

Substitutive “Hospital at Home” Versus Inpatient Care for Elderly Patients with Exacerbations of Chronic Obstructive Pulmonary Disease: A Prospective Randomized, Controlled Trial

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OBJECTIVES: To evaluate hospital readmission rates and mortality at 6-month follow-up in selected elderly patients with acute exacerbation of chronic obstructive pulmonary disease (COPD).

DESIGN: Prospective randomized, controlled, single-blind trial with 6-month follow-up.

SETTING: San Giovanni Battista Hospital of Torino.

PARTICIPANTS: One hundred four elderly patients admitted to the hospital for acute exacerbation of COPD were randomly assigned to a general medical ward (GMW, n = 52) or to a geriatric home hospitalization service (GHHS, n = 52).

MEASUREMENTS: Measurements of baseline sociodemographic information; clinical data; functional, cognitive, and nutritional status; depression; and quality of life were obtained.

RESULTS: There was a lower incidence of hospital readmissions for GHHS patients than for GMW patients at 6-month follow-up (42% vs 87%, $P < .001$). Cumulative mortality at 6 months was 20.2% in the total sample, without significant differences between the two study groups. Patients managed in the GHHS had a longer mean length of stay than those cared for in the GMW (15.5 ± 9.5 vs 11.0 ± 7.9 days, $P = .010$). Only GHHS patients experienced improvements in depression and quality-of-life scores. On a cost per patient per day basis, GHHS costs were lower than costs in GMW ($\$101.4 \pm 61.3$ vs $\$151.7 \pm 96.4$, $P = .002$).

CONCLUSION: Physician-led substitutive hospital-at-home care as an alternative to inpatient care for elderly patients with acute exacerbations of COPD is associated with a substantial reduction in the risk of hospital read-

mission at 6 months, lower healthcare costs, and better quality of life. *J Am Geriatr Soc* 56:493–500, 2008.

Key words: elderly; COPD exacerbation; hospital at home

Chronic obstructive pulmonary disease (COPD) is a major cause of chronic morbidity and mortality. In the European Union, COPD and asthma, together with pneumonia, are the third most common cause of death, whereas in North America, COPD represents the fourth leading cause of death. In Italy, COPD is the third most common cause of death (~18,000 deaths every year) and the fourth highest cause of hospital admission (130,000 admissions every year).

Patients with COPD usually have progressive airflow obstruction that is not fully reversible, which leads to a history of progressive, worsening breathlessness that can affect daily activities and health-related quality of life. Winter outbreaks of COPD exacerbations, mostly occurring in elderly people with concurrent chronic comorbidities, often generate dramatic increases in hospital emergency department admission. Such admissions have increased substantially over the past decade, constitute a significant proportion of all hospital admissions, and are associated with a high rate of readmissions, contributing to the high costs of care for COPD.¹

In addition, recent reports highlight the fact that, although the acute 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.^{2–5}

Hospital at home is an alternative to acute hospital care. A spectrum of clinical models have been described under the hospital-at-home label, including office-based or infusion center-based intravenous services, delivery of home health services or home-based nursing services, early discharge models, and more recently, “clinical unit”

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models that substitute entirely for an acute hospital admission and deliver hospital-level care in the home.^{6,7} COPD has been the focus of several hospital-at-home studies, although most models studied have been early-discharge schemes that employed nursing care, without physician care in the home. A recent meta-analysis of such models found that hospital-at-home schemes were safe but had no effect on hospital readmission rates or mortality.⁸ There have been fewer previous studies of a substitutive physician-led clinical unit model of hospital at home.

It was hypothesized that a physician-led substitutive clinical unit model of hospital at home for elderly people with exacerbations of COPD would result in a reduction in hospital readmissions and mortality and improvements in other medical outcomes.

METHODS

This study was a randomized, single-blind, controlled trial performed at the Geriatric Home Hospitalization Service (GHHS) of the San Giovanni Battista Hospital of Torino, which has been in operation since 1985. The GHHS team is multidisciplinary and consists of three geriatricians, 13 nurses, two physiotherapists, one social worker, and one counselor. The team has seven cars. The main feature of GHHS is that doctors and nurses work together as a real team, with daily meetings to discuss each patient's needs and to organize individualized medical care plans and day-to-day work. The team operates 7 days a week and looks after 25 patients a day, on average. Every year, a mean of 450 patients has been treated at home. The most common diseases treated at home are cardiopulmonary, cerebrovascular, metabolic, and neoplastic diseases.

GHHS can be activated from a direct request of the patient's general practitioner as an alternative to traditional hospital care or from a request of hospital ward doctors to allow early and protected discharge from hospital. There is a close collaboration between the GHHS and the emergency department (ED) of the hospital, to propose, where possible, home care as an alternative to traditional admission to the hospital. In the ED, all the necessary diagnostic tests (e.g., blood tests, radiography, electrocardiogram) are provided, and then the patient moves home by ambulance. Usually, patients return back home within a few hours.

Approximately 60% of the patients are referred from the ED, 25% from hospital wards, and 15% from specialists or general practitioners in the community.

Medical consultation with other hospital specialists is possible in the hospital or at the patient's home. The GHHS provides substitutive hospital-at-home care in a "clinical unit" model.^{6,7,9,10} Many services or treatments can be provided at home, including blood tests, electrocardiogram, spirometry, pulse oximetry, oxygen and other respiratory therapies, intravenous fluids, antimicrobials and other medicines, blood transfusions, surgical treatment of pressure ulcers, echocardiograms, echographs, and Doppler ultrasonographies. Other treatments include physiotherapy, occupational therapy, and counseling.

Patients aged 75 and older with a diagnosis of acute exacerbation of COPD, defined on the basis of Anthonisen

criteria as an increase in breathlessness, sputum volume, or purulence for at least 24 hours,¹¹ admitted to the ED of the hospital and requiring acute hospitalization were eligible for the study. Additional inclusion criteria were appropriate care supervision in the home, telephone connection, living in the hospital-at-home geographic catchment area, and informed consent. Exclusion criteria were absence of family and social support; severe hypoxemia (partial pressure of oxygen <50 mmHg); severe acidosis or alkalosis (pH <7.35 or >7.55); suspected pulmonary embolism; suspected myocardial infarction; severe comorbid illness as defined by presence of need for hemodialysis, severe renal impairment (glomerular filtration rate <20 mL/min), cancer (except skin cancer), hepatic failure, or severe dementia (Mini-Mental State Examination score <14).

In the ED, all patients with COPD underwent a baseline standard clinical evaluation, blood tests (blood cell count, routine biochemical tests, and arterial blood gas tensions), pulse oximetry, 12-lead electrocardiography, chest radiographs, and hand-held spirometry. Further investigations (including pneumologist's assessment) were performed when required according to the clinical judgment of the ED physician. Only patients with a COPD exacerbation evaluated in the ED for at least 12 to 24 hours and with stable clinical conditions were considered eligible to be included in the study.

Patients fulfilling inclusion criteria were informed about the nature of the study and asked to give their informed consent. Extensive information was also provided to patients' relatives to obtain their collaboration.

In the ED, eligible patients were randomly assigned to GHHS ($n = 52$) or to a general medical ward (GMW, $n = 52$) and immediately transferred home or to a hospital medical ward. Patients were randomized using 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. After acceptance of a patient, the ED nurse coordinator, who was not involved in the study, opened the appropriate numbered envelope.

This study was considered a single-blind study, because patients were aware of the treatment assignment, whereas physicians and nurses evaluating patients were blinded to the patient's allocation.

Patients assigned to hospital-at-home management were immediately transferred home by ambulance. At home, a multidimensional geriatric assessment was conducted. GHHS patients received hospital-level treatments and services, such as those listed in Table 1, at home as their condition dictated. The home care program emphasized patient and caregiver education about the knowledge of the disease, giving advice about smoking cessation, nutrition, management of activities of daily living and energy conservation, understanding and use of drugs, health maintenance, and early recognition of triggers of exacerbation that required medical intervention. The inpatient control group received routine hospital care.

In the first days after admission to GHHS, physicians and nurses visited each patient at home daily. In the following days, a nurse saw the patients every day and the doctor saw them at intervals of 2 to 3 days or less, as

Table 1. Features of the Geriatric Home Hospitalization Service

Assessment in emergency department and transport home using ambulance
Services and treatment provided
Physician and nursing visits
Standard blood tests
Pulse oximetry
Electrocardiogram
Spirometry
Echocardiogram
Echographs and Doppler ultrasonographs
Oral and intravenous medication administration, including antimicrobials and cytotoxic drugs
Oxygen therapy
Blood products transfusion
Central venous access
Surgical treatment of pressure sores
Physical therapy
Occupational therapy
Hospital-at-home patients are considered hospital patients, and the hospital, which retains legal and financial responsibility for care, provides all services

required by the patient's clinical condition. Hospital-at-home staff was 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 from hospital-at-home care.

Historical variables were collected in the ED before randomization, including history of cigarette smoking, asthma, and occupational exposure to noxious agents. The medical history was gathered from the patient and from the clinical documentation exhibited at the time of admission. Data collected from surrogates were used in patients who were unable to be interviewed. Upon admission, blood pressure, spirometric parameters (forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC), and FEV₁/FVC%), hematocrit, blood glucose, serum creatinine concentration, serum hepatic enzymes, serum nutritional parameters (e.g., total proteins, albumin, transferrin, lymphocytes) and electrolytes, arterial blood gas levels (pH, partial pressure of oxygen in arterial blood, partial pressure of carbon dioxide in arterial blood, bicarbonate, pulse oximetry), and sputum culture if possible were recorded for each patient.

A 6-month follow-up evaluation was performed on survivors by visiting them at home or in the nursing home or hospital. The evaluator was a postgraduate doctor not involved in the care of the patients and unaware of the patient's previous allocation. Morbidity (including urinary tract infections, catheterization, falls, delirium, pressure sores) during at-home or inpatient care was evaluated through chart review at the time of discharge from GHHS or GMW.

The main outcomes of the study were hospital readmission and mortality rates at 6 months. In addition, depression status was examined using the Geriatric Depression Scale,¹² functional status using Katz activities of daily living¹³ and Lawton instrumental activities of daily

living,¹⁴ cognitive status using the Mini-Mental State Examination,¹⁵ quality of life using the Nottingham Health Profile,¹⁶ nutritional status using the Mini Nutritional Assessment,¹⁷ caregiver characteristics with special attention to the level of stress using the Relatives' Stress Scale,¹⁸ and satisfaction using an ad hoc questionnaire for customer satisfaction. At baseline, the severity of illness was also evaluated using the Acute Physiology and Chronic Health Evaluation (APACHE)¹⁹ and comorbidity using the Cumulative Illness Rating Scale.²⁰

Finally, the costs of care were compared for the acute episode.

Statistical Analysis

The sample size estimation was performed according to the one-sample binomial test. No data were available on hospital readmission of patients with COPD treated at home by GHHS. Therefore, for estimating the sample size, the 6-month readmission rates in patients treated on GMWs were estimated. On this basis, at least 100 patients needed to be included in the study to have an 80% chance ($1 - \beta$ setting at 0.80) of detecting significant difference in readmission between the two group using a two-sided test with $\alpha = 0.05$.

The sample was analyzed on an intention-to-treat basis. Data are presented as means \pm standard deviations (95% confidence intervals) or as percentages in the corresponding categories. Paired and unpaired *t* tests were used to compare data within and between the groups, respectively, for parametric data, and chi-square tests for non-parametric data. Kaplan-Meier analysis was used to evaluate cumulative proportion survival during the 6-month period of follow-up. $P < .05$ was considered significant. Data were analyzed with SPSS for Windows, version 11.5 (SPSS Inc., Chicago, IL).

Economic Analysis

Costs for the acute episode of COPD were calculated, comparing only the direct health costs of GHHS interventions with those of GMW care. The costs were calculated in euro (€) and converted to dollars using an exchange rate of 1 euro = \$1.275. The daily GHHS costs was represented by costs for geriatricians, nurses, counsellors, dietitians, and social workers, calculated according to the amount of time spent with patients and including a cost for noncontact time. Data on hospital costs were collected from the official hospital medical cost database, including direct medical costs for beds, staff, examinations, medications, rehabilitation, and miscellaneous expenses. Data on costs for hospital-at-home patients were obtained in a similar manner, except that costs for hospital-at-home patients did not include costs for food, laundry, heating, or lighting. Costs for ED care were included for both patient groups. The management for each patient in ED costs \$183.6 on average and was the same for all patients in both settings, because it derived from an evaluation made before randomization.

RESULTS

Five hundred twenty-nine patients aged 75 and older were consecutively admitted to the ED from April 2004 to April 2005 with a diagnosis of acute exacerbation of

COPD according to the Anthonisen criteria.¹¹ Three hundred forty-seven patients were excluded (148 because they were not living in the healthcare catchment area; 45 because familial or social support was not available; 80 because they had a history of dementia, severe renal or hepatic failure, or cancer; and 74 because clinical conditions were unstable or intensive monitoring or mechanical ventilation was needed), and 78 patients did not sign the informed consent (Figure 1). The remaining 104 patients were randomized to GHHS ($n = 52$) and to GMW ($n = 52$). Mean time spent in the ED was 15.5 ± 3.8 hours for GHHS patients and 17.2 ± 3.6 hours for GMW patients, with no statistical differences between the two groups.

Characteristics of patients in each of the study groups are displayed in Table 2. Overall, patients were elderly, multimorbid, and functionally and cognitively impaired. The groups were similar in all baseline characteristics. Table 3 describes treatments received by patients. Patients in both groups received COPD-related treatments at similar rates. GHHS patients received a mean of 14.1 nursing visits (range 3–38, median 11) and 9.9 physician visits (range 2–28, median 8) during a hospital-at-home admission. Eleven (21.1%) hospital-at-home patients required visits to the hospital for diagnostic procedures (e.g., x-rays, endoscopy) and returned home within a few hours. Three (5.8%) hospital-at-home patients were transferred to the acute hospital to complete their care because of caregiver's health problems. Two (3.8%) GMW patients were transferred to the intensive care unit because of acute respiratory failure. Upon discharge, the mortality rate was equal in the two groups (9 deaths in total, 8.7% of the sample). Six GMW patients (11.5%) were transferred to long-term facilities at the end of the acute episode, whereas all GHHS patients remained at home. The incidence of selected medical complications did not differ between the two settings of care, with the exception of urinary tract infections, which were observed in approximately 6% of GMW patients and only in 1% of GHHS patients ($P = .049$).

Patients managed in hospital at home had a longer mean length of stay than those cared for in the acute hospital (15.5 ± 9.5 vs 11.0 ± 7.9 days, $P = .01$).

Outcomes 6 months after discharge are described in Table 4. GHHS patients experienced a lower rate of hospital readmission (42% vs 87%, $P = .001$), and the time to readmission was longer for hospital-at-home patients (78 vs 37 days). Ten GMW patients had their first readmission within 15 days from discharge; in GHHS, the first readmission was scheduled 45 days after discharge. The readmission rate per patient was 0.4 ± 0.6 in the GHHS group and 1.1 ± 1.2 in the GMW group ($P < .001$). The proportion of readmitted patients for which COPD was the reason for admission was similar between the two groups (82% for hospital at home, 85% for the acute hospital group). There was no difference in mortality. In addition, patients in hospital at home experienced statistically significantly greater improvements in depression and quality-of-life scores than the acute hospital group. There were no differences in functional, cognitive, nutritional, or caregiver burden outcomes. Satisfaction at discharge was very good or excellent for 94% of GHHS patients and 88% of acute hospital patients ($P = .83$) (Appendix A).

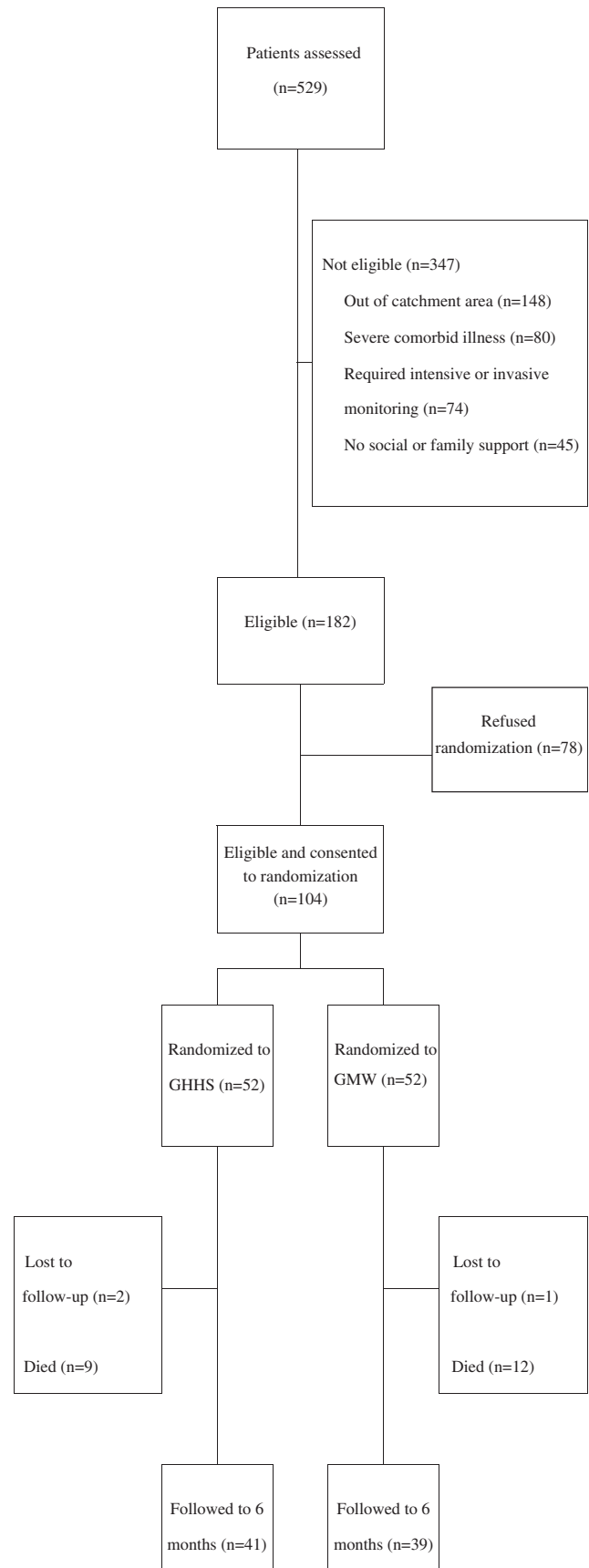


Figure 1. Trial profile.

GHHS = Geriatric Home Hospitalization Service; GMW = geriatric medical ward.

Table 2. Baseline Characteristics of the Study Populations

Characteristic	Geriatric Home Hospitalization Service (n = 52)	General Medical Ward (n = 52)	P-Value
Age, mean ± SD	80.1 ± 3.2	79.2 ± 3.1	.20
Male, n (%)	29 (56)	39 (75)	.06
Married, n (%)	27 (52)	29 (56)	.84
Family support at home, n (%)	52 (100)	52 (100)	.89
Smoking history, n (%)			
Current smoker, n (%)	7 (13)	6 (11)	.97
Ex-smoker, n (%)	34 (65)	35 (67)	.95
Nonsmoker, n (%)	11 (21)	11 (21)	.81
Number of cigarettes/d, mean ± SD	20 ± 11	21 ± 15	.83
FEV1, mean ± SD	0.92 ± 0.4	1.04 ± 0.5	.18
Percentage of predicted FEV1	38	47	
Respiratory rate, mean ± SD	24 ± 5	25 ± 7	.32
Home oxygen use before admission, n (%)	18 (35)	12 (23)	.45
Arterial blood gas, mean ± SD			
pH	7.40 ± 0.04	7.41 ± 0.03	.19
Partial pressure of oxygen	69 ± 19	65 ± 14	.23
Partial pressure of carbon dioxide	44 ± 12	46 ± 12	.47
Activities of Daily Living score, mean ± SD*	2.3 ± 2.2	1.9 ± 2.2	.36
Instrumental Activities of Daily Living score, mean ± SD [†]	7.1 ± 4.9	8.1 ± 4.2	.27
Geriatric Depression Scale score, mean ± SD [‡]	16.1 ± 6.1	17.2 ± 6.8	.45
Mini Nutritional Assessment, mean ± SD [§]	17.1 ± 6.5	18.3 ± 6.2	.37
Mini-Mental State Examination score, mean ± SD	21.8 ± 6.9	21.8 ± 6.3	.89
Cumulative Illness Rating Scale score, mean ± SD			
Comorbidity index [#]	2.6 ± 1.5	3.0 ± 1.8	.24
Severity index ^{**}	2.5 ± 0.5	2.6 ± 0.5	.19
Acute Physiology and Chronic Health Examination II score, mean ± SD ^{††}	9.5 ± 4.0	10.3 ± 4.0	.29
Nottingham Health Profile score, mean ± SD ^{‡‡}	20.6 ± 9.6	19.3 ± 8.2	.46

Normal range * 0–6, † 0–14, ‡ 0–30, § 0–30, || 0–30, # 0–14, ** 1–5, †† 0–100, ‡‡ 0–38.
SD = standard deviation; FEV1 = forced expiratory volume in 1 second.

The mean total cost was \$1,175.9 for each patient treated at home and \$1,390.9 for patients treated in the hospital ($P = .38$). On a cost per patient per day basis, hospital-at-home costs were $\$101.4 \pm 61.3$, compared with $\$151.7 \pm 96.4$ for hospital patients ($P = .002$). Analysis of costs for hospital-at-home patients revealed that 79% of costs were due to costs for staff. The remaining 21% included costs for drugs, durable medical equipment, diagnostic procedures, medications, and other nonstaff costs.

It is important to highlight that all patients discharged from GHHS had completed the care program at home, whereas 11.5% of GMW patients continued their care in a long-term facility after hospital discharge, with an average daily cost of \$174.7 for a mean period of 25 ± 8.7 days.

DISCUSSION

Older patients are an increasing proportion of hospital inpatients. They are at higher risk for many hazards of hospitalization, including mortality and adverse events, than younger patients.^{2–5,21} Providing acute hospital-level care in a patient's home can be a safe and efficacious alternative to hospital care.^{22,23}

It is well known that a nurse-led intervention can be feasible and effective for selected patients with COPD.^{8,24,25}

In the current study, we compared a physician-led substitutive hospital-at-home model of care with traditional inpatient care for elderly patients with exacerbations of COPD. Hospital-at-home care was associated with a reduction in hospital readmissions. In addition, hospital-at-home care was associated with improvements in quality of life and depressive symptoms and a reduction in cost of care. There was also a difference in the time to first readmission, with hospital-at-home patients enjoying an admission-free interval that was, on average, twice as long as that of patients cared for in the acute hospital. A study of nurse-led substitutive hospital at home demonstrated no difference in readmissions between the study groups and estimated that 3,000 patients would be needed to show a 5% difference between groups for this outcome.²⁶ A non-randomized U.S. study of a physician-led substitutive clinical unit hospital-at-home model of similar robustness to the current study cared for patients with several diagnoses including COPD, but that study was not powered to assess hospital readmission as a primary outcome.²² The particular elements of the current model were critical in produc-

Table 3. Treatments Received by Study Participants

Treatment	Geriatric Home Hospitalization Service (n = 52)	General Medical Ward (n = 52)	P-Value
	n (%)		
Oxygen therapy	30 (58)	38 (73)	.55
Intravenous antibiotics	40 (77)	39 (75)	.95
Intravenous steroids	23 (44)	27 (52)	.77
Beta-agonist bronchodilators	20 (39)	25 (48)	.66
Anticholinergic bronchodilators	26 (50)	21 (40)	.67

ing the effect on the readmission rates seen. The reduction in hospital readmission was due to a decrease in readmissions for reasons other than COPD. The reasons for this are unclear but may relate to the possible effects of the geriatric assessment embedded in the hospital-at-home intervention or the unmeasured effects of hospital at home on improving transitional care.^{27,28}

The mean length of treatment was slightly longer in the home-hospitalized group than in the hospital-admitted group, although none of the home-treated patients needed an admission to a long-term facility, compared with 11.5% of GMW patients. The GHHS patients underwent acute rehabilitative care at home, and their caregivers were encouraged to participate actively in the rehabilitation process. Individual counseling was offered to patients and caregivers if needed. Education and psychological support are important for the overall success of rehabilitation. Education improves knowledge, coping, and self-management, actively engaging patients in maintaining strategies that reduce dyspnea, maintain good lifestyle habits, and encourage participation in decision-making when an acute exacerbation occurs.

The physician-led substitutive “clinical unit” hospital-at-home model studied was robust. The clinical unit model has been described as one that provides care that substitutes entirely for an inpatient acute hospital admission; an intensity of care, including medical and nursing care, similar to that provided in the hospital, commensurate with the severity and type of illness treated; and care that usual

community-based home care services cannot provide. Some prior studies of hospital at home for COPD have been of early-discharge hospital-at-home models that treat patients at home with nursing care after they have been admitted to and stabilized in the acute hospital.^{29–32} The previously cited study of substitutive hospital-at-home care for patients with COPD employed a nurse-based model that provided only twice-daily nursing visits for 3 days, and although responsibility for patients rested with hospital physicians, patient’s clinical conditions did not necessarily require hospital physician’s visits at home.²⁶ The current intervention targeted elderly patients with multiple comorbid illnesses, functional impairments, and a high degree of clinical severity, as shown by the APACHE mean score. These patients needed frequent home visits from doctors, nurses, and physiotherapists who worked together as a team. This intervention was appropriate for this target population that is especially susceptible to iatrogenic consequences of hospital care and to disruptions in their community routines, and it is likely that it played a significant role in the positive outcomes demonstrated in this study. The importance of targeting appropriate interventions to appropriate patients has been seen in studies of preventive home care services in which more-intensive interventions that included geriatric assessment were associated with positive outcomes.²²

The improvements in secondary outcomes such as depression scores and quality of life have been seen in some previous studies of hospital at home for patients with

Table 4. Clinical Outcomes at 6-Month Follow-Up

Characteristic	Geriatric Home Hospitalization Service (n = 52)	General Medical Ward (n = 52)	P-Value
Readmission to hospital, n (%)	17 (42)	34 (87)	.001
Mortality, n (%)	9 (17)	12 (23)	.72
Number of days between discharge and readmission, mean ± SD	78 ± 55	37 ± 29	.005
Change in Geriatric Depression Scale score, mean ± SD	−3.1 ± 4.7	0.7 ± 3.2	.00
Change in Nottingham Health Profile score, mean ± SD	3.6 ± 7.9	0.8 ± 4.5	.04
Change in Activities of Daily Living score, mean ± SD	0.12 ± 0.64	0.08 ± 0.73	.81
Change in Instrumental Activities of Daily Living score, mean ± SD	−1.4 ± 2.6	−0.6 ± 1.9	.10
Change in Mini-Mental State Examination score, mean ± SD	−0.4 ± 4.0	−0.5 ± 1.8	.88
Change in Mini Nutritional Assessment score, mean ± SD	−1.7 ± 2.9	−1.2 ± 4.1	.59
Change in Relatives’ Stress Scale score, mean ± SD	4.6 ± 5.6	2.6 ± 6.1	.16
Satisfaction very good/excellent at discharge, n (%)	49 (94)	46 (88)	.83

SD = standard deviation.

COPD,^{30,33} but those studies examined these outcomes at 8 weeks. The current study demonstrated such differences at 6 months, suggesting that hospital at home can have sustained effects in the population studied.

Patients with COPD, especially the oldest ones, represent a heavy burden for hospital medical wards. Although the present study was not designed to evaluate the economic effect of this intervention, the evaluation suggests that GHHS may be cost effective and have a place in reducing the pressure on acute hospital beds.

Although not well described in the literature, most, if not all, studies of hospital at home have been performed on relatively immature care models. This is often due to the need to demonstrate the value of a novel and relatively expensive clinical model and justify maintaining its operation.²³ The hospital at home had been operating for nearly 20 years when the current study was conducted. This study may represent the first test of an operationally mature hospital at home staffed by highly functional teams, and this may also have contributed to positive results, although this may also reduce the generalizability of the results. This information should be useful to policymakers as they continue to evaluate the value of hospital at home.

There are several caveats to this study. First, to the extent that this study fielded an operationally mature hospital-at-home model, it may reduce the generalizability of the results. 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 small, and it is likely that this reduced the ability to detect differences in other important outcomes.

In conclusion, this study shows that a mature, physician-led, substitutive clinical unit model of hospital-at-home care for elderly patients with acute exacerbations of COPD is feasible and is associated with reductions in hospital readmissions and better patient outcomes at 6 months.

Although the results are promising, there is a need for further studies that include a larger number of patients and an economic evaluation of direct and indirect costs.

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Author Contributions: Nicoletta Aimonino Riccauda conceived and designed the original project, interpreted the

results, wrote the manuscript, and saw and approved the final version.

Vittoria Tibaldi conceived and designed the original project, helped with data collection, interpreted the results, wrote the manuscript, and saw and approved the final version.

Bruce Leff interpreted the results, wrote the manuscript, and saw and approved the final version.

Carla Scarafiotti, Renata Marinello, and Mario Molaschi helped to conceive and design the project, revised the manuscript, and saw and approved the final version.

Mauro Zancocchi conducted the data analysis, revised the manuscript, and saw and approved the final version.

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Appendix A: Questionnaire on Customer’s Satisfaction

Please, answer to the following questions.
 Your answers will enable us to improve the quality of our care.
 The questionnaire is anonymous and will be processed in a sealed envelope.
 You may be helped by a family member or a friend.
 Thank you for your comments at the end of the page.

What I think about:	Excellent	Very Good	Poor	Unsatisfactory
1. Medical care				
2. Nursing care				
3. Medical explanations on diagnosis				
4. Medical explanations on disease course and treatment				
5. Nursing advice				
6. Medical and nurses’ attitudes				
7. Feeling of safety and protection about home hospital or inpatient treatment				
8. Satisfaction about my home hospital or inpatient treatment				
<i>Detailed comments</i>				
Positive aspects			
Issues to be improved			
Date			