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ORIGINAL RESEARCH

The Paradox of Readmission: Effect of a Quality Improvement Program in Hospitalized Patients With Heart Failure

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BACKGROUND: Congestive heart failure (CHF) is an increasingly common condition associated with significant hospital resource utilization. Initiating better disease management at the time of initial hospital admission has the potential to reduce readmissions.

OBJECTIVE: To evaluate the impact of a multifaceted quality improvement program on 12-month hospital utilization in patients admitted to hospital with CHF.

DESIGN: Prospective longitudinal study comparing baseline and intervention cohorts.

PARTICIPANTS: All consecutive patients with CHF discharged alive from 3 metropolitan hospitals during the baseline (October 1, 2000 to April 17, 2001) and intervention (February 15, 2002 to August 31, 2002) study periods. Active prospective case-finding identified 220 baseline and 235 intervention participants; full data was available on 197 baseline and 219 intervention participants.

INTERVENTIONS: Education and performance feedback for hospital and primary care practitioners; clinical decision support tools; individualized, guideline-based treatment plans; patient education and self-management support; and improved hospital–community integration.

MEASUREMENTS: Twelve-month all-cause hospital readmission, 12-month mortality, readmission-free survival, heart failure–specific readmission, and total hospital days over 12 months.

RESULTS: Intervention patients had a higher rate of all-cause readmission (odds ratio [OR] = 1.65; 95% confidence interval [CI] = 1.10-2.46) but a trend to reduction in mortality (OR = 0.68; 95% CI = 0.44-1.07). There was no difference in frequency of hospitalizations per year, number of hospital days, or the composite outcome of death or readmission.

CONCLUSIONS: The intervention improved care processes and may have reduced mortality, but at the cost of higher readmission rates. Better understanding of intervention components, intensity, and targeting may optimize the effectiveness of disease management programs. ***Journal of Hospital Medicine*** **2010;5:148–153.** © *2010 Society of Hospital Medicine.*

KEYWORDS: **congestive heart failure, disease management, patient readmission, quality of health care.**

Congestive heart failure (CHF) is a common disease with high mortality and morbidity.[1,2] Better physiological understanding has led to significant advances in therapy in recent years, with synthesis of this evidence into widely available treatment guidelines.[3,4] However, patients who have had an acute hospitalization with heart failure continue to have a high rate of symptomatic relapse, with up to 25% readmitted within 3 months.[2] One of the major challenges in heart failure therapy is to avert these relapses to prevent hospital readmission.

Angiotensin-converting enzyme (ACE) inhibitors, beta-blockers, and spironolactone have promised a reduction in hospitalization rates as well as mortality; however, suboptimal prescribing[5] and adherence to therapy[6,7] may limit their anticipated benefits. This has led to interest in improved systems of care to reduce hospital utilization. Such approaches have included improved systems for optimizing medications,[6–8] comprehensive discharge planning and postdischarge support,[9–14] and self-management and case management strategies[15–17] to enhance patient participation in care.

Combinations of these strategies are known as disease management programs (DMPs), and trials of such combination strategies to improve patient outcomes have been promising.[18–23] Recognized features[4] include skilled multidisciplinary team care; individualized guideline-based

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treatment plans that may include dietary and exercise programs as well as optimal pharmacological therapy; patient education and self-management strategies; improved integration between hospital and community care providers; vigilant follow-up including prompt review after hospitalization; ready access to expert assessment in the event of deterioration; and regular monitoring with expert titration of therapy, through clinics, home visits, or telemonitoring. Several randomized controlled trials have suggested that DMPs may reduce heart failure-related[9,15–17] and all-cause[9,10] readmissions. Meta-analyses[12,18–23] have demonstrated reduction in risk of all-cause readmission of 12% to 25% as well as a reduction in mortality of 14% to 25%.

Trials of DMPs have generally involved careful participant selection, and differences in methods and outcome reporting have led some reviewers to be circumspect in their interpretation of the impact of these programs on readmission rates.[23] A large, "real-world" quality improvement program conducted as part of the Royal Australasian College of Physicians Clinical Support Systems Project provided an opportunity to measure whether a multifaceted program targeting a representative group of patients with CHF and their healthcare providers could reduce readmission rates. As previously published, this program delivered measurable improvements in processes of care including evidence-based prescribing, adherence, multidisciplinary involvement, and discharge communication, associated with a reduction in 12-month mortality.[24]

Objective

The Brisbane Cardiac Consortium sought to improve processes of care for patients with CHF by using evidence-based strategies targeting patients and their healthcare providers to optimize uptake of management guidelines, improve discharge processes between hospital and primary care, and increase patient participation in care. We hypothesized that the program would reduce hospital readmissions in the intervention patients in the first 12 months following discharge.

Methods

Setting

The program was conducted in 3 metropolitan public teaching hospitals in Brisbane, Australia (Royal Brisbane, Princess Alexandra, and Queen Elizabeth II Hospitals) and their associated Divisions of General Practice, targeting the hospital and posthospital care of patients with CHF.

Design

The study was a prospective time series study. Consecutive participants were enrolled continuously between October 1, 2000 and August 31, 2002. Interventions were introduced progressively as systems matured. For evaluation purposes, we predefined a "baseline" cohort (October 1, 2000 to April 17, 2001) who were admitted prior to implementation of any interventions, and an "intervention" cohort (February 15, 2002 to August 31, 2002) who were admitted after all interventions were mature. The study was approved by the Ethics Committees of all participating institutions.

Participants

All patients with a recorded clinical diagnosis of CHF within 48 hours of hospital presentation, and evidence of at least 2 supporting clinical signs (raised jugular venous pressure, third or fourth heart sounds, bilateral chest crackles, dependent edema, or cardiomegaly and/or pulmonary edema on chest x-ray) were identified prospectively by trained research nurses. Patients were ineligible for reevaluation if they had already been enrolled in the study. Detailed data were abstracted from the medical record including demographics, illness characteristics, and comorbid conditions.

Interventions

Provider-directed Interventions

Provider-directed interventions aimed to improve clinician compliance with agreed management guidelines using decision support tools, reminders, education and academic detailing, and regular performance feedback. These interventions were delivered by project staff and local clinical leaders and were directed toward both hospital clinicians (internists and cardiologists) and general practitioners providing community care.

Patient-directed Interventions

Patient-directed interventions included written evidence-based patient education, pharmacist discharge medication review and inpatient education, and patient diaries. Comprehensive discharge summaries including target-directed management plans were provided to the general practitioner and community pharmacist.

Participants were considered suitable for more intensive posthospital intervention and follow-up if they: (1) did not have cognitive impairment or psychiatric illness which would preclude participation in self-care; (2) did not have a life expectancy due to comorbidities estimated to be less than 6 months; (3) had a stable residence in the community where they could be contacted by telephone; (4) attended a general practitioner within the greater Brisbane area; and (5) consented to more detailed follow-up. In the baseline phase, this "intensive" group was contacted by nursing staff at 1, 3, 6, and 12 months for data collection purposes; in the intervention phase, these participants received enhanced predischarge pharmacist education; postdischarge pharmacist telephone follow-up of medication understanding and adherence; telephone reminders from project nursing staff at 1, 3, 6, and 12 months to attend their general practitioner; and individualized, written, guideline-based reminders sent to participating general practitioners.

Measures and Analysis

The primary outcome measure was all-cause hospital readmission over 12 months. Secondary outcomes included 12-

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month all-cause mortality, 12-month readmissions due to CHF, total hospital days, and the combined endpoint of death or readmission (ie, readmission-free survival) at 12 months.

Readmission data were obtained from the Queensland Health Information Centre by matching patient data with the Queensland Hospital Admitted Patient Data Collection. Admission to any Queensland hospital is captured in this database. Readmission was defined as due to CHF ("same-cause") if a principal diagnosis code from ICD-10-AM code chapter I50 was assigned. Mortality data were obtained from the Australian Institute of Health and Welfare (AIHW) National Death Index.

Processes of inpatient care were collected by trained research nurses using a standardized structured chart abstraction tool. Data items were based on guideline recommendations for patient assessment, investigation, and management.

All analyses were conducted using SAS version for Windows 9.1 (SAS Institute, Cary, NC). Baseline and intervention patient characteristics were compared using independent samples *t* test for continuous variables and contingency tables with chi-square tests for proportions.

Logistic regression models adjusted for hospital and post-hospital intensity (considered to be significant potential confounders) were used to test the strength of association between the intervention and readmission (or death and readmission); Cox proportional hazards model was used to assess the time to first readmission or death. A Wilcoxon 2-sample test was used to compare total number of days in hospital over the 12-month follow-up period, as these data were highly positively skewed; means rather than medians are reported, as the median was 0 in each group and hence uninformative. Frequency of readmission was compared using Poisson regression adjusted for hospital. A *P* value of 0.05 was considered significant in all analyses.

Preliminary analysis revealed a number of differences in baseline clinical characteristics between the 2 groups. To account for measured differences other than hospital and intervention intensity, propensity scores (the conditional probability of assignment to a particular treatment group given a vector of observed covariates) were developed using a logistic model with the control or intervention group as the dependent variable and baseline patient characteristic variables with $P < 0.2$ (as shown in Table 1) as the independent variables. The equation obtained from this model was used to estimate a propensity score for each patient. These scores along with hospital and intervention intensity were then used to provide estimates adjusted for baseline differences between the control and intervention groups.[25]

Results

There were 220 patients identified with a clinical diagnosis of CHF during the baseline period, and 235 during the intervention period. Figure 1 shows ascertainment, in-hospital mortality, and eligibility rates for the 2 cohorts. Eighty-nine (45%) of baseline patients and 76 (35%) of intervention patients received "intensive" posthospital follow-up as described above. Information on readmission was available for 197 baseline patients and 219 intervention patients discharged alive; this is the sample used for all analyses in this report. Table 1 shows the demographic and clinical characteristics of these patients. Table 2 summarizes the previously reported improvements in processes of care.

TABLE 1. Characteristics of Baseline and Intervention Participants

Characteristic	Baseline (n = 197)	Intervention (n = 219)	*P* Value
Hospital, n (%)			0.001
1	75 (38)	100 (46)	
2	40 (20)	17 (8)	
3	82 (42)	102 (46)	
Age (years), mean (range)	75 (24-100)	78 (32-102)	0.059
Female, n (%)	103 (52)	118 (54)	0.74
Hostel resident, n (%)	15 (8)	38 (17)	<0.01
Previous CHF admission, n (%)	52 (26)	26 (12)	<0.01
Contributing factors, n (%)			
Hypertension	104 (53)	139 (63)	0.027
Coronary disease	107 (54)	118 (54)	0.93
Valvular disease	20 (10)	45 (21)	<0.01
Cardiomyopathy	29 (15)	33 (15)	0.92
NYHA class III/IV, n (%)	143 (73)	155 (71)	0.68
Atrial fibrillation, n (%)	65 (33)	78 (36)	0.57
LVEF % (mean)	24	28	0.10
Cardiologist care, n (%)	42 (21)	61 (28)	0.12
Comorbidity score	2.6 (1,8)	2.7 (1,10)	0.52

Abbreviations: CHF, congestive heart failure; LVEF, left ventricular ejection fraction; NYHA, New York Hospital Association.

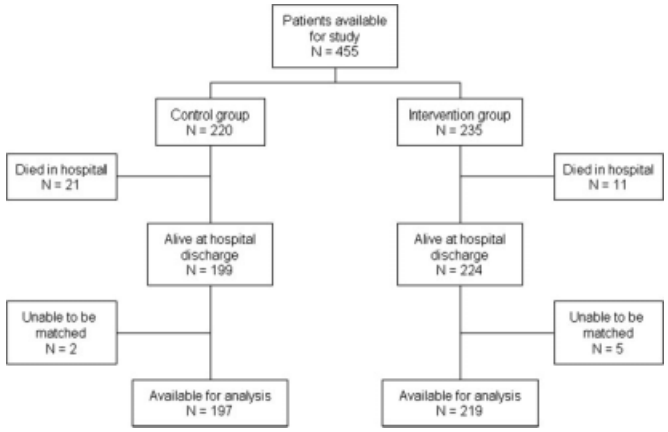

FIGURE 1. Flow diagram for participant enrollment. Baseline (control) cohort: consecutive patients with CHF admitted to study hospitals October 1, 2000 to April 17, 2001. Intervention cohort: consecutive patients with CHF admitted to study hospitals February 15, 2002 to August 31, 2002; 7 participants were excluded because they were unable to be matched to readmission datasets.

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TABLE 2. Processes of Inpatient Care for Baseline and Intervention Cohort

Process indicator	Baseline (n = 220) [n (%)>]	Intervention (n = 235) [n (%)]	*P* Value
Assessment of reversible triggers	166 (75)	211 (90)	<0.001
DVT prophylaxis	57 (26)	148 (63)	<0.001
Imaging of left ventricular function	135 (61)	164 (70)	0.002
Scheduled outpatient visit within 30 days	87 (46)*	130 (59)†	0.005
ACE inhibitor prescription at discharge	136 (71)*	163 (74)†	0.46
Beta-blocker prescription at discharge	61 (32)*	113 (52)†	<0.001
Avoid deleterious agents at discharge	180 (94)*	214 (98)†	0.79

Abbreviations: ACE, angiotensin converting enzyme; DVT, deep vein thrombosis.

*Denominator is patients discharged alive and not transferred to another facility; n = 191.

†Denominator is patients discharged alive and not transferred to another facility; n = 219.

TABLE 3. Readmission and Death Rates

	Baseline (%)	Intervention (%)	OR (95% CI)	*P* Value
Readmitted within 12 months	71/197 (36)	107/219 (49)	1.71* (1.14, 2.56); 1.90† (1.24, 2.91)	0.009; 0.004
Death within 12 months	59/197 (30)	53/219 (24)	0.68* (0.44, 1.07)	0.099
Death or readmission within 12 months	104/197 (53)	133/219 (61)	1.30* (0.87, 1.93); 1.36† (0.89, 2.08)	0.20; 0.15

Abbreviations: CI, confidence interval; OR, odds ratio.

*Estimates adjusted for hospital and intervention intensity.

†Estimates adjusted for hospital, intervention intensity, and propensity score.

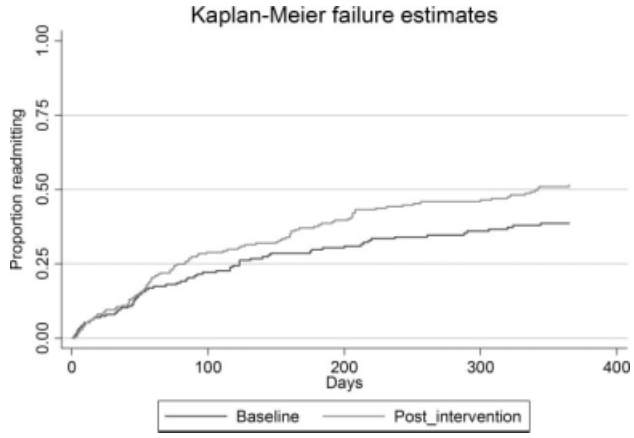

FIGURE 2. Time to first hospital readmission.

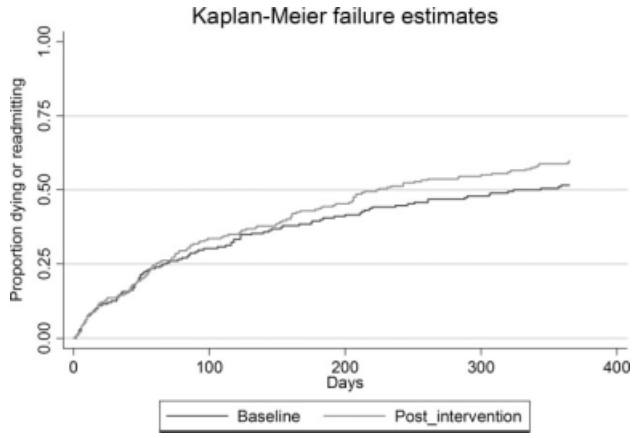

FIGURE 3. Time to death or first hospital readmission.

Duing the 12-month follow-up, 107 (49%) of intervention patients were readmitted to the hospital compared to 71 (36%) of control patients, representing a 1.7-fold increase in the adjusted probability of readmission in the intervention group (odds ratio [OR] = 1.71, 95% confidence interval [CI] = 1.14-2.56; $P = 0.009$). As shown in Table 3, this was partly balanced by a trend toward reduced post-hospital mortality, such that no significant difference was seen in readmission-free survival.

Time-to-event analysis (Figures 2 and 3) demonstrated similar findings, with a significant reduction in time to first readmission in the intervention group (adjusted hazard ratio [HR] = 1.43; 95% CI = 1.04-1.97; $P = 0.046$) but no difference in time to death or first readmission (adjusted HR = 1.14; 95% CI = 0.86-1.46; $P = 0.36$).

There was a trend to increased readmissions attributed to heart failure: 47 (21.5%) of intervention patients compared to 33 (16.7%) in the baseline group (OR = 1.30; 95% CI = 0.87-1.93; $P = 0.20$). No significant difference was demonstrated in the frequency of readmissions (average 0.75 admission per participant per year in baseline, compared to 0.93 intervention; $P = 0.32$) nor the mean number of days in hospital in 12 months subsequent to the index admission (5.9 in the baseline group compared to 6.5 in the intervention group; $P = 0.1$).

Subgroup analysis by intervention intensity showed similar results, with 42 of 76 (55.3%) "intensive" group participants in the intervention group and 36 of 89 (40.4%) in the baseline group requiring hospital readmission within 12 months. The HR for death or readmission was estimated to be 1.27 (95% CI = 0.85-1.9).

Discussion

In this study, heart failure patients who received a multidisciplinary intervention (including inpatient education, self-management support, improved timely medical follow-up, and better integration between hospital and primary care) showed a trend to improved 1-year post-hospital survival, but this appeared to be at the cost of increased readmissions among survivors. This occurred despite our previously

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reported improved optimization of pharmacological therapy both in-hospital and posthospital with this program.[18]

There are a number of potential explanations for this finding, which have important implications for adoption of disease management programs. First, the intervention may not have been of sufficient intensity. Programs primarily aimed at educating providers and patients in evidence-based guidelines, without structured postdischarge support, have not always improved clinical outcomes.[26] In our study, general practitioners were supported to provide improved postdischarge care to their CHF patients, but direct postdischarge patient support was only provided to consenting patients and was limited in scope. There is still some debate about which elements of successful DMPs are most important for efficacy. Most authorities support the central importance of medication optimization, intensive education, and self-care support. Taylor et al.[23] found stronger evidence for programs using individual case management or outreach rather than clinic-based interventions. Yu et al.[27] concluded that outpatient drug titration and ready access to specialist review were factors contributing to success. In our program, even the more intensive intervention did not include regular clinical review by specialist nurses, a system for rapid review in the event of deterioration or supervised drug titration protocols. Furthermore, strategies which prompted more frequent primary care review and improved patient, carer, and general practitioner recognition of disease deterioration may have provided more opportunities to initiate readmission, especially in the absence of an alternative care pathway such as rapid-access clinics or outreach services.[28]

Second, this study may reflect the reality of generalizing randomized controlled trial data to an unselected population. Many trials enrolled patients with high anticipated event rates but excluded patients with complex comorbidities, poor life expectancy, and cognitive impairment. Such studies enrolled a high-risk population (10%-48% of screened patients randomized) who had a relatively high readmission rate (50%-60% at 6-12 months) compared to our unselected population. These studies may overstate the benefits of applying heart failure DMPs in an unselected population. Galbreath et al.[29] enrolled a self-selected community sample of heart failure patients into a disease management program incorporating education, self-management, telephone support, and advice to primary care providers and home health providers. Like our model, they demonstrated a survival benefit in the intervention group but no reduction in hospital or other healthcare utilization.

Third, only about one-half of the readmissions were due to heart failure, again reflecting the complexity of this real-world patient group. Interventions that focus on a single disease in patients with complex comorbidities might be expected to have only limited impact on their subsequent healthcare needs.

Fourth, findings may reflect differences in patient characteristics between the 2 cohorts. While statistical adjustment for measured differences did not have any significant impact on results, unmeasured patient characteristics may have introduced bias. The before–after nature of the study also raises the possibility that temporal trends in care practices influenced patient outcomes, such as changing patterns of drug and device therapies. There is conflicting evidence in the literature regarding trends in CHF readmission rates,[30–32] but it is possible that health system factors external to the study contributed to a higher readmission rate in the later cohort.

Finally, there was a trend toward reduction in mortality within the intervention cohort. These additional survivors might be expected to have more advanced heart failure or other comorbid disease, and therefore may have been more susceptible to deterioration and the need for inpatient care.

Conclusions

We acknowledge the weaknesses inherent in this nonrandomized study design, including convenience sampling, measured and unmeasured confounders and temporal trends in processes and systems of care. Nonetheless, this real world study suggests a note of caution in the widespread enthusiasm for chronic disease management programs. A complex bundle of interventions that resulted in measurable improvements in adherence to evidence-based guidelines, discharge processes, integration between care providers, and patient education appeared to prolong life expectancy but increase hospital utilization. Mortality reduction in an incurable chronic disease such as heart failure will increase the burden of disease (and therefore treatment costs) unless treatments concurrently reduce disability and the frequency of symptomatic relapse.[33] Whether this balance is achieved will depend on patient selection and the intensity and/or components of the intervention. These factors have not been fully defined in the literature to date.

Our study suggests that a widely applied, discharge-focused intervention which primarily augmented the CHF management knowledge of care providers and patients, and enhanced attendance within the existing care model of primary care and internal medicine/cardiology outpatient services, improved the quality of care and may have reduced mortality at the cost of higher hospital utilization. It raises questions about whether a disease management service can achieve the uncertain promise of reduced readmissions in a cost-effective manner outside of a "high-risk" experimental population.

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