

The Costs and Outcomes of Multifaceted Interventions Designed to Improve the Care of Congestive Heart Failure in the Inpatient Setting: A Review of the Literature

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Various multifaceted interventions have been developed in response to the overwhelming burden of congestive heart failure and its costs. These interventions range from improvements in the delivery of inpatient care (e.g., by assigning multidisciplinary teams to the care of a patient or ensuring that clinical practice guidelines are followed) to comprehensive discharge planning that includes home health care. While it is intuitive that such interventions improve care, few have been evaluated in randomized controlled trials and fewer still include data on costs. In this article, the authors review the findings of randomized controlled trials of interventions designed to improve the quality of life, decrease hospital admissions, and decrease costs associated with heart disease. They conclude that inpatient-based multifaceted interventions appear to be effective and inexpensive. Future studies should attempt to tease interventions apart to ascertain which are the most effective. Formal cost-effectiveness analyses are also needed.

Keywords: *heart failure; congestive; cost and cost-benefit analysis; discharge planning; home health care; health care team; multifaceted interventions*

In the United States, approximately 4.6 million persons live with congestive heart failure (American Heart Association 2000). Over the past 50 years, sur-

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vival rates for congestive heart failure have improved by approximately 12 percent per decade, but it is likely that larger gains could be realized by optimizing the medical management of this condition (Levy et al. 2002). Hospitalization charges associated with congestive heart failure exceeded \$15 billion in 2000 (Agency for Healthcare Research and Quality 2002), and the cost of caring for people with this condition has led some to call for improvements in inpatient management (O'Connell and Bristow 1993). Most tertiary preventive interventions designed to reduce the burden and cost of heart disease in the United States have been designed to improve both inpatient and outpatient follow-up care (Naylor and McCauley 1999; Rich et al. 1995).

The interventions proposed to improve the management of congestive heart failure are almost always multifaceted. In other words, they involve multiple subcomponents, such as a team approach to medical care, intensive dietary counseling, optimization of medications by a pharmacist, and detailed planning follow-up care. They sometimes involve administratively difficult coordination of medical professionals, such as establishing continuity of care between the inpatient providers and outpatient providers.

Interventions targeted toward inpatients with heart disease in general have included a team approach to care, a 24-hour clinical coordinator assigned to a patient, adherence to practice guidelines, as well as a wide variety of other patient education and management strategies (Hughes et al. 2000; Knox and Mischke 1999; Uzark et al. 1998; Riddle, Dunston, and Castanis 1996). Outpatient interventions include intensive follow-up, home care, in-home technologies (i.e., telephone-linked care), social networking, patient education, and self-help groups (Robinson 1999). These strategies can overlap or be combined in a variety of ways. For instance, dietary counseling can be seamlessly delivered in both the inpatient and outpatient setting by the same dietician, and cardiac care teams can be limited to physicians and nurses or can span the spectrum of clinical care providers, including physical therapists, dieticians, and social workers. To our knowledge, no randomized controlled trials have examined interventions independently. Therefore, multidisciplinary interventions can only be judged based on their collective efficacy and cost.

While all patients with heart disease may benefit from multifaceted interventions, patients with congestive heart failure are especially susceptible to dietary changes. They must also carefully titrate medications, such as diuretics and agents that enhance cardiac output (e.g., digoxin), which do not usually offer a great deal of leeway in dosing. Therefore, it is hypothesized that careful patient management and patient education programs could

potentially produce significant improvements in the health-related quality of life of such patients, may reduce the total number of hospitalizations and the length of stay in a hospital, and may even reduce mortality rates (Philbin et al. 2000). Congestive heart failure may also prove to be a sensitive measure of the efficacy of hospital-based and outpatient-based interventions for other diseases, which may produce less dramatic benefits (Gooding and Jette 1985). When the incremental improvement in effectiveness is small, large randomized trials are needed; such trials are not generally feasible unless expensive multicenter interventions are studied.

In this article, we examine the randomized trials published to date. Unfortunately, few studies provide in-depth descriptions of the interventions they propose, and few data are available from prospective randomized trials that examine both the efficacy and cost of such programs. Therefore, we also briefly examine studies evaluating the efficacy of congestive heart failure health strategies using preintervention-postintervention study designs.

NEW CONTRIBUTION

A small number of randomized controlled trials of multifaceted interventions to improve the care of congestive heart failure patients have been published. However, these studies leave little room for the synthesis of information on efficacy and cost across programs. Possibly due to the limited number of randomized controlled trials available for evaluation at the time, a previous review of multidisciplinary programs examined multidisciplinary programs through the lens of varied study designs, most of which were preintervention-postintervention trials focusing on inpatient and outpatient management (Philbin 1999). In this article, we attempt to update Philbin's (1999) findings and synthesize the results of randomized controlled studies of inpatient interventions. We also examine the design and results of pretrial-posttrial evaluations targeted toward inpatient care of congestive heart failure to present the reader with the breadth of alternative interventions of possible efficacy, but we only include them in a secondary analysis. We focus on the hospital setting in part because multidisciplinary teams and the patient have more contact, presenting a great opportunity for interventions to be employed in a controlled setting. The hospital environment also affords the opportunity for more intensive interventions.

CONCEPTUAL FRAMEWORK

Despite the availability of a number of treatment modalities that have demonstrated efficacy in reducing the incidence and mortality rates of congestive

heart failure, relatively little improvement has been seen in practice (Cohn et al. 1986; Packer et al. 1996; Pitt et al. 1999). This suggests that there is a good deal of room for optimizing the medical management of this disease.

In current practice, a patient admitted to the hospital for congestive heart failure may or may not receive counseling from a dietician, rehabilitation, comprehensive discharge planning, or a variety of other modalities. An intensive and coordinated approach to inpatient care of congestive heart failure patients is intuitively more effective than the typical practice of admitting patients to an internal medicine ward with standard care delivered by a physician and nurse alone. Though such programs can be costly on face value, they may also reduce the long-term costs of care by reducing the severity of illness and thus reducing hospital readmissions and dependence on long-term care. They may also have intangible benefits, such as improvements in health-related quality of life.

In practice, the implementation of such a program requires commitment on the part of hospital administrators, the cooperation of providers and patients, and sufficient financial resources to implement them. For instance, to implement a team approach to care, physicians must be willing to meet with nurses, dieticians, physical therapists, and other health professionals on a regular basis. The needs of patients with congestive heart failure are individually discussed in such meetings, and the time commitment can be quite large; one patient may have financial circumstances that require his or her enrollment in social services by a social worker, while another patient may have overriding cultural or social circumstances that require extensive involvement of the patient's family. The latter process may require additional meetings between the patient's continuity of care provider, the social worker, and the dietician. Clearly, this coordination of care is administratively challenging and is fraught with scheduling problems, interpersonal conflicts, and other unforeseeable issues.

Moreover, some institutions may be reluctant to implement these interventions due to their high up-front costs and a lack of consensus on their efficacy. Likewise, many insurers may be reluctant to reimburse for the additional care provided by the institutions that provide them. Both perspectives are understandable, given the extent to which failure to contain costs may affect the quality of care delivered to other patients. It is therefore important to examine the ways in which different parties may or may not benefit from multidisciplinary interventions.

From the patients' perspective, multidisciplinary programs have the potential to speed recovery from exacerbations of their disease, reduce the chances of decompensation in the future, and improve their ability to enjoy recreational activities. Hospital administrators can maximize the quality of

care and minimize costs by providing treatment that is effective in reducing the length of stay in the hospital. Care is typically reimbursed either under negotiated payments or via capitation. In the former case, the longer a patient remains in the hospital, the lower the profits (Bodenheimer and Grumbach 2002). To the extent that patients are discharged at the appropriate time, care that is more effective will lead to speedier recovery and earlier discharge. Finally, insurers are given incentives to reimburse for care that is more expensive if they know that such care has the potential to reduce the long-term costs of insuring a patient. Medicare may be especially responsive to empirically based interventions that demonstrate improvements in the quality of care and the cost of delivering such services.

By providing a systematic review of the most rigorous studies, we hope to critically examine and synthesize the information that is currently available and to reduce the uncertainty associated with the implementation of such programs. We also seek to identify areas in which the current body of literature on this topic can be expanded.

STUDY DESIGN

An extensive review of the cardiac care literature was conducted using the Medline search engine between the years 1988 and 2000. In our review, we included all studies we found that used at least three of the following components to the multifaceted intervention: (1) coordination of care by a multidisciplinary team, (2) medication review and/or planning, (3) hospital-based education program, (4) comprehensive discharge planning, (5) home or ambulatory care-based education, and (6) home care by a licensed clinician. These criteria were chosen based on a preliminary review of the literature. We included only studies conducted in English and limited our search to human participants. Studies were included regardless of whether results were found to be statistically significant; however, publication bias may have occurred. Descriptive studies and uncontrolled studies were excluded, and no retrospective studies were found.

We included Medical Subject Heading (MeSH) terms specific to cardiac care interventions (*heart failure*, *congestive* and *intervention studies*) and coupled these with the keywords *hospital-based* and *multifaceted*. We also examined searches conducted by the PubMed search engine's "Related Articles" feature, which allow for an algorithmic search of articles with content most relevant to those included in the review. Finally, we reviewed the bibliographies of articles that we felt were germane to this topic. We identified 57 studies relevant to our topic, of which 4 met our inclusion criteria. All costs were adjusted to constant 2000 U.S. dollars for comparability.

Because few well-designed studies examining the cost and efficacy of patient management strategies were available, studies that used a preintervention-postintervention design are briefly reviewed in a separate analysis.

DESCRIPTION OF INTERVENTIONS

There are several types of interventions designed to decrease morbidity and mortality among congestive heart failure patients. Those included in this literature review include a structured initial assessment, a multidisciplinary team approach to care, patient education, home care, and intensive follow-up monitoring—patient care objectives that ideally would seamlessly overlap (see Table 1). Most of these interventions encourage communication between parties that might not otherwise collaborate using a structured initial assessment and follow-through. For instance, practitioners conducting initial assessments invite admitting nurses, cardiac rehabilitation specialists, pharmacists, dietitians, surgeons, and others to meet immediately and evaluate not only the patient's health status at time of admission but also his or her history of medications, the precipitating symptoms prior to admission, and laboratory test results. These initial assessments help to inform multidisciplinary teams of the optimal clinical pathway as well as the different ways in which they can coordinate and maximize the use of resources according to each individual patient's needs. Overarching care algorithms may also be implemented.

After the patient has undergone initial assessment, he or she receives ongoing follow-up by team members, who then evaluate the ongoing inpatient care plan and discharge plan. This way, patient education can begin early in the care process so that messages can be reinforced and behavior can be modified while the patient is still under team supervision.

Patient education consists of instruction in proper diet, proper administration of drugs, and stress management. Behaviors learned in the hospital can then be reinforced by home care providers in the outpatient setting. Home care and monitoring are usually conducted by trained nurses, and they consist of regular nurse-initiated telephone calls and hotline operations as well as home visits.

In addition to increasing compliance to dietary, exercise, and medication regimens, home care and monitoring are intended to improve patients' health statuses and lower anxiety levels by allowing more frequent adjustments in regimens to fit the patients' needs. Often, the intervention also includes education of the patients' relatives as means of constructing a "network of care" and encouraging the maintenance of necessary lifestyle changes. Finally, some interventions include follow-up care in the patients' homes by a clinical outreach team headed by a physician.

TABLE 1 Components of Interventions Targeted toward Congestive Heart Failure Patients Using a Randomized Controlled Study Design

<i>Component</i>	<i>Rich et al. (1993, 1995)</i>	<i>Naylor et al. (1994)</i>	<i>Naylor and McCauley (1999)</i>
Inpatient components (initiated at admission and followed through to discharge)			
Coordination of care	Yes	Yes	Yes
Social services	Yes	Yes	NI
Medication review	Yes	Yes	NI
Patient education	Yes	Yes	NI
Comprehensive discharge plan	Yes	Yes	Yes
Outpatient components (initiated on discharge and followed by nurse or by team)			
Home care	Yes	Yes	Two visits
Telephone follow-up	Yes	No	Yes
Periodic reevaluation of discharge plan	No	Yes	NI

Note: NI = it was not indicated whether these services were included in the comprehensive discharge planning.

PROSPECTIVE RANDOMIZED TRIALS

This section reviews four studies measuring the effects of multidisciplinary treatment interventions among elderly patients with congestive heart failure. These studies examined the efficacy of various multifaceted interventions intended to improve patients' health statuses, reduce readmission rates, and possibly prolong life. Three of these authors also sought to measure the overall program cost, hypothesizing that the improved health status of the patients, reduced hospital days, and reduced readmission rates may produce savings or reduce the cost of implementing these interventions.

These studies are prospective randomized trials in which all patients were assigned to either the control or the intervention groups; they were then monitored for a period between 12 and 24 weeks. The studies cite different outcomes from the interventions, including readmission rates, average length of stay (ALOS), hospital charges, and charges after hospitalization. The strengths and weaknesses of each study are listed in Table 2.

Two of the studies were conducted by Rich et al. (1993, 1995) at the Jewish Hospital at Washington University Medical Center. The Rich et al. (1993)

TABLE 2 Strengths and Weaknesses of the Studies Reviewed

<i>Study</i>	<i>Strength</i>	<i>Weakness</i>
Rich et al. (1993)	Clearly defined study design; attempted to include measurement of costs; study design was adequately described, including randomization scheme and inclusion/exclusion criteria	Many outcome measures suggested efficacy but were nonsignificant in statistical testing, possibly due to the small sample size; did not include analysis of statistical power; short analytic horizon of the study limits the measurement of distal outcomes, such as mortality rates or long-term program costs; crude measurement of costs
Rich et al. (1995)	Collected detailed cost data; sample size was adequate to detect statistical differences between experimental and control group for most outcome measures; study design was well described, including randomization scheme, inclusion/exclusion criteria, and power calculations; study included a crude quality of life measure	Quality-of-life methods and cost methods were poorly defined; short analytic horizon of the study limits the measurement of distal outcomes
Naylor et al. (1994)	Examined medical and surgical patients separately, potentially capturing meaningful differences by diagnosis and treatment modality; study design was adequately described, including randomization scheme and inclusion/exclusion criteria	Many outcome measures suggested efficacy but were nonsignificant in statistical testing, possibly due to the small sample size; short analytic horizon of the study limits the measurement of distal outcomes
Naylor and McCauley (1999)	Examined medical and surgical patients separately	No cost data were provided; reasons for using a categorical data analysis were not described

study followed 98 patients for 90 days; the 63 patients in the intervention group enrolled in a multidisciplinary treatment strategy program with intensive teaching by a geriatric cardiac nurse, a detailed review of medications, comprehensive discharge planning, dietary teaching, and close follow-up after discharge through home care and telephone contacts.

For inclusion in the study, the patient had to be older than 70 years of age, had to have either radiological evidence of congestive heart failure or a documented history of congestive heart failure with consistent findings, and had to respond to diuresis. Patients were stratified by risk group, and those deemed to be at low risk (fewer than two risk factors for congestive heart failure hospitalization) were excluded from the study.

Among moderate-risk patients, the readmission rate was 42.2 percent lower in the intervention group ($p = .10$) (see Table 3). Readmission rates in the high-risk group were similar, with approximately 43 percent of patients from each group readmitted; however, the time to readmission was shorter in the high-risk intervention group than in the high-risk control group (27.8 days versus 60.2 days, $p = .026$). The authors hypothesized that this may be a result of better follow-up among treated patients, thus leading to the prompt detection of medical conditions and rapid initiation of therapy. Lacking mortality statistics, however, no data were available to support or refute this hypothesis. It is also impossible to know whether early detection is beneficial, should the hypothesis prove to be correct. Other results, including those regarding ALOS in the hospital, were not statistically significant.

Although the overall statistical power of the study was low, the intervention achieved an absolute reduction in readmissions of 20 percent among moderate-risk patients, and the median charge for a congestive heart failure hospitalization at the time was \$3,631 (\$4,492 in 2000 dollars). The authors assumed a cost/charge ratio—which is used to adjust for artificial price inflation by hospitals—of 0.8, and they then multiplied the savings per patient by the national number of congestive heart failure discharges to calculate an annual projected cost savings of \$145.2 million (\$179.6 million in 2000 dollars) for the study intervention. Given that these results were based on a nonsignificant reduction in admissions—albeit possibly due to the small sample size and subsequent lack of statistical power—no conclusions can be drawn from them. However, they do provide context for the Rich et al. (1995) study, which mitigated some of these limitations.

While the study site and 90-day intervention design were the same in this later randomized trial, it had a larger sample of 282 patients, with 142 patients in the treatment group, and adequately detailed cost data were collected. Similar exclusion criteria were employed, with low-risk patients eliminated from the study. In this study, however, patients were not stratified by risk group.

TABLE 3 Efficacy and Cost Results from Published Prospective Randomized Trials

<i>Study</i>	<i>Principal Result</i>	<i>Cost (2000 U.S. dollars)^a</i>
Rich et al. (1993)	Readmission rate 42.2 percent lower among moderate-risk patients	Savings of 20 percent (\$4,492 per patient per year)
Rich et al. (1995)	Readmission rate 44.4 percent lower; hospital days 36.6 percent lower	Savings of \$2,251 per patient per year
Naylor et al. (1994)	Readmission rate 57 percent lower at 6 weeks in medical intervention group (not significant at 12 weeks)	Savings of \$19,699 per patient per year in medical intervention groupb (not significantly lower for surgical group)
Naylor and McCauley (1999)	In medical intervention group: hospitalized days decreased by 54 percent; in surgical intervention group: number of readmissions up to 6 weeks 62 percent lower	No cost data; however, the intervention is similar to Naylor et al. (1994)

a. Costs were adjusted to 2000 U.S. dollars using the medical portion of the Consumer Price Index.

b. Calculated by dividing total savings by the number of patients over the 12-week study period and then extrapolating these savings to one year.

With the enhanced sample size, they found that the number of overall readmissions was reduced by 44.4 percent in the treatment group ($p = .02$), paralleling their earlier findings, and the number of readmissions for heart failure was reduced by 56.2 percent in the treatment group ($p = .04$). In addition, 16.4 percent of the control group had more than one readmission, compared to 6.3 percent of the treatment group ($p = .01$). Lengths of stay were reduced by 36.6 percent in the treatment group ($p = .04$). In this study, the authors examined distal outcomes such as deaths, survival without readmission, and deaths without readmission. There were fewer deaths, and survival times were longer among experimental group participants, but none of these results were significant (again, possibly due to a relatively short follow-up time and a small sample size). A subgroup sample of 126 patients was used to measure quality of life; these patients answered questionnaires rating factors such as fatigue and emotional function. Scores were higher in the treatment group than in the control group (22.1 out of 28 versus 11.3 out of 28, respectively; $p = .001$).

In their cost analysis, Rich et al. (1995) assigned different hourly rates for nurses and unpaid caregivers, and other costs, such as hospital admissions, were based on the allowed reimbursements provided according to standard codes for each diagnosis-related group (DRG). The average cost of the intervention was \$336 per patient (\$416 in year 2000 dollars). However, the costs of hospital readmissions were higher in the control group by an average of \$1,058 per patient ($p = .03$). In total, the overall cost of care was higher in the control group by \$460 (\$569 in year 2000 dollars) over the 90-day study period, or an average of \$153 per patient per month. In 2000 dollars, savings would have been \$188 per patient per month or \$2,251 per year.

Another pair of studies was conducted at the Hospital of the University of Pennsylvania. The first randomized clinical trial, Naylor et al. (1994), also enrolled patients aged 70 and older, to study the effects of comprehensive discharge planning for elderly patients hospitalized for congestive heart failure. The comprehensive discharge planning intervention evaluated by these authors consisted of six elements: (1) comprehensive initial and ongoing assessment of the discharge planning needs of the elderly patient and his or her caregiver, (2) development of a discharge plan in collaboration with the patient and all health care team members, (3) validation of patient and caregiver education, (4) coordination of the discharge plan throughout the patient's hospitalization through 2 weeks after discharge, (5) interdisciplinary communication, and (6) ongoing evaluation of the effectiveness of the discharge plan.

This study followed 276 patients for 12 weeks. These patients were analyzed separately, according to whether they were medical or surgical DRGs. There were 72 patients in the medical intervention group and 70 in the control group. There were 68 patients in the surgical intervention group and 66 in the surgical control group.

While almost all ALOS and readmission statistics are significant for 2- and 6-week follow-up for the medical group, the statistics at the 12-week follow-up were not, due to a reduction in the magnitude of effect for the intervention. For instance, during the initial 2-week period after discharge, 16 percent of the control group and 4 percent of the intervention group were readmitted ($p = .02$). After 6 weeks, 10 percent of the intervention group versus 23 percent of control patients had been readmitted ($p = .04$). Results regarding the length of time between initial discharge and readmission do indicate a longer time to readmission in the intervention group, but these numbers are not statistically significant. No statistically significant differences were found between intervention and control data found in the surgical group at any point in time.

Subsequently, lower charges for intervention group patients were found only in the medical DRG, and only for care up to 6 weeks after discharge.

Charges for rehospitalizations, health services after discharge, and nurse specialists' services were analyzed both separately and in total. Because the number of days of rehospitalization was lower in the intervention group, total charges were \$170,248 lower at 2 weeks after discharge (\$203,966 in 2000 dollars, $p = .001$) and \$137,508 lower between 2 and 6 weeks after discharge (\$164,693 in 2000 dollars, $p = .001$). When cumulative data are considered, total health care services charges at 6 weeks after discharge were \$295,598 less for the medical intervention group than for the control group (\$354,038 in 2000 dollars, $p = .02$). Dividing this figure by the total number of patients in the experimental group yields a savings of \$4,917 over the 12-week period or \$19,699 per patient per year. However, given that the effectiveness of the intervention decreases over time and the costs of the intervention are high, it is unlikely that long-term savings would actually be realized. It is also unclear whether all of the costs of the intervention were included in these calculations.

The results in the later Naylor and McCauley (1999) study differ in patient demographics from the other three; its participants were age 65 and older, rather than 70 and older, and may have contained few members of minority groups in the surgical intervention arm (the specific racial and ethnic composition of the patients is not stated, however).

The patients were admitted from their homes to either the Hospital of the University of Pennsylvania or the Presbyterian Medical Center of the University of Pennsylvania Health System. The study followed 202 patients, a sample drawn from 363 admitted in the hospitals from the study period, for 24 weeks. Of these 202 patients, 108 were in the medical status group, with 52 participating in the intervention, and there were 94 in the surgical status group, with 44 participating in the intervention. The 24-week postdischarge follow-up program consisted of comprehensive discharge planning and care from advanced practice nurses for 4 weeks after discharge. These nurses conducted an initial assessment, visits every 48 hours during the index hospitalization, and a minimum of two home visits. In addition, the nurses were available via telephone 7 days a week, and they initiated weekly telephone calls.

Results were reported both categorically (e.g., the number of patients admitted one or more times) or as means, depending on the outcome measure. The authors did not comment on why different outcome measures were used. The authors also tested different categorical outcomes depending on the group evaluated. For instance, the authors examined two or more readmissions in the medical group and one or more readmissions in the surgical group. Standard practice is to use identical outcome measures across groups.

Among medical congestive heart failure patients, those in the intervention group were less likely to have been readmitted two or more times ($p = .05$), and

the hospital days per patient decreased from 5.0 in the control group to 2.3 days in the intervention group ($p = .05$). Other statistics for the medical congestive heart failure patients, including the number of readmissions, were not statistically significant. Surgical congestive heart failure patients in the control group were more likely to be readmitted at least once (36 percent) than those in the intervention group (18 percent, $p = .05$). In addition, the number of readmissions up to 6 weeks after discharge decreased from 12 in the control group to 4 in the intervention group ($p = .02$). Other results among surgical congestive heart failure patients, including hospital days, were not statistically significant.

Each of the studies was limited by a small sample size and an analytical horizon that was too short to measure the effect of the interventions on mortality rates. Most of the studies demonstrated trends toward better outcomes in the experimental group than in the control group. However, with the exception of Rich et al. (1995), only primary outcomes demonstrated statistically significant results for the bulk of the outcome measures under study. This is disconcerting in that 1 in 20 outcomes may be attributed to chance alone, and the authors generally did not adjust their results.

All of the studies failed to follow participants over a period of time adequate to capture distal outcomes, such as deaths or long-term costs. Therefore, the authors of these studies relied on proximal outcome measures such as hospital days and readmission rates as their primary outcome measure. These studies also generally failed to provide detailed descriptions of the interventions studied, relying instead on nonspecific terms such as *comprehensive discharge planning*.

These studies were also somewhat limited by their settings. For example, each was conducted at a university medical center in an urban setting. Their results may not be comparable to those found in a rural setting or other settings where specialized comprehensive care is not available. Moreover, the setting of these studies and small sample size limited their ability to capture potentially meaningful differences in outcomes by race or socioeconomic status. This may be relevant since some groups may be less adherent to protocols or may use optional services at a lower rate than others. The later Naylor and McCauley (1999) study sheds some light on intervention effects by socioeconomic status. While the surgical congestive heart failure care patients tended to be white, male, and well educated, those in the medical congestive heart failure care sample tended to be female, more poorly educated, and nonwhite. Given the similarity of the results for each intervention, it is possible that this intervention was externally valid across demographic groups.

PREINTERVENTION-POSTINTERVENTION DESIGNS

A second category of articles on discharge planning and congestive heart failure care includes those describing preintervention-postintervention studies, in which data from a convenience sample of patients were examined both before and after an intervention. The samples are not randomized, so these studies may merely reflect year-to-year changes in patient care or in the characteristics of patient populations. Nevertheless, collectively, the findings may be suggestive of the directionality of the effects of multifaceted interventions and may help researchers pinpoint issues for further discussion or investigation.

These studies measure costs, readmission rates, and ALOS before and after an intervention program dealing with unique clinical pathways and home care for congestive heart failure. For instance, Fonarow et al. (1997) examined the effects of a comprehensive heart failure management program, with initial assessment, medications, education, and care and monitoring after discharge. The authors found an 85 percent reduction in hospital admissions ($p < .0001$), and the estimated savings in hospital admissions, less the initial hospital costs for management, was \$9,800 per patient (\$10,793 in 2000 dollars).

Riddle, Dunston, and Castanis (1996) examined the implementation of a multidisciplinary team approach to rapid recovery in congestive heart failure care for patients with a broad array of cardiovascular conditions. Cardiovascular surgeons, anesthesiologists, staff nurses, clinical nurse coordinators, and the patient care manager arranged home health, social service, pastoral, dietary, pharmacy, cardiac rehabilitation, perfusion, and respiratory therapy care. The primary difference between the approach by Riddle, Dunston, and Castanis and the studies described in the prospective randomized controlled trials above is the optimization of inpatient medications (i.e., the use of short-acting anesthetics among surgical patients) and more extensive coordination of inpatient care. Lengths of stay were reduced ($p = .001$), and average costs decreased for three out of four selected DRGs, but these results were not statistically significant. Moreover, it was not clear that all of the costs of the intervention were accounted for.

Riegel et al. (1996) used a convenience sample to test the effects of an early discharge program that included inpatient interventions similar to Riddle, Dunston, and Castanis (1996) as well as specialized outpatient services, such as a home care cardiac specialty team, on hospital lengths of stay and direct variable costs. Direct variable costs are those costs spent on goods and services that can change when an intervention is applied (such as the consumption of a medicine). Fixed costs include items such as hospital maintenance, which remain stable regardless of the care provided. While hospital lengths of stay did not decrease substantially, inpatient direct variable costs decreased by an

average of \$1,790 (\$2,072 in 2000 dollars) per patient. These authors claimed that costs were significantly lower and patient satisfaction significantly higher among participants receiving the intervention; however, the 95 percent confidence intervals for these measures overlapped between the intervention and control groups.

DISCUSSION

In this article, we reviewed published randomized prospective trials of inpatient multifaceted programs targeted toward reducing morbidity associated with congestive heart failure and described various related interventions and outcomes from preintervention-postintervention designs, which are more prevalent in the literature. While the different studies vary in their quality and statistical power, each indicates, or at a minimum suggests, that multifaceted interventions can have a beneficial effect on readmission rates and lengths of stay, potentially reducing costs beyond the initial cost of the intervention. Not all of these studies demonstrated statistically significant reductions in the outcomes they examined. However, the direction of all effects was consistent. This is especially relevant given that the statistical power of all but one of the studies was likely inadequate.

Given the poor statistical power of these analyses, a meta-analysis of these studies would provide useful information on their overall effectiveness. Unfortunately, these studies differ in the type and scope of intervention applied and have disparate inclusion and exclusion criteria, so a credible meta-analysis is not feasible. From a patient care perspective as well as an accounting perspective, it is tempting to implement inpatient, home care, and ambulatory care programs at face value since these programs have the potential to reduce readmission rates, reduce length of stay, improve health-related quality of life, and even reduce mortality rates (Philbin 2000).

Countering this argument are questions surrounding publication bias, the external validity (the validity of generalizing the study results to other institutions) of such studies, and the failure of these studies to include all relevant costs. It is conceivable that studies that demonstrated limited efficacy or high costs either went unpublished or were not submitted for publication. Researchers who investigate multifaceted interventions may be too invested in them to include all relevant costs or may not have the economic backgrounds necessary to understand which costs are relevant and which are not. The absence of patient time costs in most analyses stands out as evidence of the latter.

Moreover, these studies were designed to measure efficacy—the performance of multifaceted interventions under experimental conditions—rather

than effectiveness or performance under real-world conditions. In the real world, factors such as institutional culture may play a role. Some hospitals are set up with coordinated care teams in place, and such teams may simply require refocusing and enhancement. Other institutions may rely heavily on outpatient providers that have admitting privileges, without offering intensive internal oversight. In these instances, institutions may deal with a myriad of providers that may be unfamiliar with, or lack access to, institutional protocols. Therefore, it is important for hospitals considering implementing these programs to assess their patient populations, their institutional cultures, and their internal allocation of resources before considering such programs.

In the broader picture, local needs should also be considered when implementing such programs. Multiethnic communities may see providers as benevolent instructors rather than collaborators or may not believe that the care being delivered is efficacious (Green, Betancourt, and Carrillo 2002). In inner-city environments, social work needs may override other considerations. In any setting, interpersonal conflicts both between medical care teams trained in different specialties and between providers and patients may require mediation. One way of circumventing such problems is to pilot test any planned interventions and adjust the program design before full implementation. This way, it is possible to address problems before they surface and potentially avoid unnecessary conflicts or costs. Participatory models, which involve the democratic input of all players—specialists, nurses, administrators, and patients—in their design may improve the chances of success.

A cost-effectiveness analysis of these interventions would go a long way toward improving real-world evaluation of such programs. The distinction made in this review between the cost and efficacy of an intervention and the cost-effectiveness of an intervention is deliberate. While a cost-effectiveness analysis attempts to evaluate the performance of a strategy under real-world conditions and is careful to enumerate costs according to the perspective of the analysis, the studies evaluated here provide limited clinical efficacy data alongside coarse estimates of costs (Gold et al. 1996; Muennig 2002). For instance, a cost-effectiveness analysis from the societal perspective includes all costs, regardless of who pays for them, and attempts to measure changes in morbidity and mortality when the intervention is applied. The literature to date on comprehensive care programs for patients with congestive heart failure lacks sufficient follow-up to capture important distal outcomes such as mortality rates, adequate description of the interventions themselves, and adequate documentation of program costs. Given Naylor et al.'s (1994) findings that benefits of multifaceted interventions may dissipate over time, long-term follow-up is especially relevant. Most studies cited here also fail to

indicate whether all of the costs associated with the inpatient management/discharge planning and care strategies were captured or include a piggybacked cost component (see, for instance, Weinberger et al. 1998). Omitted intervention costs result in an overestimate of the economic benefits of the programs (Gold et al. 1996; Muennig 2002).

Given the limited space allotted to original research studies in most journals, it is difficult for either cost-effectiveness researchers or hospital administrators to glean exactly what the interventions entailed, what conflicts ensued in their implementation, or what the itemized costs were. Comprehensive program information could be a larger component of published program evaluations or made available via the Internet. Finally, future prospective randomized trials might be directed at specific interventions, rather than at multifaceted interventions, to better delineate which components are effective and which are not. It is impossible to ascertain whether dietary education, for instance, was more effective than telephone monitoring. This would allow practice guidelines to be further tailored.

Those studies that do examine individual interventions have suggested some efficacy using preintervention-postintervention design. For example, one study examined the effects of intensive home care surveillance alone on morbidity rates of elderly patients with severe congestive heart failure in Israel (Kornowski et al. 1995). The overall hospitalization rate and cardiovascular-specific hospitalization rate decreased by 62 percent and 72 percent, respectively ($p < .001$), suggesting that home care alone is an effective intervention. However, other studies of the cost and efficacy of home care have produced mixed results (Dennis et al. 1996; Hughes et al. 2000; Martens and Mellor 1997; Miller, Warren, and Myers 1996). Few efficacy data were available for other interventions.

Despite these concerns, little evidence has surfaced to date that multifaceted interventions are ineffective or unusually expensive. Given their potential for benefit, prudence suggests cautious implementation rather than a wait-and-see approach. When implemented with careful consideration of the institutional culture, the patient base, the infrastructure needs, and the financial capacity of the institution, these programs may have a greater chance of succeeding. Hospitals may also wish to conduct their own internal evaluations of the feasibility of their programs by piloting them before full implementation. Given that the efficacy of medical treatments for congestive heart failure has improved greatly over the past few decades (Levy et al. 2002), it is remarkable that interventions to improve the medical care and management of this disease are not yet the standard of care.

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