

## Disease Management Interventions to Improve Outcomes in Congestive Heart Failure

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### Abstract

This study is part of a planned 24-month, multicenter, longitudinal comparison of a comprehensive congestive heart failure (CHF) disease management program and was designed to determine effectiveness after 12 months of implementation. The impact of interventions such as telemonitoring of patients, post-hospitalization follow-up, and provider education on selected primary outcomes (hospital admission and readmission rates, length of stay, total hospital days, and emergency room utilization) in a managed care setting was evaluated. Subjects in the study included all participants in the managed care plan, as well as 149 selected program participants. The effects of the program were analyzed for pure CHF and CHF-related diagnoses, with outcomes for the third quarter of 1996 (postintervention follow-up) being compared with those for the third quarter of 1995 (preintervention baseline). Overall, the data demonstrated significantly reduced admission and readmission rates for patients with the pure CHF diagnosis. Among the entire CHF patient population, the third quarter admission rate declined 63% ( $P = 0.00002$ ), and the 30-day and 90-day readmission rates declined 75% ( $P = 0.02$ ) and 74% ( $P = 0.004$ ), respectively. Among program participants with pure CHF diagnoses, the 30-day readmission rate was reduced to 0, and an 83% reduction occurred for both the third quarter admission ( $P = 0.008$ ) and 90-day readmission ( $P = 0.06$ ) rates. In addition, the average length of stay for patients with CHF-related diagnoses was significantly reduced among both plan participants ( $P = 0.03$ ) and program participants ( $P = 0.001$ ). Reductions were also seen in total hospital days and emergency room utilization. These data thus indicate that a comprehensive disease management program can reduce

healthcare utilization not only among CHF patients in the program but also among the entire managed care plan population.

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Congestive heart failure (CHF) has been shown to be an appropriate target for disease management intervention programs because of its relatively high prevalence and high treatment costs.<sup>1-6</sup> According to the American Heart Association, CHF affects about 4.7 million Americans, and 400,000 new cases are diagnosed each year. The disease is present in up to 4.5% of elderly men and up to 3.3% of elderly women. Patients with CHF face a poor prognosis—mortality rates at 1 and 5 years are 10% and 50%, respectively, according to data compiled by the Agency for Health Care Policy and Research.<sup>2</sup> CHF directly leads to about 36,000 deaths each year and is estimated to contribute to an additional 250,000 deaths.<sup>6</sup> The mortality among patients hospitalized for CHF range from 8%<sup>3,7</sup> to 19%.<sup>1</sup>

Hospitalization places a financial burden on the healthcare system. In 1990, CHF treatment costs totaled more than \$10.3 billion, of which \$7.5 billion was attributed to 5.8 million days of hospitalization.<sup>2</sup> CHF is the primary cause of hospitalization in patients older than 65 years of age, and the hospitalization rate is climbing.<sup>8</sup> In 1993, hospital discharge records indicated that 900,000 admissions were due to CHF, more than twice the number reported in 1979. Women accounted for about 55% of these CHF hospitalizations.<sup>6</sup> Almost 50% of the patients discharged with CHF are readmitted to the hospital within 90 days.<sup>4</sup>

The national incidence and associated financial burden of CHF are expected to increase as the popu-

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lation ages and as the life expectancy of patients with cardiovascular disease is extended. More patients are surviving heart attacks, which increases the risk for CHF; also, patients with CHF are surviving longer.<sup>3</sup> Therefore, because the number of elderly patients enrolled in managed care plans is expected to increase, such plans will have increased numbers of patients at risk for CHF.

Previous hospitalization for CHF is the risk factor with the greatest predictive value for subsequent CHF hospitalizations.<sup>3</sup> Other factors predictive for CHF rehospitalization include smoking, patient weight,<sup>3</sup> previous myocardial infarction, increasing age, female gender, left ventricular wall motion score, use of digitalis or furosemide,<sup>9</sup> diabetes mellitus, elevated systolic blood pressure, and increased blood urea nitrogen and serum sodium levels.<sup>10</sup>

Other factors that make CHF appropriate for programmatic long-term medical intervention are (1) significant variations in CHF treatment practices and drug usage; (2) poor patient compliance with treatment; (3) high rates of acute care such as hospital and emergency room (ER) use; and (4) availability of established treatment guidelines. Thus, poor inpatient and outpatient care for patients with CHF affect outcomes negatively and result in higher mortality rates.<sup>14,15</sup> However, intensive and appropriate attention to risk-factor reduction (by stratifying patients for risk after hospital admission), together with CHF intervention programs, can reduce the frequency and length of hospital stays for patients and improve patients' quality of life.<sup>1-5,10-13,16,17</sup> Clinically justifiable reductions in hospital length of stay do not increase postdischarge mortality rates for patients with CHF.<sup>18</sup> Improved compliance with drug therapy can reduce mortality among patients with CHF<sup>19,21</sup> and also leads to significant cost savings.<sup>22,23</sup>

On the basis of these considerations, a comprehensive disease management program for CHF was developed by NYLCare Health Plans of New York (NYLCare) in collaboration with SDMS, Inc. (Wilmington, DE), a medical management and consulting firm. This intervention is based on national guidelines from the American College of Cardiology and American Heart Association,<sup>24,25</sup> the Agency for Health Care Policy and Research,<sup>2</sup> and NYLCare Health Plans (January 1996). The intervention is designed to provide early intervention after worsening of a patient's condition, in an effort to reduce or eliminate future more costly treatment. Interventions include education and telemonitoring of patients, which are important because compliance with drug

therapy and accepted treatment guidelines are key factors in determining the success of a CHF disease management program. The provider education arm includes providing physicians with current information on patient status, the plan's CHF treatment guidelines, and CHF treatment options. This educational emphasis is critical because the lack of knowledge about proper CHF management is the leading factor in hospital readmissions.<sup>4</sup>

This study investigated the impact of our comprehensive CHF disease management program on selected primary outcomes not only among patients with CHF enrolled in the program, but also among the entire managed care organization membership. This analysis is part of a planned 24-month, multicenter, longitudinal comparison. It was conducted to examine the effectiveness of the program after 1 year of implementation.

#### ... METHODS ...

##### CHF Disease Management Program

The components of the CHF disease management program were the following:

*Telemonitoring.* The telemonitoring program entailed a weekly phone call to the patient, during which a nurse obtained information about the patient's overall health and then administered an automated telephone questionnaire. Results from this questionnaire were provided to physicians, with a physician being notified immediately if a patient's score exceeded a predetermined threshold. Educational and informational mailings were generated based on results of the telemonitoring. The patient educational mailings included information on nutrition, medication compliance, exercise, and other relevant topics.

*Posthospitalization Discharge Intervention.* This included a home visit by a nurse with the patient. During the home visit, patients received additional education about CHF and self-management of the disease. Follow-up educational materials were mailed as needed.

*Physician Education.* Informational mailings and phone calls to physicians were designed to increase awareness of the CHF disease management program, treatment guidelines, formulary recommendations, and clinical studies that supported the guideline rationale.

##### Subjects

The telemonitoring and education-oriented interventions were available only to patients enrolled in the CHF disease management program. Patients were nominated for enrollment in the pro-

gram in one of three ways: (1) by their physician, (2) through a review of claims from October 1, 1994 through September 30, 1995 (claims were checked for the appropriate International Classification of Diseases, Ninth Edition [ICD-9] codes and for presentation of the patient at a hospital or ER), or (3) by a case manager after hospital discharge for a CHF event on or after October 1, 1995.

In addition, all patients in the NYLCare Health Plans were eligible for the recommended clinical interventions because participating physicians received the CHF treatment guidelines.

### Design

Enrollment in the intervention program began October 1, 1995. Data for the preintervention period were obtained through a review of medical claims occurring between October 1, 1994 and September 30, 1995. The postintervention period extended from October 1, 1995 through September 30, 1996. The mean duration of patient participation in the CHF disease management program as of September 30, 1996 was 161 days (SD, 110 days).

Hospital or ER utilization data for patients enrolled in the CHF disease management program were compiled by matching member identification numbers for program participants with the plan's utilization database. Hospital utilization data (ie, admission and readmission rates and lengths of stay) were based on a preauthorization database maintained by NYLCare. Data related to utilization of ER services were compiled from a NYLCare database of paid claims. Utilization events were assigned to the pure CHF or CHF-related diagnosis groups on the basis of a proprietary definition of pure CHF and CHF-related disease using ICD-9 codes. For pure CHF, the most common ICD-9 code was 428 (heart failure). CHF-related diagnoses were primary diagnoses that were associated with a secondary diagnosis of pure CHF and that occurred in more than 8% of the population (eg, pneumonia).

For the analysis of the plan population, 90-day admission rates were based on hospitalization rates per 1000 members (the rate denominator was the quarterly average monthly membership) for pure CHF and CHF-related diagnoses over a 2-year period beginning October 1, 1994 (fourth quarter) and ending September 30, 1996 (third quarter).

To analyze the impact of the CHF program on hospital and ER utilization, admission rates in the third quarter of 1996 were compared with those in the third quarter of 1995. This analytic strategy was chosen for three reasons: (1) seasonal variation in CHF admissions in northeastern United States (ie,

increased CHF admissions in the winter) would lead to underestimation of the effect of the program on reducing hospitalization rates; (2) the third quarter of 1996 was the period with the highest program enrollment; and (3) the CHF program was expected to have a cumulative effect, the impact increasing over time.

Analysis of CHF disease management program participants was limited to plan members who enrolled in the program between October 1, 1995 and September 30, 1996. As in the plan population analysis, hospital and ER utilization for CHF program participants was based on comparison of rates per 1000 patients from the third quarter of 1996 with rates per 1000 patients from the third quarter of 1995. The analysis excluded patients who died during participation and patients who disenrolled from the managed care organization (MCO) during the study period.

The Score test was used to test the null hypothesis of equal hospitalization rates. Student's *t*-test of means was used to examine differences in average length of stay per quarter for patients with a diagnosis of CHF.

### Outcomes

The following utilization measures were tracked for pure CHF and CHF-related diagnoses and for both groups combined :

- third quarter admission rate
- readmission rate (within 30 and 90 days)
- average length of stay
- total hospital days
- frequency of ER utilization.

## ... RESULTS ...

### Analysis of the Plan Population

This was based on membership of 139,922 for the third quarter of 1995 and on membership of 161,267 for the third quarter of 1996.

*Admission Rate.* The admission rate per 1000 members for patients with pure CHF diagnoses in the overall population declined 63% in the third quarter of 1996 compared with the third quarter of 1995, a highly significant improvement ( $P = 0.00002$ ). Reductions were found in the admission rates for the CHF-related and combined pure CHF and CHF-related diagnoses, but the differences were not statistically significant (Table 1).

*Readmission Rate.* The disease management program also had a statistically significant effect on reduc-

ing the 30-day and 90-day readmission rates per 1000 members for pure CHF diagnoses in the plan population.

The 30-day readmission rate for pure CHF diagnoses decreased 75% from 0.08 in the third quarter of 1995 to 0.02 in the third quarter of 1996 ( $P = 0.02$ ). For

CHF-related diagnoses, the 30-day readmission rate decreased 4% from 0.71 in the third quarter of 1995 to 0.68 in the third quarter of 1996 ( $P = 0.69$ ). For pure CHF and CHF-related diagnoses combined, the 30-day readmission rate declined 13% from 0.79 in the third quarter of 1995 to 0.69 in the third quarter of 1996 ( $P = 0.32$ ).

The 90-day readmission rate per 1000 members for the pure CHF diagnoses decreased 74% from 0.12 in the third quarter of 1995 to 0.03 in the third quarter of 1996 ( $P = 0.004$ ). For CHF-related diagnoses, the 90-day readmission rate decreased 4%, from 1.01 in the third quarter of 1995 to 0.97 in the third quarter of 1996 ( $P = 0.72$ ). For pure CHF and CHF-related diagnoses combined, the 90-day readmission rate declined 12%, from 1.14 in the third quarter of 1995 to 1.0 in the third quarter of 1996 ( $P = 0.27$ ) (Figure 1).

*Average Length of Stay.* The analysis also revealed a decline in average length of stay for patients with the pure CHF and those with the CHF-related diagnoses. With the pure CHF diagnosis, the average length of stay declined 26% from 7.6 days in the third quarter of 1995 to 5.6 days in the third quarter of 1996 (mean reduction, 2 days;  $P = 0.2$ ). With the CHF-related diagnoses, the average length of stay declined 21%, from 7.1 days in the third quarter of 1995 to 5.6 days in the third quarter of 1996 (mean reduction, 1.5 days;  $P = 0.03$ ) (Figure 2).

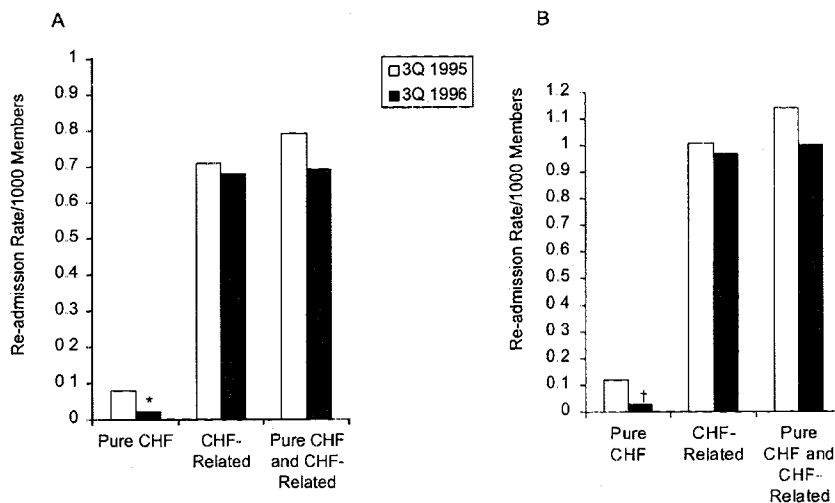
*ER Utilization.* Emergency room visitation rates per 1000 members for the third quarter of 1996 declined by 14% to 16% compared with the third quarter of 1995, but this reduction was not significant (Table 2).

**Table 1.** Third Quarter Admission Rates for CHF and CHF-Related Diagnoses for the Plan Population

Measure	3Q 1995 Rate per 1000 Members	3Q 1996 Rate per 1000 Members	Rate Ratio 3Q 1996/ 3Q 1995	Change in Rate (%)	P Value
Pure CHF	0.27	0.10	0.37	-63	0.00002
CHF-related	3.1	2.8	0.93	-7	0.27
Pure CHF and CHF-related	3.3	2.9	0.88	-12	0.06

3Q 1995, n = 139,922; 3Q 1996, n = 161,267.

**Figure 1.** 30-day (A) and 90-day (B) Hospital Readmission Rates Per 1000 Members for Pure CHF and CHF-Related Disorders and the Combined Diagnoses for the Plan Population



3Q 1995, n = 139,922; 3Q 1996, n = 161,267

\* $P = 0.02$

† $P = 0.004$

**Hospital Days.** Among the plan membership, owing to decreases in length of stay and admission rates, the number of third quarter 1996 hospital days per 1000 members declined 73% for pure CHF diagnoses and 27% for CHF-related diagnoses, compared with the third quarter of 1995 (Figure 4). Tests of significance were not conducted.

**Readmission Rate.** No 30-day readmissions were recorded during the third quarter of 1996 for patients with pure CHF diagnoses; this is a 100% reduction compared with 20.1 readmissions per 1000 patients in the third quarter of 1995. The 30-day

**Analysis of Program Participants**

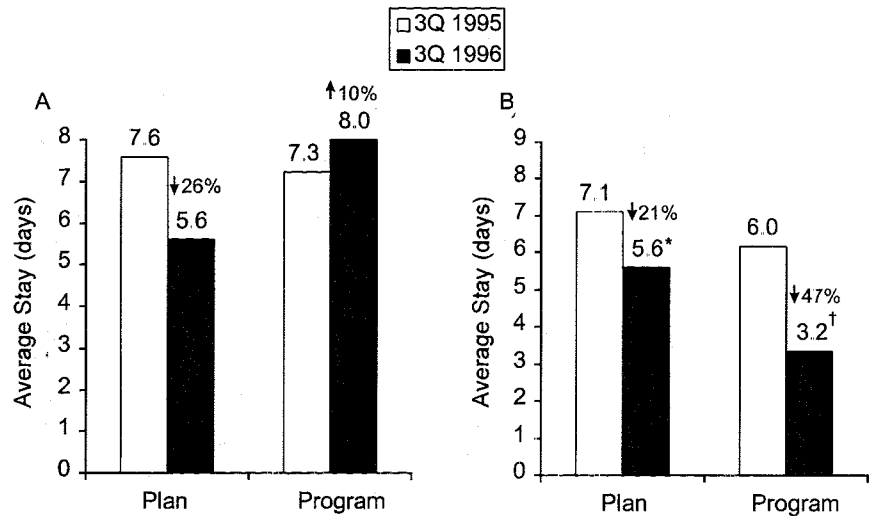
The average age of patients in the program was 75.4 years (as of January 1, 1997). The program population was 59% male and 41% female.

Ejection fraction and New York Heart Association (NYHA) Classification scores were not available for all patients in the program, but for those patients for whom data were available, the modal NYHA Classification score was 3 and the modal ejection fraction was 30%. The median ejection fraction was 30%, and the mean ejection fraction was 36.4% (SD, 15.7%; n = 73).

Analyses were restricted to 149 program participants who were enrolled in the CHF disease management program prior to October 1, 1996 and excluded patients who died (n = 15) or disenrolled from the managed care plan (n = 9) before October 1, 1996.

**Admission Rate.** Among program participants, third quarter day admission rates decreased by 83% for those with the pure CHF diagnosis (P = 0.008). Third quarter day admission rates were not significantly reduced for CHF-related admissions or for the pure CHF and CHF-related diagnoses combined (Table 3).

**Figure 2.** Average Length of Stay Among the Plan Population and Program Participants for Pure CHF (A) and CHF-Related (B) Disorders



Plan population: 3Q 1995, n = 139,922; 3Q 1996, n = 161,267; program participants: n = 149

\*P = 0.03

†P = 0.001

**Table 2.** Emergency Room Utilization Rates Among the Plan Population and Program Participants

Measure	3Q 1995 Rate per 1000 Members	3Q 1996 Rate per 1000 Members	Rate Ratio 3Q 1996/ 3Q 1995	Change in Rate (%)	P Value
<b>Plan Population</b>					
Pure CHF	0.029	0.025	0.86	-14	0.84
CHF-related	0.89	0.75	0.84	-16	0.19
<b>Program Participants</b>					
Pure CHF	6.7	0.0	0.0	-100	0.32
CHF-related	13.4	0.0	0.0	-100	0.16

Plan population: 3Q 1995, n = 139,922; 3Q 1996, n = 161,267

Program participants: n = 149

readmission rate per 1000 patients for the CHF-related diagnoses during the third quarter of 1996 was 26.8, which represents a 20% reduction when compared with the rate of 33.6 in the third quarter of 1995 ( $P = 0.01$ ). For the pure CHF and

CHF-related diagnoses combined, the 30-day readmission rate per 1000 patients decreased 50%, from 53.7 in the third quarter of 1995 to 26.8 in the third quarter of 1996 ( $P = 0.25$ ).

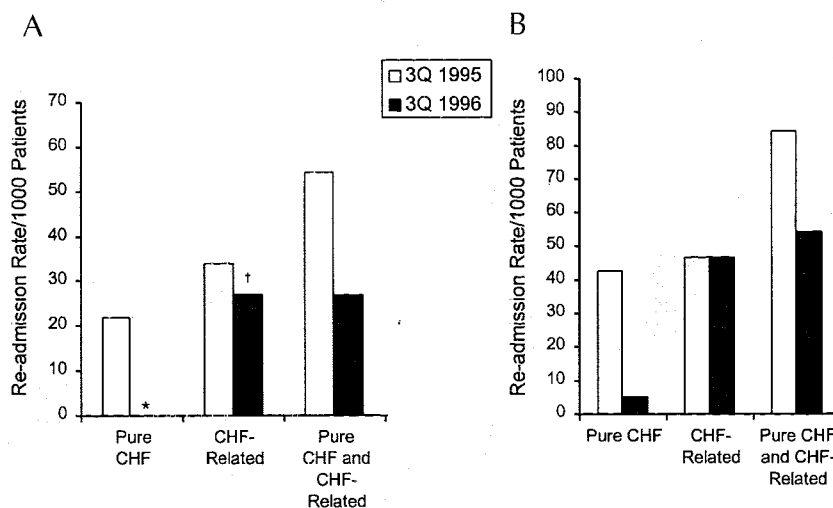
Ninety-day readmission rates per 1000 patients for the pure CHF diagnoses declined 83% from 40.3 in the third quarter of 1995 to 6.7 in the third quarter of 1996 ( $P = 0.06$ ). For the CHF-related diagnoses, the 90-day readmission rate per 1000 patients did not change from the 47.0 readmissions in the third quarter of 1995. For the pure CHF and CHF-related diagnoses combined, the rate decreased 38%, from 87.2 in the third quarter of 1995 to 53.7 in the third quarter of 1996 ( $P = 0.28$ ) (Figure 3).

*Average Length of Stay.* For the pure CHF diagnosis, the length of stay among program participants increased 10%, from 7.3 days in the third quarter of 1995 to 8.0 days in the third quarter of 1996. For the CHF-related diagnoses, the average length of stay declined 47%, from 6.0 days in the third quarter of 1995 to 3.2 days in the third quarter of 1996 (mean reduction, 2.8 days;  $P = 0.001$ ) (see Figure 2).

*ER Utilization.* There were no ER visits for patients with pure CHF or CHF-related diagnoses during the third quarter of 1996. This translates into a 100% reduction in ER utilization among program participants because ER visits in the third quarter of 1995 totaled 6.7 per 1000 patients for pure CHF diagnoses and 13.4 per 1000 patients for CHF-related diagnoses (see Table 2).

*Hospital Days.* Among program participants, total hos-

**Figure 3.** 30-Day (A) and 90-Day (B) Hospital Readmission Rates Per 1000 Patients for Pure CHF and CHF-Related Disorders and the Combined Diagnoses for the Program Participants



n = 149  
 \*3Q 1996 readmission rate = 0.  
 † $P = 0.01$ .

**Table 3.** Third Quarter Admission Rates for CHF and CHF-Related Diagnoses Among Program Participants

Measure	3Q 1995 Rate per 1000 Patients	3Q 1996 Rate per 1000 Patients	Rate Ratio 3Q 1996/ 3Q 1995	Change in Rate (%)	P Value
Pure CHF	80.5	13.4	0.17	-83	0.008
CHF-related	80.5	100.7	1.25	+25%	0.56
Pure CHF and CHF-related	161	114.1	0.71	-29	0.27

n = 149.

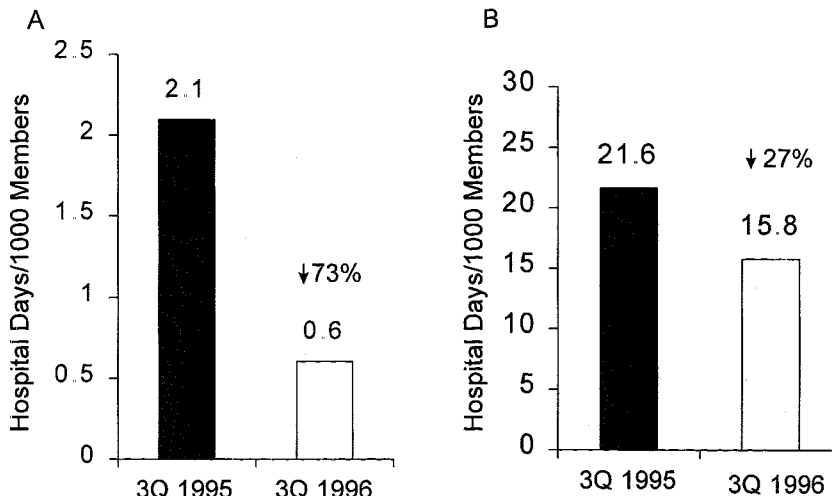
pital days for pure CHF and CHF-related diagnoses declined 82% and 33%, respectively (Figure 5). The program significantly reduced the mean hospital days per program participant for both pure CHF diagnoses ( $P < 0.001$ ) and CHF-related diagnoses ( $P = 0.01$ ).

... DISCUSSION ...

We have shown that a comprehensive CHF disease management program that includes intensive interventions, such as telemonitoring and physician and patient education, reduced health-care utilization not only in patients participating in the program, but in the overall plan population as well. The positive impact of the CHF disease management program was most pronounced for patients with pure CHF diagnoses, which are associated with high rates of hospital and ER utilization. Statistically significant reductions in the admission rate in both the overall plan population and the program participants were achieved for the pure CHF diagnoses, compared with the corresponding rates before the introduction of the program. Reductions were also found in readmission rates for pure CHF diagnoses among both the overall plan population and program participants. These reductions, however, were not significant for 30- or 90-day readmissions.

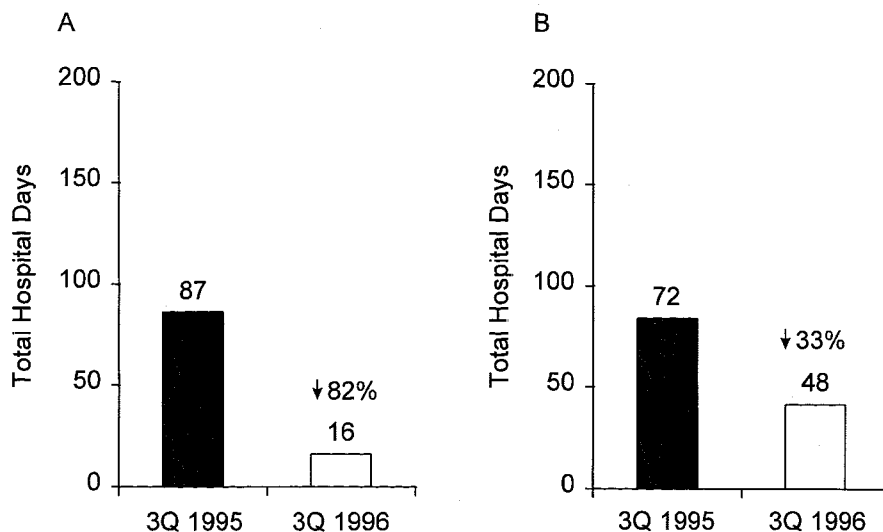
This reduction in admission and readmission rates with the CHF disease management program is consistent with other reports exam-

**Figure 4.** Hospital Days for Pure CHF (A) and CHF-Related (B) Disorders Per 1000 Members for the Plan Population



3Q 1995, n = 139,922; 3Q 1996, n = 161,267.

**Figure 5.** Hospital Days for Pure CHF (A) and CHF-Related (B) Disorders for the Program Participants



n = 149

ining CHF disease management initiatives.<sup>10,17</sup> Rich et al<sup>10</sup> reported that intensive interventions that focused on patient and family education, reduced the number of early (within 90 days) CHF readmissions by 56.5%. In our study, for the pure CHF diagnoses in the plan population, the admission rate declined 63%, and the 30- and 90-day readmission rates declined 75% and 74%, respectively. For pure CHF diagnoses in program participants, the admission rate declined 83%, and the 30-day and 90-day readmission rates declined 100% and 83%, respectively.

For the CHF-related and combined diagnoses, the reduction in admission and readmission rates was statistically significant only for the 30-day readmissions for CHF-related diagnoses among the program participants; however, the data suggest a downward trend within the overall plan population. The failure to demonstrate, at present, a significant reduction in the admission rate for the CHF-related diagnoses may be an indication that the definition of CHF-related diagnoses is too broad.

Statistically significant reductions in the average length of stay were found in admissions for CHF-related diagnoses for both the overall plan population and the program participants. For the pure CHF diagnoses, length of stay decreased insignificantly within the overall plan population and increased for program participants. This increase in the length of stay was not entirely unexpected. It suggests that the rate of admissions declined in response to implementation of the disease management program because only the sickest patients were admitted to the hospital for care of pure CHF episodes and the interventions for the remaining patients were shifted appropriately to the ambulatory care setting. Other CHF studies, however, have demonstrated a reduction in length of stay after disease management interventions and monitoring.<sup>10,17</sup>

When the number of hospital days are calculated on the basis of length of stay and the rate of admission, data reveal an overall reduction in hospital days for the third quarter of 1996 compared with the third quarter of 1995 among the entire plan membership and among program participants. Among the plan membership, owing to decreases in length of stay and admission rates, the number of third quarter 1996 hospital days per 1000 members declined 73% for pure CHF diagnoses and 27% for CHF-related diagnoses, compared with the third quarter of 1995. Among program participants, total hospital days for pure CHF and CHF-related diagnoses declined 82% and 33%, respectively. For CHF-related diagnoses, the decrease in length of stay was large enough to offset the higher admission rate, accounting for the reduction in hospital days. For pure CHF diagnoses, the decrease in admission rate was large enough

to offset an incremental increase in the length of stay, resulting in fewer hospital days.

Some limitations are associated with this analysis of data from the CHF disease management program. These include: (1) the small number of program participants studied reduces statistical power; (2) the study did not include a control group; and (3) consistent with the intention to treat principle, the program participant analysis retained members who did not die or disenroll from the plan and who were enrolled in the CHF disease management program at any time during the implementation period, including the third quarter of 1996. Analyses did not incorporate adjustments for duration of exposure to the CHF program; estimates of program effectiveness would likely increase were such adjustments to be made. There is a potential for selection bias with regard to the program participant analysis because the analysis was conducted employing data only from members who neither died nor disenrolled from the MCO. The excluded group may have been more ill than the program participants retained in the analysis. The mean age (75.6 years) and mean NYHA classification (2.7) of program participants retained in the analysis were essentially the same as the mean age (74.5 years) and mean NYHA classification score (2.9) of program participants excluded from the analysis. However, the mean ejection fraction for program participants retained in the analysis was 38.7 (n = 60), whereas the mean ejection fraction for program participants excluded from the analysis was 27.3 (n = 11). The magnitude of missing data for these measures of disease severity is too large to permit more than speculation about possible differences between these groups. (4) Inferences concerning program impact are based on the comparison of quarterly data, which are less stable than longer-term semiannual or annual data. Because patients with CHF were selected for the program on the basis of their high rate of service utilization, regression to the mean may partially account for the observed reductions in utilization among program participants. A time series analysis may be conducted to control for seasonal variation in utilization when more data points are available.

This ongoing study incorporates measures of quality of life and patient satisfaction, which are determined at 6-month intervals. However, the follow-up sample was inadequate at the time of writing for analysis of data on patient satisfaction and quality of life. Program-participant analysis may also be confounded by mortality, leading to an underestimation of reductions in hospital utilization. Although reduction of mortality is not an objective of the program, future analyses could examine the disease management program's effect on mortality.

... CONCLUSION ...

Despite the availability of published national CHF treatment guidelines, significant variations in the short-term treatment and long-term management of patients with this disease can lead to inadequate patient care, increased treatment costs, and ultimately, poor patient outcomes. In addition, CHF is an appropriate target for disease management intervention programs in managed care organizations because of its high prevalence, the high treatment costs, and the potential to improve outcomes through compliance with proven treatment practices.

In this study of a CHF disease management program, we have shown a reduction in hospital and ER utilization rates in a commercial and Medicare HMO population. The study is ongoing, and as more patients are enrolled in the program, future research will also examine whether the CHF disease management program improves quality of life and reduces mortality.

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