

## HEALTH CARE REFORM

# Hospital at Home for Elderly Patients With Acute Decompensation of Chronic Heart Failure

## A Prospective Randomized Controlled Trial

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*hospital → long term care*  
*home " "*

*Better outcomes at home!*  
*Cost per day \$159 vs \$401*  
*↳ Understates cost differential*

**Background:** Although the hospital is the standard venue for short-term medical care, it may be hazardous for older persons. This study was performed to evaluate the feasibility and effectiveness of a physician-led hospital-at-home service for selected elderly patients with acute decompensation of chronic heart failure (CHF).

**Methods:** Prospective, single-blind, randomized controlled trial with 6-month follow-up for patients 75 years or older admitted to the hospital from April 1, 2004, through April 31, 2005, for acute decompensation of CHF. Patients were randomly assigned to the general medical ward (n=53) or to the Geriatric Home Hospitalization Service (GHHS; n=48). The GHHS provides diagnostic and therapeutic treatments by hospital health care professionals in the home of the patient.

**Results:** Patient mortality at 6 months was 15% in the total sample, without significant differences between the

2 settings of care. The number of subsequent hospital admissions was not statistically different in the 2 groups, but the mean (SD) time to first additional admission was longer for the GHHS patients (84.3 [22.2] days vs 69.8 [36.2] days,  $P = .02$ ). Only the GHHS patients experienced improvements in depression, nutritional status, and quality-of-life scores.

**Conclusions:** Substitutive hospital-at-home care is a viable alternative to traditional hospital inpatient care for elderly patients with acutely decompensated CHF. This type of care demonstrated clinical feasibility and efficacy in comparison with its alternative.

**Trial Registration:** clinicaltrials.gov Identifier: NCT00623571

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**C**HRONIC HEART FAILURE (CHF) is a progressive and disabling syndrome that affects close to 7 million Europeans and 5 million North Americans.<sup>1</sup> Hospitalization rates for patients older than 65 years with CHF have progressively increased, and the

### See Invited Commentary at end of article

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annual incidence reaches 2% to 3% in patients older than 85 years.<sup>2,3</sup>

Decompensation of CHF accounts for more than 1 million acute care hospital admissions per year in the United States and is associated with significant in-hospital mortality, ranging from 2% to 22%.<sup>4</sup> Prognosis in elderly patients (whose median age is 71-75 years) is poor after hospital dis-

charge.<sup>2</sup> The risk of subsequent hospitalization is approximately 50% within 6 months of hospital discharge,<sup>5</sup> which contributes to the high emergency department (ED) workload. In Italy, there were nearly 185 000 hospital admissions for CHF in 2001.<sup>6</sup>

In the United Kingdom, the proportion of health care funding directly attributable to CHF has almost doubled since 1990, reaching 2% of health care expenditures in the year 2000.<sup>7</sup> In Italy, CHF costs represent 1.4% of yearly health care expenditures.<sup>8</sup>

Although the hospital is the standard venue for providing acute medical care, it may be hazardous for older persons, who commonly experience iatrogenic illness, functional decline, and other adverse events. Recent studies<sup>3,9</sup> have evaluated innovative interventions to facilitate the transition from hospital to home of older adults

with CHF. Findings suggest that elderly patients with CHF at risk of poor outcomes after discharge might benefit from a comprehensive discharge planning protocol implemented by advanced practice nurses and multidisciplinary strategies.

A spectrum of clinical models has been described under the hospital-at-home label, such as office-based or infusion center-based intravenous services, provision of home health care services or home-based nursing services, early discharge models, and more recently clinical unit models that substitute entirely for an acute care hospitalization and provide hospital-level care in the home.<sup>10-17</sup> In particular, elderly patients with CHF can benefit from home care programs and specialized nurse-led postdischarge supports.<sup>9,18</sup>

Chronic heart failure has been the focus of several home-based care studies.<sup>19-22</sup> However, most models had schemes that used nursing care without physician care in the home. The objective of this randomized clinical trial was to examine the efficacy of a physician-led clinical unit model of a hospital-at-home service for elderly patients with an acute decompensation of preexisting CHF. We hypothesized that a hospital-at-home service could be a practical alternative to the traditional hospital setting for the care of selected elderly patients with acute decompensated CHF.

## METHODS

### STUDY SAMPLE

The study was conducted at San Giovanni Battista Hospital of Torino, Italy, a large, urban university teaching and tertiary care hospital. Patients 75 years and older with a preexisting diagnosis of CHF (stage C according to the American Heart Association classification) and a persistent functional impairment indicative of New York Heart Association (NYHA) class III or IV status were considered eligible for the study when admitted to the ED of the hospital for acute decompensation of their chronic condition and assessed as being in need of hospital care. Acute decompensation of CHF was defined as a rapid and significant worsening of both specific CHF signs (peripheral edema, pulmonary rales) and symptoms (dyspnea, fatigue) caused by abnormal cardiac function and supported by appropriate investigations (electrocardiography, chest x-ray examination, laboratory tests, echocardiography). The cardiac dysfunction could be related to systolic or diastolic dysfunction, to abnormalities in cardiac rhythm, or to preload and afterload mismatch.<sup>23</sup>

Additional inclusion criteria were appropriate care supervision at home, telephone connection, living in the hospital-at-home catchment area, informed consent, at least 1 previous admission for acute CHF, and need for intravenous drug infusion. Exclusion criteria were new-onset heart failure; absence of family and social support; need for mechanical ventilation, hemodialysis, or intensive monitoring; severe dementia (Mini-Mental State Examination score <14); terminal malignant neoplasm; severe renal impairment (estimated glomerular filtration rate <20 mL/min); hepatic failure (Child-Pugh classes B and C); serum hemoglobin level less than 9 g/dL (to convert to grams per liter, multiply by 10); and planned cardiac surgery (eg, valve replacement). The study protocol complies with the ethical rules for human experimentation and was approved by the ethics committee of the hospital.

## STUDY DESIGN

In the ED all potentially eligible patients with an acute decompensation of CHF underwent baseline standard clinical evaluation, routine blood tests, pulse oximetry, 12-lead electrocardiography, and chest radiography. Echocardiography was conducted to document left ventricular function if it had not been performed within the previous 6 months. Further investigations, including the assessment of a cardiologist, were performed when required, according to the clinical judgment of the ED physician.

Study patients were enrolled within 12 to 24 hours of ED admission by research assistants masked to randomized assignments and hypotheses. After screening patients for eligibility and obtaining informed consent, the research assistant notified the project manager, who randomly assigned patients to the geriatric hospital-at-home service (GHHS; n=48) or to the general medical ward (GMW; n=53) by the use of a set of computer-generated random numbers in a 1:1 ratio. The allocation sequence was unknown to any of the investigators and was contained in a set of sealed envelopes, each bearing on the outside only the name of the hospital and a number, which was opened after the acceptance of the patient. The project manager contacted the GHHS team if patients were assigned to the GHHS group. Extensive information was also provided to the relatives of each patient to obtain their collaboration.

Baseline multidimensional assessment was performed on the enrolled patients within the ED before randomization by the use of standardized instruments: the Barthel Index<sup>24</sup> and Instrumental Activities of Daily Living<sup>25</sup> for functional status, the Geriatric Depression Scale<sup>26</sup> for depression, the Mini-Mental State Examination<sup>27</sup> for cognitive status, the Nottingham Health Profile<sup>28</sup> for quality of life, the Mini Nutritional Assessment<sup>29</sup> for nutritional status, the Acute Physiology and Chronic Health Evaluation II<sup>30</sup> for illness acuity, the Cumulative Illness Rating Scale<sup>31</sup> for comorbidity, and the Relative Stress Scale<sup>32</sup> for the level of stress of the caregiver.

Historical variables were also collected in the ED before randomization, such as history of cigarette smoking, hypertension, type 1 and type 2 diabetes mellitus, obesity, alcohol consumption, lipid disorders, and familiarity for cardiac diseases. The medical history was gathered from the patient and from clinical documentation provided on admission. Data collected from surrogates were used in those patients who were unable to be interviewed. The evaluators were postgraduate physicians not involved in the care of the patients, unaware of the allocation of patients, and not part of the formal research team.

On discharge, a complete re-evaluation of the patients and their caregivers was performed. Morbidity during at-home or inpatient care was evaluated through medical records review at the time of discharge from the GHHS or GMW. A complete 6-month follow-up evaluation was performed on survivors by visiting them wherever they were residing at that moment. All study participants underwent similar medical treatments according to the current European guidelines for acute CHF.<sup>23</sup>

### CONTROL GROUP/INTERVENTION GROUP

The inpatient control group (GMW) received routine hospital care. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients.

The intervention group included the patients treated at home by the GHHS. The GHHS has been described previously.<sup>10-12</sup> It provides substitutive hospital-at-home care in a clinical unit model and has been in operation for more than 20 years. The team, equipped with 7 cars, is multidisciplinary and consists

of 4 geriatricians, 13 nurses, 3 physiotherapists, 1 social worker, and 1 counselor. The main feature of the GHHS is that physicians and nurses work together as a team, with daily meetings to discuss the needs of each patient and to organize individualized medical care plans. The team operates 7 days a week and on average cares for 25 patients per day and 450 patients per year. The most common diseases treated at home are cardiopulmonary, cerebrovascular, metabolic, and neoplastic diseases.

The GHHS can be activated by a direct request of the general physician of the patient as an alternative to traditional hospital care or by a request from hospital ward physicians to allow early and protected discharge from the hospital. There is a close collaboration between the GHHS and the ED of our hospital to propose, when possible, home care as an alternative to traditional hospital admission. In the ED all the necessary diagnostic tests are provided and then the patient moves home by ambulance, usually within a few hours. Approximately 60% of our patients are referred from the ED, 25% from hospital wards, and 15% from specialists or general physicians in the community. Medical consultation with other hospital specialists is possible in the hospital or at the home of the patient. In the last 10 years, approximately 1000 patients affected by an acute decompensation of CHF have been treated at home through the GHHS. The GHHS patients received hospital-level treatments similar to those provided in the GMW and services at home, as dictated by their condition. Treatments included physician and nurse visits, standard blood tests, pulse oximetry, spirometry, electrocardiography, echocardiography, internistic echography and Doppler ultrasonography, ambulatory electrocardiography and arterial blood pressure monitoring, oral and intravenous medication administration (such as antimicrobials and cytotoxic drugs), oxygen therapy, blood products transfusion, central venous access, surgical treatment of pressure sores, physical therapy, occupational therapy, and counseling. Hospital-at-home patients are considered hospital patients, and all services are provided by the hospital, which retains legal and financial responsibility for care.

Patients treated at home and family members obtained adequate education, such as an explanation of the disease process and constant advice about the importance of daily monitoring of body weight, smoking cessation, physical activity and diet, compliance with drugs, and early recognition of symptoms indicative of worsening heart failure. The advice given was individualized and complemented with medication information and reminder cards. Protocols for prevention of nosocomial infections, bed sores, and immobilization are routinely adopted for frail elderly inpatients.

In the first days after admission to the GHHS each patient was visited at home on a daily basis by physicians and nurses. In the following days the patients were seen by a nurse and the physician at intervals of 2 to 3 days or less, as required by the clinical condition of the patient. Consultation with cardiologists or other hospital specialists was possible at the home of the patient. Physicians and nurses of the hospital-at-home staff were available at all times for urgent home visits. From an administrative, legal, and financial standpoint, hospital-at-home patients were considered hospital inpatients until discharge.

## OUTCOME MEASURES

The main outcome of the study was mortality at 6 months. Secondary outcomes were morbidity (infections, delirium, bed sores, deep vein thrombosis, and falls) during hospitalization, admissions to a nursing home, and subsequent hospital admissions related to any cause.

## STATISTICAL ANALYSIS

The sample size estimation was performed in accordance with the 1-sample binomial test. No published data were found with regard to mortality rates of patients with an acute decompensation of CHF treated at home by a hospital-at-home service. Therefore, to predict the sample size, the 6-month cumulative survival rates in patients treated in the GMW were estimated.

One-year mortality from acute CHF has been reported within a wide range, depending on the clinical characteristics and illness stage. The population to be enrolled in the present study was very old, comorbid, and acutely ill. On this basis, at least 100 patients had to be included in the study to have an 80% chance ( $1 - \beta$  setting at .80) for the detection of significant differences in mortality between the 2 groups by the use of a 2-sided test with  $\alpha = .05$ .

The sample was analyzed on an intent-to-treat basis. Data are presented as means (SDs) or as percentages in the corresponding categories. We used paired and unpaired *t* tests to compare parametric data within and between the groups and  $\chi^2$  tests or Fisher exact tests for nonparametric data. Kaplan-Meier analysis was used to evaluate cumulative proportion survival during the 6-month follow-up.  $P < .05$  was considered statistically significant. Data were analyzed with SPSS for Windows, version 11.5 (SPSS Inc, Chicago, Illinois).

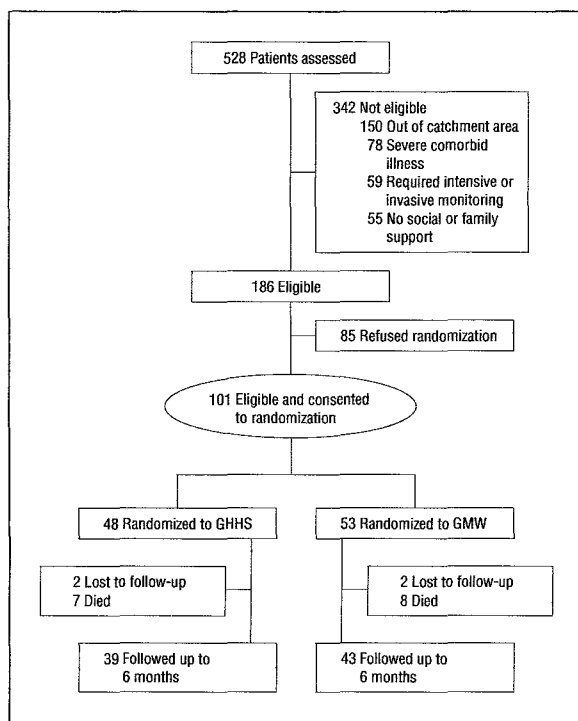
Costs for the acute CHF episode were calculated in euros (€1 = US \$1.19 on October 4, 2005); a comparison was made between the health care costs of GHHS interventions and those of GMW care. Data on hospital costs were collected from the official hospital medical cost database, such as direct medical costs for beds, staff, examination, medications, and rehabilitation. Non-sanitary and administrative hospital costs were also included.

The daily GHHS expenditure included costs for geriatricians, nurses, counselors, dieticians, and social workers calculated in accordance with the amount of time spent with patients and with the inclusion of a cost for noncontact time. Hospital-at-home patient costs included transportation of equipment and of patients to and from the hospital and administrative costs. The expenses for ED care were the same in both groups and accounted for €173.05 on average.

## RESULTS

Of the 528 patients with an acute decompensation of CHF screened from April 1, 2004, through April 31, 2005, 101 (19%) were enrolled and randomly assigned to the GHHS ( $n = 48$ ) and the GMW ( $n = 53$ ). Four hundred twenty-seven patients were excluded (150 because they were not living in the hospital catchment area; 55 because familial support was not available; 78 because they had a history of advanced dementia, cancer, or severe renal or hepatic failure; and 59 because clinical conditions were unstable or intensive monitoring or mechanical ventilation was needed), and 85 patients did not sign the informed consent form (**Figure 1**). Enrolled patients and patients who refused enrollment did not have significant differences in age and sex. The mean time spent in the ED was 14.6 (3.4) hours for the GHHS patients (range, 3-24 hours) and 16.3 (3.0) hours for the GMW patients (range, 5-24 hours), with no statistical differences between the 2 groups.

At baseline, the 2 groups were similar in all sociodemographic, health, and clinical characteristics. The mean age of the entire sample was 81 years, patients were mostly multimorbid and functionally and cognitively im-



**Figure 1.** Trial profile. GHHS indicates Geriatric Home Hospitalization Service; GMW, general medical ward.

paired, and 52% were men. Systemic hypertension, coronary artery disease, and valvular dysfunction were the most common underlying causes of CHF in both groups. Lung infections, new atrial fibrillation, hypertensive crisis, and lack of compliance with medical treatment were the most important triggers for clinical deterioration. Some patients showed more than 1 underlying cardiac disorder or more than 1 possible trigger (**Table 1** and **Table 2**). A NYHA functional class IV was found in 35% of the entire sample and a reduced systolic function (left ventricular ejection fraction, <40%) in 40%, without significant differences between the 2 settings of care.

The GHHS patients received a mean of 13.8 (9.0) nursing visits (range, 4-40) and 11.1 (6.2) physician visits (range, 2-30) during the hospital-at-home admission. Four GHHS patients (8%) were transferred to the acute care hospital for a fall with Colles fracture (n=1), intestinal bleeding (n=1), or minor stroke (n=1), or owing to health problems on the part of the caregiver (n=1). None of them died during hospital admission. Two GMW patients (3%) were transferred to the intensive care unit. At the time of discharge, the mortality rate was equal in the 2 groups (3 deaths each, 3% of the total sample) and was owing to cardiac problems in 2 patients and pneumonia in the third patient.

Eight GMW patients (16%) were transferred to long-term facilities at the end of the acute care episode, whereas all GHHS patients remained at home ( $P=.02$ ). A marginally, although not statistically significant, lower rate of selected medical complications was observed in the home-treated group (mainly delirium and infections). Depression, nutritional status, and quality-of-life scores were significantly better in GHHS patients compared with those in the GMW group (**Table 3**).

**Table 1. Sociodemographic and Historical Characteristics of the Study Populations<sup>a</sup>**

Characteristic	No. (%) of Patients		P Value
	GHHS (n=48)	GMW (n=53)	
Age, mean (SD), y	82.2 (5.2)	80.1 (4.9)	.04
Male	22 (46)	30 (57)	.66
Married	22 (46)	24 (45)	.88
Family support at home	48 (100)	53 (100)	.89
Schooling <5 y	33 (69)	36 (68)	.91
Length of disease, mean (SD), y	5.4 (4.7)	5.2 (4.5)	.80
Prevalent heart disease			
Hypertensive cardiopathy	19 (40)	18 (34)	.84
Ischemic cardiopathy or coronary artery disease	13 (27)	14 (26)	.87
Heart valve disease	8 (17)	8 (15)	.93
Dilative cardiomyopathy	5 (10)	6 (11)	.85
Hypertrophic cardiomyopathy	0	2 (4)	.54
Other	3 (6)	5 (9)	.86
Precipitating factors			
Infections	17 (35)	23 (43)	.72
Acute arrhythmia (new atrial fibrillation)	14 (29)	17 (32)	.98
Hypertensive crisis	7 (14)	3 (6)	.31
Valvular dysfunction	3 (6)	4 (8)	.88
Acute coronary syndrome	2 (4)	4 (8)	.80
Lack of compliance with drug regimen	4 (8)	6 (11)	.90
Other	5 (10)	3 (6)	.65

Abbreviations: GHHS, Geriatric Home Hospitalization Service; GMW, general medical ward.

<sup>a</sup>Data are presented as number (percentage) of patients unless otherwise indicated.

Patients in both groups received appropriate pharmacologic treatments at similar rates.  $\beta$ -receptor blockers were given to 68% of the patients, angiotensin-converting enzyme inhibitors to 71%, and digoxin to 38%. Diuretics were administered intravenously to all patients, and  $\beta$ -receptor agonists, such as dobutamine or dopamine hydrochloride, were used in 2% of the entire sample.

Home-hospitalized patients had a longer period of treatment than those cared for in the hospital (20.7 [6.9] vs 11.6 [10.7] days,  $P=.001$ ). The overall length of stay was longer for patients treated at home but not one of them was institutionalized, whereas 8 patients treated in the GMW (16%) were transferred to a long-term facility after hospital discharge.

The level of stress of the caregiver was high on admission in both groups but more severe in caregivers of GHHS patients (Relative Stress Scale score, 25.4 [16.6] in the GHHS group vs 17.1 [10.8] in the GMW group;  $P=.003$ ). On discharge, we noticed a stress decrease only in the GHHS group, although this finding was not statistically significant (Relative Stress Scale score, 25.4 [16.6] at time of admission and 22.4 [15.8] at time of discharge;  $P=.37$ ).

Outcomes 6 months after discharge are described in **Table 4**. The number of subsequent hospital admissions was not statistically different in the 2 groups, but

**Table 2. Baseline Clinical Characteristics of the Study Populations<sup>a</sup>**

Characteristic	No. (%) of Patients		P Value
	GHHS (n=48)	GMW (n=53)	
Symptoms on admission			
Dyspnea at rest	30 (62)	38 (72)	.78
Dyspnea at minimal effort	14 (29)	20 (38)	.66
Orthopnea	23 (48)	17 (32)	.38
Paroxysmal nocturnal dyspnea	9 (19)	9 (17)	.95
Fatigue	43 (90)	29 (55)	.15
Mental disorder or confusion	14 (29)	12 (23)	.72
Clinical signs on admission			
Pulmonary rales	21 (44)	30 (57)	.57
Peripheral edema	37 (77)	41 (77)	.89
Positive hepatojugular reflux	4 (8)	7 (13)	.70
Jugular vein distention	11 (23)	13 (24)	.94
Third heart sound	1 (2)	4 (8)	.46
Tachycardia	10 (21)	11 (21)	.82
Systolic blood pressure, mean (SD), mm Hg	138.4 (26)	137.8 (24)	.90
Heart rate, mean (SD), /min	81.9 (17)	92.8 (21)	.006
Barthel Index, mean (SD)	66.5 (27)	62.2 (29)	.84
Instrumental Activities of Daily Living score, mean (SD)	6.8 (4)	7.7 (4)	.32
Geriatric Depression Scale score, mean (SD)	14.3 (6)	12.8 (5)	.17
Mini-Mental State Examination score, mean (SD)	22.6 (7)	24.6 (6)	.12
Mini Nutritional Assessment score, mean (SD)	18.9 (6)	20.8 (5)	.07
Cumulative Illness Rating Scale scores, mean (SD)			
Comorbidity Index	3.6 (1)	3.4 (2)	.54
Severity index	2.7 (1)	2.9 (1)	.20
Acute Physiology and Chronic Health Examination II score, mean (SD)	10.7 (3)	11.6 (4)	.24
Nottingham Health Profile score, mean (SD)	18.9 (9)	16.5 (9)	.17

Abbreviations: GHHS, Geriatric Home Hospitalization Service; GMW, general medical ward.

<sup>a</sup>Data are presented as number (percentage) of patients unless otherwise indicated. Scale ranges are as follows: Barthel Index, 0 to 100; instrumental activities of daily living, 0 to 14; Mini-Mental State Examination, 0 to 30; Geriatric Depression Scale, 0 to 30; Mini Nutritional Assessment, 0 to 30; Cumulative Illness Rating Scale Comorbidity Index, 0 to 14; Cumulative Illness Rating Scale Severity Index, 1 to 5; Acute Physiology and Chronic Health Examination II, 0 to 100; and Nottingham Health Profile, 0 to 38 (the lower the score, the better the quality of life).

the time to first additional admission was longer for the GHHS patients (**Figure 2**). The proportion of patients for whom CHF was the reason for subsequent hospitalization was 76%, without significant differences between the 2 groups. There was no difference in mortality at the end of the 6-month follow-up (15% in the total sample) (**Figure 3**). Also, no differences were found in functional, cognitive, nutritional, affective status, quality of life, and caregiver burden in the 2 settings.

The mean total cost was €1820.92 (US \$2604.46) for each patient treated at home and €2116.89 (US \$3027.78) for patients treated in the hospital ( $P < .001$ ). On a cost-per-patient-per-day basis, hospital-at-home costs were on average €110.98 (US \$158.73) compared with (US \$401.37) €280.62 for in-hospital patients. All patients dis-

**Table 3. Mean (SD) Depression, Functional, Nutritional, and Cognitive Status and Quality-of-Life Scores of Study Patients: Clinical Outcomes at 6-Month Follow-up**

Characteristic	GHHS (n=48)	GMW (n=53)	P Value
Barthel Index	-1.95 (9.61)	-0.30 (10.12)	.40
Instrumental Activities of Daily Living	-0.95 (1.97)	-0.54 (1.92)	.29
Geriatric Depression Scale	+1.48 (1.86)	+0.12 (3.36)	.02
Mini-Mental State Examination	+0.07 (1.38)	+0.08 (1.36)	.97
Mini Nutritional Assessment	-0.86 (1.12)	-0.27 (1.78)	.05
Nottingham Health Profile	+1.09 (2.57)	+0.18 (1.94)	.046

Abbreviations: GHHS, geriatric home hospitalization service; GMW, general medical ward.

Plus and minus signs refer to changes in scores.

**Table 4. Mortality and Subsequent Hospital Admissions at 6-Month Follow-up**

Characteristic	GHHS (n=48)	GMW (n=53)	P Value
Mortality, No. (%)	7 (15)	8 (15)	.83
Subsequent admission to hospital, No. (%)	8 (17)	18 (34)	.19
No. of days between discharge and first additional hospital admission, mean (SD)	84.3 (22.2)	69.8 (36.2)	.02
Length of stay of first additional hospital admission, mean (SD)	22.1 (9.5)	25.3 (12.2)	.15

Abbreviations: GHHS, geriatric home hospitalization service; GMW, general medical ward.

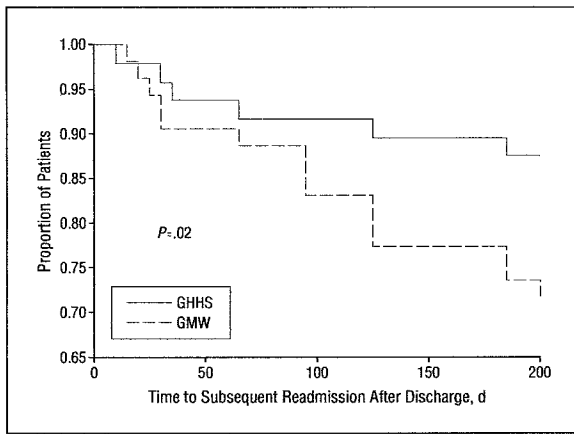
charged from the GHHS were not institutionalized, whereas 16% of the GMW patients continued their care in a long-term facility after hospital discharge, with an average daily cost of €157.12 (US \$224.73), for a mean period of 26 days; therefore, such costs should be added to the total GMW costs.

## COMMENT

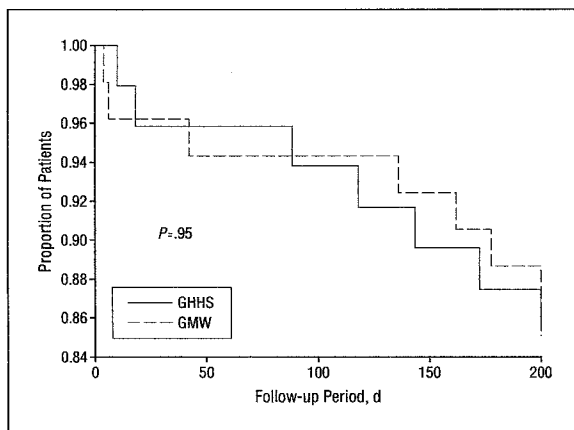
A common definition of hospital at home is "care provided at home that would otherwise require a hospital stay."<sup>33</sup> Hospital at home functions as a distinct but integrated ward of a hospital. It accepts direct admissions from the office of a physician or from the ED, as well as transfers from other inpatient services.

Several studies<sup>10-17</sup> demonstrated that it is possible to treat patients at home with results similar to those obtained with traditional hospital care. Care interventions for CHF outside the hospital demonstrated a significant decrease in additional CHF admissions, less use of EDs, and significant improvements in health-related quality of life.<sup>34,35</sup> However, these interventions were performed on early-discharged and younger inpatients.

The original contribution of our study includes several peculiar characteristics: our model is a physician-led hospital-at-home service that substitutes for the traditional hospital admission and provides an intensive level



**Figure 2.** Subsequent hospital admission–free period in the geriatric home hospitalization service (GHHS) and general medical ward (GMW) groups at 6-month follow-up.



**Figure 3.** Mortality-free period in the geriatric home hospitalization service (GHHS) and general medical ward (GMW) groups at 6-month follow-up.

of medical services. The study patients were taken home within 24 hours after admission to the ED (mean, 14 hours) without ever having been admitted to a hospital ward, although their clinical features were not different from those of the control group admitted to the GMW. Moreover, we enrolled very elderly, frail patients with multiple comorbidities, more than a third of whom had severe CHF symptoms (NYHA functional class IV). Nevertheless, no significant differences were observed in mortality rates, which confirms the feasibility of hospital-at-home care for this target population.

Although the mean duration of treatment in the GHHS was longer than in the GMW, none of the home-treated patients required further admissions to long-term care, compared with 16% of those admitted to the GMW. This is an interesting finding if we consider that the GHHS caregivers scored a higher level of stress on admission of the patients for whom they were caring. Nevertheless, the continuous home education and psychological support contributed to stress reduction.

The GHHS care was associated with a prolonged interval between discharge and subsequent hospital admission but not with a reduction in the number of

additional hospital admissions. The chronic and progressive nature of the disease and the characteristics of the sample could explain the similar rate of subsequent hospital admissions in both settings of care. The intensive, tailored support and health education given to the GHHS patients and families likely improved their attitude and compliance enough to delay subsequent hospital admissions.

Home-treated patients showed significantly fewer depressive symptoms and better quality of life. Multidisciplinary home management may exert positive effects in the education of the patient and the family on the nature and course of the disease, good lifestyle habits, and self-management, with an emphasis on active patient and family involvement in care, as stated by Rich.<sup>36</sup> Altogether, these aspects are likely to account for the benefit with regard to depressive symptoms and quality of life. The relatively lower rate of selected medical complications, particularly nosocomial infections, that occurred at home could also contribute to a better quality of life for GHHS patients.

Despite the positive results of this study, there are several caveats. First, we compared home care provided by geriatricians with GMW care, not with cardiologic care. In Italy, elderly patients with CHF are frequently treated in geriatric wards or GMWs. Second, the study focused on patients with a single condition, and the results may not apply to older adults with other acute medical illnesses. Third, the number of patients studied was relatively small, which likely reduced our ability to detect differences in other important outcomes. This sample size could detect large mortality differences between the 2 groups of patients, which is acceptable in a pilot study such as this one. Fourth, hospital-at-home care faces substantial dissemination barriers, and the generalizability of the results to other institutions, countries, and patient populations requires additional studies. The present report suggests that home care of selected patients may be associated with delayed additional admissions, improvements in quality of life, and alleviation of depressive symptoms without adverse effects in regard to mortality.

Hospital at home is a complex clinical model that could be successful as one element in a portfolio of models of care.<sup>37</sup> Recent trends in health care favor alternatives to traditional acute care in hospitals. These trends include advancement in telehealth technologies and increased demand for treatment at home. Further development of hospital-at-home care will require additional research and dedicated resources to support dissemination.

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