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Original Article

Geriatric Inpatient Units in the Care of Hospitalized Frail Adults with a History of Heart Failure☆,☆☆

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SUMMARY

Background: Frail hospitalized older adults are at risk for adverse outcomes. Previous studies have suggested benefits for inpatient geriatric management (GEM). We sought to determine whether hospitalized patients with a history of heart failure (HF) benefitted from inpatient GEM or not.

Methods: We studied 309 inpatients previously diagnosed with HF who were participants in a randomized trial of geriatric evaluation and management (GEM) versus usual care (UC). The intervention involved multidisciplinary teams that provided comprehensive geriatric assessment. We evaluated health-related quality of life (HRQOL), basic activities of daily living (ADLs), health service utilization, and survival at discharge, 6 months, and 1 year post randomization.

Results: GEM patients had higher mean change scores for physical function (unadjusted means: 0.17 vs. −4.67, $p = 0.046$) and basic ADLs (1.25 vs. 0.67, $p = 0.003$) at hospital discharge, which remained significant after adjusting for baseline HRQOL scores and in-hospital days. Outcomes were not significantly different at 1 year. Length of stay for GEM was greater than UC (24 days vs. 17 days, $p = 0.03$), but total costs at 1 year were not different ($p = 0.9$). Mortality rates at 1 year were high and similar (GEM 29.0%, UC 27.3%, $p = 0.73$) in both the groups.

Conclusion: Inpatient GEM was associated with better maintenance of physical function and basic ADLs at hospital discharge; however, no differences in HRQOL or survival were observed between GEM and UC at 1 year post randomization. Restructuring inpatient care models to incorporate inpatient GEM principles may be one method to optimize health-care delivery.

1. Introduction

Frail older adults hospitalized for acute illness are vulnerable to adverse in-hospital and intermediate term outcomes[1–3]. It has been shown that up to 23% of patients have functional decline prior to hospitalization, which does not return to baseline by the time of hospital discharge[4]. Prevalence of heart failure (HF) in frail older adults can be up to 30% among hospitalized patients[5], and, given the associated comorbidities, costs, and diminished quality of life of patients with HF, efforts to optimize care in this population are needed[6]. Similar to positive outcomes observed from outpatient disease management programs that emphasize adherence and behavioral modifications[6,7], care designed around core geriatric principles in hospitalized older adults, when compared to traditional (inpatient) care models, has been shown to improve functional independence and reduce institutionalization at the time of hospital discharge[8,9]. Given the emphasis on health prevention through modifying behavior and implementing multidisciplinary intervention, comprehensive geriatric assessment applied to inpatient care may have unique advantages in frail older adults with a history of HF[7,10–14].

Geriatric evaluation and geriatric management (GEM) has been used over the past two decades to identify frail elders at high risk for functional decline and to develop targeted intervention

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programs to arrest or reduce the trajectory of decline[15,16]. Key elements of GEM include identifying risk for falls, pharmacologic optimization, evaluating cognitive and affective status, assessing nutrition, and identifying social support and community resources[12]. In a randomized controlled trial of inpatient and outpatient GEM versus usual care (UC), positive outcomes on several health domains and functional status in frail adults were observed with GEM[9]. However, whether such a strategy could also benefit patients with previously diagnosed HF is unknown. Therefore, we hypothesized that a model of care utilizing inpatient GEM in acutely hospitalized frail adults with chronic HF may be associated with improvements in important health outcomes when compared to UC.

2. Methods

This study was a secondary analysis of 309 inpatients from the Veterans Administration (VA) Cooperative study entitled "A Controlled Trial of Inpatient and Outpatient Geriatric Evaluation and Management[9]." The parent trial was a VA multicenter 2 × 2 factorial study, randomizing 1388 participants to an inpatient GEM or an inpatient UC, and, upon hospital discharge, to either geriatric outpatient clinic or usual outpatient care. The details of the parent trial have previously been described[9]. Briefly, patients were enrolled between August 1995 and January 1999, and stratified randomization occurred within site and level of functional status. Research assistants at each site identified eligible patients according to prespecified criteria: age ≥65 years and hospitalized on a medical or surgical ward with an expected length of stay ≥2 days.

2.1. Study population

HF patients were classified as such based on a prior clinical documentation of HF in the medical record. The history of HF had been recognized and documented by a health-care provider on clinical grounds, irrespective of left ventricular function. In addition, a corresponding International Classification of Diseases, 9th Revision (ICD-9) code for HF, was present in the medical record. Eligible patients also had to be frail, defined as having at least two of the following characteristics: inability to perform one or more basic activities of daily living (ADLs), a stroke within the previous 3 months, a history of falls, difficulty walking, malnutrition, dementia, depression, one or more unplanned admissions in the previous 3 months, prolonged bed rest, or incontinence. These target criteria were selected to capture patients most likely to benefit from a program of GEM[17,18]. Patients were excluded if they were admitted from a nursing home, had previously been hospitalized in an inpatient GEM, were currently enrolled in another clinical trial, had a severe disabling disease or terminal condition or severe dementia, did not speak English, lacked access to a telephone for follow-up, or were unwilling or unable to return for follow-up for any reason. Finally, the Charlson comorbidity index was calculated for trial participants[19].

2.2. Inpatient geriatric intervention versus UC

The geriatric intervention consisted of core multidisciplinary teams providing GEM according to VA standards and consistent with care guidelines[20]. The inpatient and outpatient team members included a geriatrician, a nurse, and a social worker, who followed standard protocols for GEM. Specific instructions included obtaining a history and performing a physical examination; screening for geriatric syndromes; assessing functional, cognitive, affective, and nutritional status; evaluating the primary caregiver's capabilities; and assessing the patient's social situation. After formulation of the treatment plan, the multidisciplinary team would meet at least twice a week to review the plan.

Inpatients randomized to UC received all standard diagnostic studies and treatment approaches as appropriate for the medical condition that prompted hospitalization. However, the distinguishing feature between UC and GEM was the absence of the multidisciplinary approach for geriatric evaluation and management to patients in the UC group.

2.3. Outcomes

Outcomes for this study included the primary and secondary outcomes from the parent trial, which were survival and health-related quality of life (HRQOL)[9]. The primary outcome for our analysis was the subscale score for physical function as measured by the Medical Outcomes Study 36-Item Short-Form General Health Survey (SF-36)[21,22]. Scores on the SF-36 were scaled such that, for each item, higher scores reflected improved functioning. The secondary study outcomes included the remaining subscales of the SF-36 and functional status as measured by basic and instrumental ADLs[23]. The scale for the basic six-item Katz ADL measure included bathing, dressing, toileting, transferring, feeding, and continence, with a score of 1 for independent functioning on each domain and a maximal score of 6[24]. The scale for instrumental ADL included meal preparation, housecleaning, medication management, performing financial management, driving or arranging for transportation, telephone use, and shopping with a score of 1 for independent functioning on each and a maximal score of 9. Health services use and costs were other secondary outcomes that were measured by information collected from the decentralized computer at each center, centralized VA databases, and Medicare databases. Research assistants recorded all data on predesignated forms during hospitalization. Data obtained during hospitalization included baseline characteristics and changes in HRQOL and ADLs. Follow-up outcome data, including HRQOL, ability to perform ADLs, and vital status, were gathered via telephone calls conducted by a research assistant based in Durham, NC, blinded to the patient's treatment assignment. Both face-to-face and telephone-based data collection for the SF-36 have previously been shown to have high concordance with one another[25]. Data collected at the participating research sites were faxed directly to the coordinating center. Follow-up information was obtained after discharge and at 6 and 12 months post randomization.

2.4. Statistical analysis

The primary study objective involved assessing the efficacy of inpatient GEM versus UC on the primary and secondary outcomes of 309 participants with a prior diagnosis of HF. Since this study involved the evaluation of outcomes (postdischarge and 1 year) among hospitalized older adults with a history of HF by management strategy, we limited our analysis of GEM or UC to inpatients only. We then tested the change in HRQOL and ADLs from baseline (prerandomization) to (1) discharge from the inpatient episode, (2) 6 months from baseline, and (3) 12 months from baseline. Arm differences in continuous outcomes were tested with the general linear model, with the general form of: $Y_{(\text{discharge, 6 months, or 12 months})} - Y_{(\text{baseline})} = Y_{(\text{baseline})} + \text{Arm}_{(\text{GEMU or UC})} +$ Number of days of the inpatient episode. While physical function was the primary outcome, group differences in nine secondary outcomes were also tested. The alpha level for these tests was controlled at an overall two-sided level of 0.05 using the procedure by Holm[26]. We considered each time point (discharge, 6 months, and 1 year) separately when applying the Holm procedure. The continuous outcomes included SF-36 HRQOL

subscale scores, basic ADL scores, and instrumental ADL scores as assessed at prerandomization, discharge, and 6- and 12-month follow-up. Mortality was assessed using nonparametric log-rank survival analysis, after subtracting the number of days spent in the index inpatient episode from the days at risk for death. Total costs included all costs of inpatient, outpatient, and long-term care provided by Veterans Affairs medical centers, including care in private nursing homes. Costs of inpatient and outpatient care at non-Veterans Affairs facilities were not included in the analysis of total costs. As there were no baseline cost values to consider and because total costs were highly correlated with inpatient length of stay, costs were treated separately from the other outcomes in this study. The unadjusted bivariate test for total costs by arm was evaluated using a t test after a log transformation due to the non-normal distribution, and corroborated by using the Wilcoxon rank-sum test. A p value of <0.05 was considered statistically significant for all tests, except for the utilization of the Holm procedure, as mentioned above. All analyses were performed using SAS version 9.1 (SAS Institute, Inc., Cary, NC, USA).

3. Results

From the 1388 study participants enrolled in the original trial, we identified 309 patients with a previous diagnosis of HF by ICD-9 codes. Table 1 shows the baseline characteristics of the hospitalized participants by treatment group. Patients were similar with respect to baseline demographic characteristics, including age, race, educational achievement, admitting service, and comorbid illness. In addition, most parameters related to the SF-36 measures were also similar at baseline, with the exception of physical function ($p = 0.03$) and mental health ($p = 0.01$) (Table 1). The ability to perform basic and instrumental ADLs was also noted to be similar between study groups at baseline. After adjusting for the number of in-hospital days and mean SF-36 subscale scores at baseline in the two treatment arms, patients who had been randomized to inpatient GEM had less decline in physical function and basic ADLs at the time of hospital discharge compared to those randomized to UC (Table 2), the latter even in comparison to the adjusted Holm p value. At 6 months and 1 year post randomization, the benefits of inpatient GEM in domains of basic ADLs and physical function seen at hospital discharge were no longer observed (Table 2), and hence no need to invoke the corrected Holm p values. The favorable trends observed in the SF-36 subscale scores at discharge and at 1 year for patients in the inpatient GEM group compared to those in the inpatient UC group were noted, but none of these reached statistical significance. There were no observed HRQOL outcomes for

Table 1
Baseline characteristics of the 309 HF patients.

Characteristics	Usual care inpatient ($n = 154$)	GEM inpatient ($n = 155$)	p
Age	74.4 ± 5.9	74.3 ± 6.0	0.95
Age ≥74, *n* (%)	77 (50.0)	84 (54.2)	0.46
Marital status—married, *n* (%)	92 (60.4)	87 (56.1)	0.45
Race—White, *n* (%)	113 (73.4)	119 (76.8)	0.49
Education—high-school graduate, *n* (%)	68 (44.2)	71 (45.8)	0.77
Admitting service—medicine, *n* (%)	133 (86.4)	121 (78.1)	0.06
Chronic pulmonary disease, *n* (%)	68 (44.2)	65 (41.9)	0.69
Cerebrovascular disease, *n* (%)	40 (26.0)	34 (21.9)	0.41
Peripheral vascular disease, *n* (%)	34 (22.1)	45 (29.0)	0.16
Myocardial infarction, *n* (%)	42 (27.3)	55 (35.5)	0.12
Dementia, *n* (%)	11 (7.1)	10 (6.5)	0.81
Comorbidity (Charlson score)— mean[a]	3.73 ± 2.05	3.86 ± 1.98	0.57
SF36 subscales[b]			
Physical function	24.5 ± 23.9	18.9 ± 21.7	0.03
Physical limitations	16.6 ± 30.9	11.1 ± 22.8	0.08
Emotional limitation	64.7 ± 43.8	60.5 ± 44.0	0.40
Bodily pain	44.5 ± 30.5	41.3 ± 28.6	0.33
Energy/fatigue	33.3 ± 24.2	30.0 ± 21.3	0.21
Mental health	67.0 ± 22.7	60.0 ± 24.8	0.01
Social activity	49.8 ± 32.5	52.7 ± 34.3	0.45
General health	28.1 ± 24.7	28.0 ± 21.9	0.98
ADL scores[c]			
ADL basic	3.3 ± 2.2	3.2 ± 2.1	0.49
ADL instrumental	4.0 ± 2.8	4.3 ± 2.5	0.22

Data are presented as mean ± SD or %.
ADL = activity of daily living; GEM = geriatric management; HF = heart failure; SD = standard deviation; SF-36 = Medical Outcomes Study 36-Item Short-Form General Health Survey.
[a] The comorbidity index indicates the number and severity of coexisting conditions, on a scale from 0 to 34, with higher scores indicative of greater comorbidity.
[b] Scores on the SF-36 were adjusted so that, for each item, higher scores indicate better functioning.
[c] The scale for basic ADLs included six items, with a score of 1 for independent functioning on each and a maximal score of 6. The scale for instrumental ADL was a nine-item one (maximal score of 9), with a score of 1 for independent functioning on each.

Table 2
Mean change from randomization to discharge, 6 months, and 1 year for patients with a history of HF by treatment arm.[a]

SF-36 subscales		Usual care inpatient	GEM inpatient	p[b]	Holm procedure α level[c]
Physical functioning	D/C	−4.7	0.17	0.046	N/A
	6 mo	−3.3	2.64	0.45	
	12 mo	−1.5	3.3	0.61	
Bodily pain	D/C	9.8	11.1	0.74	0.0083
	6 mo	8.0	11.9	0.63	
	12 mo	19.0	15.5	0.37	
Vitality	D/C	−2.5	−2.2	0.90	0.0167
	6 mo	−0.4	0.6	0.70	
	12 mo	0.8	−0.4	0.69	
Physical role	D/C	5.1	6.0	0.79	0.0125
	6 mo	16.8	24.2	0.26	
	12 mo	23.6	25.0	0.77	
General health	D/C	−6.3	−5.5	0.74	0.0071
	6 mo	−6.5	−6.4	0.93	
	12 mo	−6.4	−6.7	0.92	
Social functioning	D/C	0.7	−1.3	0.60	0.0063
	6 mo	4.7	5.9	0.20	
	12 mo	8.8	13.7	0.27	
Emotional role	D/C	10.5	9.2	0.78	0.01
	6 mo	7.8	11.6	0.61	
	12 mo	21.4	17.3	0.31	
Mental health	D/C	−2.2	−2.0	0.95	0.025
	6 mo	−0.9	1.6	0.63	
	12 mo	−1.5	1.0	0.41	
ADL scores					
Basic	D/C	0.7	1.3	0.003	0.0056
	6 mo	0.9	1.3	0.17	
	12 mo	0.8	1.1	0.24	
Instrumental	D/C	−1.6	−1.6	0.98	0.05
	6 mo	−0.9	−1.1	0.91	
	12 mo	−1.5	−1.2	0.37	

ADL = activity of daily living; D/C = discharge; GEM = geriatric management; HF = heart failure; SF-36 = Medical Outcomes Study 36-Item Short-Form General Health Survey.
[a] Mean scores shown are unadjusted for length of stay and baseline status. Higher scores are indicative of better function.
[b] p values are for between-group differences of mean changes in scores and are adjusted.
[c] The Holm procedure first ranks the 10 p values from lowest to highest. The first (lowest) p value has to be less than 0.0056 (0.05/9) to be statistically significant and to permit continuation to the other t tests. The Holm procedure continues sequentially in this fashion using α levels of 0.0063 (0.05/8), 0.0071 (0.05/7) … 0.05 (0.05/1) for the remaining six tests, respectively. The primary outcome (physical function) is not considered under the testing of multiple secondary outcomes. The Holm procedure p values presented here are for mean change at discharge only, as p values at 6 months and 1 year were not significant.

which GEM scored significantly worse than UC. The unadjusted mortality curves demonstrated no difference in 1-year mortality between groups (29.0% in GEM and 27.3% in UC; $p = 0.73$) (Fig. 1). Patients in GEM had a greater mean length of stay during the index hospitalization compared to UC (24 vs. 17 days, $p = 0.03$). We observed no significant differences in total costs between management strategies after log transformation of costs due to non-normal distribution. Neither the parametric t test (of transformed data, $p = 0.90$) nor the nonparametric Wilcoxon rank-sum test ($p = 0.89$) detected differences in total costs between the groups.

4. Discussion

Hospitalized older veterans with a history of HF were at high risk for functional decline, as evidenced by baseline SF-36 scores and functional disabilities. The study population was also characterized by multimorbidity (average Charlson index of 3.8) with nearly a 30% mortality rate at 1 year post randomization. After adjusting for baseline differences, our findings suggested that the GEM strategy, as compared with UC, was associated with greater preservation of physical function and basic ADLs from baseline to the time of hospital discharge. Other HRQOL domains measured by the SF-36 subscales also trended favorably for GEM but did not reach statistical significance. There were no observed differences in the survival rate between the GEM group and the UC group, and early improvements in physical function and basic ADLs seen with GEM group at hospital discharge were not sustained at 1 year. Importantly, there were no observed outcomes for which GEM was a less desirable strategy than UC, including no difference in total cost between the two strategies. Given the prevalence of HF in the community, coexisting multimorbidities in older HF patients, associated costs, and recognized consequences from traditional hospitalization, inpatient GEM may represent an alternative care paradigm for arresting decline in functional capacity prior to transitioning patients from the hospital setting to the community.

We believe that the early short-term benefit observed may have been attributed to improved recognition of clinical conditions that were then targeted for evaluation and management, a characteristic feature of the GEM strategy[8,12,17]. Such interventions may have included improved pharmacotherapy optimization, refinement of physical therapy exercises toward individualized goals, and patient education regarding their medical ailments and techniques to promote health education. Our observation that GEM, as compared with UC, was associated with better preservation of functional

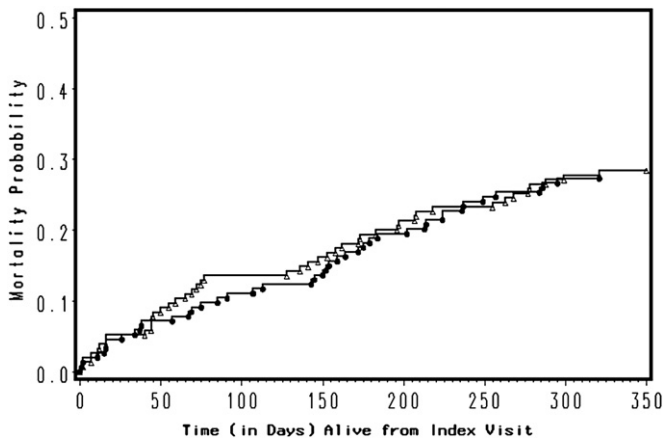

Fig. 1. Kaplan–Meier mortality curve for frail older adults with a history of HF by inpatient treatment group assignment. ●-●-● represents inpatient GEM and Δ-Δ-Δ represents UC. GEM = geriatric management; HF = heart failure; UC = usual care.

reserves in basic ADLs at the time of hospital discharge has important implications. It has previously been shown that functional decline in hospitalized patients is associated with rehospitalization, institutionalization, and mortality[1,2,4,27]. Improvement in physical function and reduced disability in older adults with HF at the time of hospital discharge may be functional biomarkers that could be associated with better outcomes[6,7]. Absence of sustained benefits using GEM, as observed in our study, has also been noted in previously published studies[8,9,28] and remains poorly understood. Although the downward spiral of the frailty syndrome was not attenuated over the long term after inpatient GEM in our study, it may be possible to reinforce inpatient GEM management strategies longitudinally in an effort to maintain functional reserves and adaptive capacity in older adults at high risk for clinical deterioration. Therefore, one possibility of a lack of observed lasting benefit of the GEM approach for physical function and ADLs was the absence of periodic intensive assessments to identify, target, and manage functional deficiencies and health decline. Efforts to understand alternative health-care delivery strategies to care for the growing sector of older adults with frailty and comorbid clinic conditions, including the bulk of patients with chronic HF, require an integrated and goal-directed management plan that improves upon current GEM delivery models[6,13,14,29]. The use of disease management programs as adjunctive management strategies in the care of high-risk HF patients is becoming increasingly common[7,30], and it has been suggested that implementation of disease management strategies should engage researchers, policy makers, and payers toward addressing this unmet need in outpatient HF management[10]. What remains to be determined is whether strategies targeted to improve patient functional status through conditioning and reconditioning therapies can be applied to the hospitalized vulnerable older adult and also be translated to improvements in important health outcomes.

Our study has limitations. We were unable to validate HF disease severity or examine the existence of a temporal relationship between HF symptoms and hospitalization. In addition, we did not have information regarding left ventricular systolic function or New York Heart Association functional class, both of which have independent prognostic value in HF[6]. We used ICD-9 codes for HF as entry criteria for this study, representing a population of patients who had previously received a diagnosis of HF by a health-care provider. The use of ICD-9 codes to identify a cohort of patients with HF has previously been validated and reported in the literature[31]. By selecting frail older patients hospitalized with a prior history of clinical HF, we included a cohort of patients who were at high risk for future adverse clinical outcomes and a population that is commonly encountered in clinical settings[5,6,11,14]. Findings from the Cardiovascular Health Study, an observational study that included 5201 patients aged 65 and older and was designed to determine the risk factors for and consequences of cardiovascular disease in older adults, demonstrated that of the 78 patient characteristics studied, the only medical condition in the clinical history that was a significant predictor of mortality in multivariate analysis was a clinical history of HF[32]. Our study was also limited by sample size and may have limited our ability to detect clinically important differences in HRQOL at 1 year. However, we included all patients from the parent trial with a prior diagnosis of HF ($n = 309$) in our analysis, and the follow-up in the original trial was near complete with 99% of all planned telephone follow-up interviews having been conducted successfully[9].

We observed a greater length of stay for patients in GEM compared to UC. We believe that this finding is likely related to the additional time investment for multidisciplinary assessment, intervention, and management. This increase in length of stay occurred at no significant increase in total costs over the course of

a full year. There may have been unmeasured beneficial effects in early transition to inpatient GEM after resolution of acute illness compared with ongoing inpatient hospitalization with its associated risks of adverse outcomes among vulnerable elders. The effect of inpatient transition to GEM versus UC prior to hospital discharge has previously demonstrated reduced disability and less institutionalization[8] but may also reduce adverse in-hospital events (e.g., delirium, falls, and errors) and should be investigated in future studies.

Frail adults are at high risk for adverse clinical outcomes, and strategies to attenuate functional, psychological, and general health decline remain an important area of ongoing research in gerontology[24]. The care of frail older adults with HF in practice is often underscored by complicated issues of polypharmacy, depression, high resource utilization, and functional decline. Studies evaluating optimal management strategies for elderly HF patients may require an amalgam of advances in GEM in consort with evidence-based HF therapy that optimizes transition from hospital to community with less perturbation. Care models, such as inpatient GEM, that aim at specifically improving functional outcomes and reducing disability after hospitalization among frail adults with chronic HF should be actively investigated given the public health and health policy implications.

5. Conclusions

Frail older adults with a history of HF derived greater short-term benefits utilizing an inpatient GEM strategy as compared with UC. No differences in HRQOL or survival were observed between GEM and UC at 1 year post randomization. Multidisciplinary models of care, of which the GEM approach has previously been studied, may be important given the high rates of hospitalizations, functional decline, and readmissions in older adults with comorbidities.

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