH terms that we employed included but were not limited to heart failure, congestive; disease management; case management; telemedicine; telephone; home care services; home nursing; home care services; home visits; hospitalization. We also reviewed reference lists of retrieved papers for relevant publications not identified by database queries.

We read each of the retrieved papers to determine the type of telemedicine used and to evaluate their methodologic and reporting quality. We employed the 4 categories of McAlister et al [21] in classifying interventions: (1) multidisciplinary team delivering a clinic-based intervention; (2) multidisciplinary team providing expanded follow-up in a mostly nonclinic setting (eg, patients’ homes); (3) home telephone follow-up by a nurse, with encouragement for primary care follow-up in the event of clinical deterioration; and (4) educational programs to enhance patient self-care. While there is inevitably overlap among these categories, they capture fundamental distinctions among various HFDM efforts.

We qualitatively assessed the quality of papers included in the review by considering study design, methodology, and
reporting against criteria for RCTs and systematic reviews outlined in User’s Guides to the Medical Literature [22,23]. For RCTs that attempted cost analysis, we judged the quality of the cost analyses against the criteria of Gold et al [24].

**Results**

Six systematic reviews initially met our inclusion criteria. However, 1 review [25], an earlier version of (and completely subsumed by) a later meta-analysis [21] was discarded, leaving 5 systematic reviews for detailed analysis.

**Original RCTs Included in at Least 1 Systematic Review**

Table 1 lists the 30 original RCTs of HFDM incorporating telemedicine that appeared in at least 1 of the 5 remaining systematic reviews, as well as the intervention category of and component telemedicine technologies evaluated in each.
None of the 30 original RCTs was included in all of the reviews. Nearly all focused on patients admitted to or recently discharged from the hospital with a heart failure exacerbation. Almost all patients included had New York Heart Association (NYHA) class II–IV heart failure; the majority had class III or IV heart failure. Regarding telemedicine technology in the RCTs, 28 (93%) included regular telephone calls (nearly always from nurses) and 5 (17%) included trans-telephonic monitoring of vital signs or other critical status indicators (eg, weight, pulse oximetry) via peripheral devices. Only 2 studies (7%) concerned interactive videoconferencing between nurses and patients.

Only 8 (27%) of the 30 RCTs were judged to be of acceptable methodologic quality based on User’s Guides to the Medical Literature criteria. Common problems included lack of a power analysis or failure to reach a preplanned sample size, unblinded assessment of outcomes, and incomplete follow-up. Of papers attempting a cost analysis, none of the analyses were judged to be of acceptable quality per the criteria of Gold et al [24].

### Systematic Reviews

Of the 5 systematic reviews we analyzed, all had at least 1 major methodologic flaw when judged against User’s Guides to the Medical Literature criteria. The most common major problems were lack of a clearly defined clinical focus (4 of the 5 reviews lacked an explicit definition of “disease management” to guide scope of and literature searching for the review) and lack of an explicit, reproducible process for ascertaining the quality of RCTs included in the review (noted for 3 of the 5 reviews). Detailed comments concerning each review follow.

Louis et al [26] conducted a systematic review of the literature (both observational studies and RCTs) published from 1966 to 2002 on “telemonitoring for the management of heart failure.” Telemonitoring was defined as “home monitoring of patients using special telecare devices in conjunction with a telecommunication system,” thus excluding interventions employing regular telephone calls. The authors reported finding 6 RCTs on this topic. However, they misclassified one pseudoexperimental study [61] as a RCT, leaving 5 actual RCTs involving a total of 788 patients with heart failure. The authors concluded that some evidence existed that heart failure management interventions incorporating telemedicine can lead to reduced all-cause [11,52] and heart failure [11,36,43,52] readmissions; fewer hospital days [54]; increased time to re-admission following an index admission [43]; reduced heart failure–associated emergency visits [41]; improved quality of life [11]; and lower acute care costs [43,53]. However, they noted that among “positive” studies, findings for the specific outcomes listed were inconsistent. Furthermore, they noted that 1 RCT found no significant benefit of a care management intervention incorporating telemedicine [40], and another found a significant increase in all-cause and heart failure hospital admissions and outpatient visits resulting from such a program [58].

McAlister et al [21] conducted a meta-analysis of the published literature from 1966 to 2003 “to investigate which types of (HFDM) programs are most efficacious.” The review included but was not limited to papers describing RCTs with telemedicine elements. The term “disease management” was not defined explicitly. Twenty-nine RCTs were retrieved; 25 of these studies involving a total of 4446 patients with heart failure concerned programs with telemedicine elements (Table 1). The authors did not summarize results separately for programs incorporating telemedicine. Unless otherwise noted, their findings we summarize here were derived from pooling studies of programs both with and without telemedicine elements.

The main conclusions of their meta-analysis were as follows. (1) Disease management programs for heart failure that involved specialized follow-up by a multidisciplinary team in either a clinic or nonclinic setting (15 studies, 12 involving telemedicine [11,32,33,35,38,42,45,49,53–56]) led to a reduction in mortality (relative risk [RR], 0.75 [95% confidence interval [CI], 0.59–0.96]), heart failure hospitalizations (RR, 0.74 [95% CI, 0.63–0.87]), and all-cause hospitalizations (RR, 0.81 [95% CI, 0.71–0.92]). (2) Programs that focused on enhancing patient self-care (4 studies, 3 involving telemedicine [39,40,43]) reduced heart failure (RR, 0.66 [95% CI, 0.52–0.83]) and all-cause (RR, 0.73 [95% CI, 0.57–0.93]) hospitalizations but not
mortality. (3) Programs that employed telephone contact and advised primary care clinic attendance in the event of increased symptoms (10 studies, by definition all [34,36,41,44,48,50–52,57,58] including telemedicine) reduced heart failure hospitalizations (RR, 0.75 [95% CI, 0.57–0.99]) but not all-cause hospitalizations or mortality.

Phillips et al [27] conducted a meta-analysis of RCTs of the effect of “comprehensive discharge planning” (including both inpatient and outpatient components) plus post-discharge support on hospital readmissions (primary outcome) and a variety of other heart failure outcomes. The authors searched the literature for papers published from 1966 to October 2003. Eighteen RCTs were retrieved; 15 studies involving 2908 patients with heart failure concerned programs with telemedicine elements (Table 1). The authors did not summarize results separately for programs incorporating telemedicine. Thus, their findings summarized here were derived from pooling studies of programs with and without telemedicine elements.

In considering all retrieved studies, the authors noted that during a mean observation period of 8 months, patients in intervention programs had fewer readmissions compared with usual care patients (RR, 0.75 [95% CI, 0.64–0.88]; number needed to treat, 12). They also noted that in pooling results of 14 studies in which all-cause mortality was included as a secondary outcome (including 12 studies involving telemedicine [11,32,33,39,40,43,44,47,51,52,54,59]), there was a trend toward lower all-cause mortality (RR, 0.87 [95% CI, 0.73–1.03]). For 6 studies that examined impact on quality of life (including 5 that incorporated telemedicine [11,39,40,54,59]), there was a significantly greater percentage improvement from baseline scores in the intervention patients than in controls. Finally, the authors found similar or lower medical care charges per patient per month for initial hospitalization, readmission, intervention administration, and outpatient care in the 11 studies reporting cost outcomes, including 9 [11,33,43,44,47–49,52,54] related to programs incorporating telemedicine.

Gorseth et al [29] conducted a systematic review of the literature (both observational studies and RCTs) published from 1966 to August 2003 on disease management interventions to improve care for patients aged 65 years and older with heart failure. They conducted a meta-analysis of the RCTs and a separate qualitative analysis of observational studies. This was the only systematic review to include an explicit definition of disease management. A total of 27 RCTs were included in their review; 17 studies involving a total of 3148 patients concerned disease management with telemedicine elements (Table 1). Not all of the RCTs discussed in their review were included in the meta-analyses of various endpoints (see below), and criteria for inclusion or exclusion from meta-analyses were unclear. The authors did not summarize results separately for programs incorporating telemedicine. Thus, their findings were derived from pooling studies of programs with and without telemedicine elements.

In the meta-analyses, the authors found that compared with usual care, patients in the disease management programs had a significantly lower risk of heart failure or other cardiovascular readmission (RR, 0.70 [95% CI, 0.62–0.79]) (11 studies, 8 involving telemedicine [32,35,40,43,44,47,51,52]); all-cause readmission (RR, 0.88 [95% CI, 0.79–0.97]) (16 studies, 10 involving telemedicine [11,32,35,40,44,49,52–54,58]); and the combined endpoint of readmission or death (RR, 0.82 [95% CI, 0.72–0.94]) (10 studies, 7 involving telemedicine [11,32,42,43,47,51,55]). They also noted that most studies commenting on cost issues reported that the disease management programs reduced acute care costs.

Duplicate Reports
We encountered 2 duplicate reports of RCTs. In the first, results from the abstract-only report of Bondmass et al [30] (included in the Louis et al review) were also included in a later report by the same group of authors [31]. In the second, the report of Oddone et al [59] concerning only heart failure patients (included in the Phillips et al meta-analysis) was derived from the larger, multidiagnosis population described previously by Weinberger et al [58] (cited in the McAlister et al and Windham et al systematic reviews). These duplications are noted in Table 1.

RCTs Not Included in Previous Systematic Reviews
We retrieved 3 RCTs not included in any of the previous systematic reviews (Table 2). Two [62,63] were very small and of poor quality. The third, by DeBusk et al from 2004 [64], was of good quality and reported on a RCT of nurse management consisting of structured telephone surveillance, treatment, and primary care coordination (n = 228 subjects) versus usual care (n = 234). Half of enrolled subjects had NYHA class I or II heart failure. The primary outcome was time to rehospitalization (any cause), with a secondary outcome of time to a combined end point of first rehospitalization, emergency department visit, or death. There were no significant differences between groups for either outcome at 1 year.

Discussion
Principal Findings and Limitations of Studies
There is preliminary evidence from RCTs that, when targeted to recently hospitalized patients with moderately severe to severe heart failure (NYHA class III or IV), a variety of loosely related “disease management” interventions that incorporate telemedicine can result in significantly improved outcomes as compared with usual care. The strongest evidence exists for their impact on heart failure–related and all-cause hospitalizations and emergency visits. Evidence to support reductions in all-cause mortality, acute care costs, and improved quality of life is less impressive, since fewer studies
have rigorously examined these outcomes and their findings have varied. Given the well-known problem of publication bias, which strongly favors the publication of RCTs with "positive" results [65], these findings likely overstate the effectiveness of such interventions to some degree. Some reviewers have also concluded from these studies that multidisciplinary team interventions are clearly superior to other categories of HFDM (eg, home nurse telephone follow-up) [21,66]. We disagree for 2 important reasons. First, we noted substantial heterogeneity among studies, including those within the multidisciplinary team category, in regard to intervention components, methodologic quality, target population, clinical setting, telemedicine technology, outcomes assessed, personnel involved, and other key factors. Even the 5 systematic reviews we analyzed varied greatly in their criteria for inclusion and classification of various RCTs, and all had important methodologic flaws. We also found no adequately powered RCTs comparing various categories of interventions head to head. Thus, it seems premature to make confident judgments regarding the relative merits of the various types of HFDM intervention approaches.

Tempering the overall favorable impression regarding the potential of HFDM programs incorporating telemedicine were several well-done RCTs of interventions that yielded no significant improvement in any outcomes [44,59,64]. In attempting to explain these "negative" findings, commentators have identified 2 plausible explanations [67,68]. First, patients in the negative studies were at relatively low risk compared with those in the positive RCTs. For example, half of patients in the DeBusk et al study had NYHA class I or II heart failure. The classic "disease management" approach may be less likely to benefit this population, since baseline acute care utilization is generally low and quality of life relatively high. Second, patients in at least 2 [59,64] of the 3 negative RCTs had ready access to high-quality primary care at baseline. By contrast, in most positive studies, patients were drawn from indigent populations with less access to primary care. Thus, post-hospitalization HFDM interventions may be less likely to "add value" to the care of patients in well-coordinated and proactive health care systems than in more fragmented, poorly coordinated systems. This idea raises a further intriguing question: might the monetary and human resources deployed in HFDM projects have been more equitably invested in improving "dysfunctional" health care systems at a broader level?

Unresolved Issues and Suggested Approaches for Addressing Them
Given the current rather primitive state of the literature on HFDM interventions incorporating telemedicine, how can we move forward? We believe the following issues to be the most pressing ones in the field and that addressing them will
help to improve the quality and utility of future interventions and RCTs to evaluate their impact.

A universal terminology is lacking. There is no consensus definition of the fundamental terms utilized in determining the focus of previous RCTs and systematic reviews. For example, one paper defined case management as “a program that uses physician or nonphysician providers to maintain continuous contact with patients via telephone or in home visits in order to prevent disease exacerbation through intensive assessment and education techniques” [69]. Yet, this overlaps with the definition of disease management proposed in another paper [15], and in our region the term “case management” is generally reserved for only the most intensive nursing contact, typically aimed at people with “inappropriate” acute care utilization patterns. The point is not to say which definition is correct but to emphasize that there is currently no consensus answer. Without agreement on such fundamental concepts, the literature will remain muddled.

Telemedicine is often conceptualized too narrowly. Some researchers have reserved the term “telemedicine” for work involving “telephone plus” technologies (eg, videoconferencing). A clear rationale for employing these technologies has generally been lacking: was it included to convey more of a “human touch”? Out of financial necessity (video home nursing calls are potentially reimbursable [70] while standard telephone calls are not)? For other reasons? It is also not clear which heart failure outcomes could plausibly be expected to differ for patients cared for with “telephone plus” technologies compared with standard telephone calls. Our literature review found a complete lack of convincing evidence to support any “telemedicine plus” technology but a growing body of RCTs suggesting utility of standard telephone calls (Table 1). The scant and admittedly preliminary evidence from head-to-head comparison of these technologies suggests video may not yield incremental clinical benefit [41]. Thus, we suggest that conventional telephone technology be included under the rubric of “telemedicine” and that, given its reliability, simplicity, and low cost, future program designers should carefully consider the rationale for including additional technologies.

A comprehensive taxonomy of care interventions is lacking. Once agreement regarding terminology is reached, a taxonomy [71] of heart failure care interventions can be assembled based on their goals, elements, and personnel. This would allow clearer identification of the similarities and differences between various interventions. It would also provide “food for thought” for those seeking to develop or refine heart failure care interventions and help ensure no potentially important elements are overlooked. We propose the basic taxonomy of heart failure care interventions in Table 3 as a starting point, and encourage other investigators to adapt, modify, and add to it over time until consensus is achieved.

Interventions are seldom grounded in health behavior theory. Nearly all previous interventions have lacked grounding in a research-supported theory of health behavior. Firm theoretical grounding should increase the likelihood of success of heart failure care interventions, which nearly all involve educating patients and encouraging them to change health care utilization patterns and self-care behaviors. Proper grounding also drives the choice of potential mediating and moderating variables [72] to measure. For example, for an intervention grounded in social cognitive theory [73], self-efficacy would be an important potential mediator variable to measure, and if it was confirmed to be a mediator of the intervention effect, it would provide guidance in defining program strategies and elements. Finally, theoretical grounding would help to overcome the “black box” problem endemic to previous RCTs of multidisciplinary heart failure interventions, which makes it impossible to determine which of the many program elements actually influenced patient outcomes.

The disease management approach is probably not appropriate for all heart failure patients. “Positive” studies of heart failure care management have involved highly selected...
Table 3. A Proposed Taxonomy for Heart Failure Care Interventions

<table>
<thead>
<tr>
<th>Program Categories and Subcategories</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall direction</td>
<td>Acute care cost reduction; improved care quality; increased market share</td>
</tr>
<tr>
<td>Primary goals of program</td>
<td>Who is “driving” the effort? Health plan, doctors, nurses</td>
</tr>
<tr>
<td>Perspective</td>
<td>Patient behavioral or learning theory in which intervention is grounded</td>
</tr>
<tr>
<td>Theoretical framework</td>
<td>Health plan; health system; federal grant; private foundation</td>
</tr>
<tr>
<td>Funding</td>
<td>Health plan; health system; federal grant; private foundation</td>
</tr>
<tr>
<td>Personnel</td>
<td>Cardiologist; primary care physician; advanced practice nurse</td>
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<tr>
<td>Primary person(s) in charge</td>
<td>Social workers; lay advocates; technical support people</td>
</tr>
<tr>
<td>Other personnel</td>
<td>Special training required beyond typical skills of equivalent person in usual practice</td>
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<tr>
<td>Target population</td>
<td>Heart failure only; multiple comorbid diseases</td>
</tr>
<tr>
<td>Diseases/diagnoses/problems</td>
<td>High utilizers of care; health plan type(s); demographics</td>
</tr>
<tr>
<td>Intervention environment(s)</td>
<td>Hospital; clinic; patients’ homes</td>
</tr>
<tr>
<td>Geographic location(s)</td>
<td>Primary care; specialty clinic</td>
</tr>
<tr>
<td>Specialty setting(s)</td>
<td>Hospital; clinic; patients’ homes</td>
</tr>
<tr>
<td>Communication methods</td>
<td>Traditional visits</td>
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<tr>
<td>Face-to-face</td>
<td>Posted reminder slips</td>
</tr>
<tr>
<td>Mail</td>
<td>Standard telephone; videophone; internet; automated messaging</td>
</tr>
<tr>
<td>Telemedicine technologies</td>
<td>Phone calls as adjunct to home visits versus primary method of delivering an intervention</td>
</tr>
<tr>
<td>Role</td>
<td>In hospital; 2 weeks post-discharge</td>
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<tr>
<td>Timing and dose</td>
<td>2 weeks; 3 months; 1 year</td>
</tr>
<tr>
<td>Initiation</td>
<td>E-mail reminders; skilled nursing visits; comprehensive multidisciplinary assessment</td>
</tr>
<tr>
<td>Duration</td>
<td>Daily; weekly; monthly</td>
</tr>
<tr>
<td>Frequency of contact</td>
<td>Increased contact and consensus among various providers involved in care</td>
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<tr>
<td>Care coordination</td>
<td>“Feedback” loops with iterative development of program over time</td>
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<tr>
<td>Continuous quality improvement</td>
<td>In hospital and/or outpatient elements</td>
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<tr>
<td>Discharge planning</td>
<td>Symptom status; adherence</td>
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<tr>
<td>Home monitoring</td>
<td>Traditional skilled nursing role</td>
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<tr>
<td>Home nursing care</td>
<td>Patient and/or provider electronic medical record</td>
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<tr>
<td>Information management</td>
<td>Nurse medication titration based on explicit protocols</td>
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<tr>
<td>Evidence-based therapy adjustment</td>
<td>Regarding disease and its treatment (knowledge driven)</td>
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<tr>
<td>Patient education</td>
<td>Action planning; problem solving; emotional coping strategies (skills driven)</td>
</tr>
<tr>
<td>Patient self-management support</td>
<td>Proactive care utilizing an electronic registry of the target population</td>
</tr>
<tr>
<td>Population management</td>
<td>Familiarization with and reminders about evidence-based practice guidelines</td>
</tr>
<tr>
<td>Provider education</td>
<td>Fundamental study design issues</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Comprehensive cost-effectiveness analysis versus rough cost-minimization calculations</td>
</tr>
<tr>
<td>Overall quality</td>
<td>Based on weighing all of the above categories and elements</td>
</tr>
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</table>
groups of patients; for example, one widely cited study recruited only about 20% of screened subjects [11]. By contrast, the prominent “negative” studies of HFDM involved less selected populations and suggest it may not benefit the majority of patients with heart failure. Asymptomatic or minimally symptomatic patients, and those with multiple comorbid conditions (often excluded from prior RCTs) may require other strategies. Lower-intensity, generic (not disease- or diagnosis-specific) interventions to bolster universal patient self-management skills (eg, problem solving, symptom monitoring) appear promising for such patients from both a clinical and cost standpoint. For example, the Chronic Disease Self-Management Program (CDSMP) of Lorig and colleagues, delivered at low cost by trained lay persons with chronic conditions, has been shown in an RCT to result in long-term improvements in patient self-efficacy and quality of life and reduced acute care utilization and costs [74,75]. Although the original CDSMP was conducted face-to-face, results from a recently completed RCT of an internet delivery variant [76] will soon be available (Kate Lorig, RN, DrPH, personal communication), and we are currently conducting a RCT to determine whether a telephone delivery variant is clinically effective and cost-effective [77].

Finally, although some prior RCTs examined mortality as an outcome, none of the interventions appear to have included strategies to help their predominantly class III or IV heart failure patients transition away from disease management to palliative care when appropriate. This is unfortunate given that average survival is dramatically foreshortened for such patients [78]. Future interventions must remedy this situation, which has both quality of care and ethical implications.
HEART FAILURE DISEASE MANAGEMENT

44. Ledwidge M, Barry M, Cahill J, et al. Is multidisciplinary


