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## Original Study

# Effectiveness of a Hospital-at-Home Integrated Care Program as Alternative Resource for Medical Crises Care in Older Adults With Complex Chronic Conditions



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## A B S T R A C T

## Keywords:

Hospital-at-home  
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 multimorbidity

**Objectives:** To compare clinical outcomes in older patients with acute medical crises attended by a geriatrician-led home hospitalization unit (HHU) vs an inpatient intermediate-care geriatric unit (ICGU) in a post-acute care setting.

**Design:** Quasi-experimental longitudinal study, with 30-day follow-up.

**Participants:** Older patients with chronic conditions attended at the emergency department or day hospital for an acute medical crisis.

**Interventions:** Patients were referred to geriatrician-led HHU or ICGU wards.

**Setting:** An acute care hospital, an intermediate care hospital, and the community of an urban area in the North of Barcelona, in Southern Europe.

**Measurements:** We compared health crisis outcomes (recovery from the acute health crisis, referral to an acute hospital, or death), length of stay, relative functional gain (RFG) at discharge, readmission to an acute care unit within 30 days of discharge, and mortality within 30 days of discharge.

**Results:** We included 171 older adults (57 in the HHU and 114 in the ICGU) with complex conditions at risk of negative outcomes. At baseline, HHU patients were significantly younger and less likely to be cognitively impaired and referred from an emergency department. Most patients in both groups recovered from their health crises (91.2% in the HHU group vs 88.6% in the ICGU group,  $P = .79$ ). No differences were found between the 2 groups in 30-day mortality (8.6% vs 9.6%,  $P = >.99$ ). There was a trend toward lower 30-day readmission to an acute care unit in the HHU group (10.5% vs 19.3% in the ICGU group,  $P = .19$ ). HHU patients had higher RFG (mean 0.75 days vs 0.51 in the ICGU group,  $P = .01$ ), and a longer stay in the unit (9.7 vs 8.2 days in the ICGU group,  $P < .01$ ).

**Conclusions:** These preliminary results suggest that the geriatrician-led HHU seems effective in resolving acute medical crises in older patients with chronic disease. Patients attended by the HHU obtained better functional outcomes compared to those from the ICGU, although the groups did have some baseline differences.

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The authors declare no conflicts of interest.

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The aging of the population has led to a high prevalence of older people with complex chronic conditions worldwide, leading to the development of several successful models of comprehensive care.<sup>1</sup> In recent decades, different home-based and hospital-based resources have been adapted to high-risk patients by tailoring interventions not only to chronic conditions<sup>2</sup> but also to medical crises.<sup>3,4</sup>

In Catalonia, intermediate care geriatric units (ICGUs) are low-tech geriatric wards located in post-acute care settings. ICGUs are used as alternatives to acute hospitalization for select older patients with acute medical crises.<sup>5–7</sup> Moreover, a Comprehensive Geriatric Assessment–based hospital-at-home model, provided by a geriatrician-led home hospitalization unit (HHU), was developed to deal with disabling health crises,<sup>8</sup> based on previous evidence.<sup>9,10</sup> Outcomes of orthopedic crises treated by the HHU were at least as good as those treated by conventional hospitalization; furthermore, HHU reduced hospital stays and overall costs.<sup>11,12</sup> The current study aimed to compare the effectiveness of the HHU vs the ICGU in older patients with chronic conditions and acute medical crises.

## Methods

This quasi-experimental longitudinal study compared clinical outcomes in older patients with chronic conditions and acute medical crises at 2 units belonging to an integrated care institution in the urban area of Badalona, north of Barcelona, in Catalonia: the ICGU (post-acute care setting), which has been providing acute care to frail older patients in selected crises with good prognoses since 2010;<sup>6</sup> and the HHU, which has been providing acute medical care to the same profile of patients since 2015. The university's ethics committee approved the study (Universitat Autònoma de Barcelona, reference number 3438).

We included older patients with chronic conditions who had an acute medical crisis between December 1, 2015, and June 30, 2016, whom emergency department or day hospital physicians classified as having a good prognosis and not needing further complex diagnostic tests or management by other specialized units of the acute hospital. Assignment to the HHU or ICGU was based on the availability of resources, on caregiver availability, and on patient acceptance (it was not randomized). To be admitted to the HHU, patients needed to have another person in their home (24/7) who was physically and cognitively able to act as a caregiver, and both patients and caregivers needed to provide informed consent acceptance.

All patients in both groups received an initial assessment and treatment visit from a nurse specialized in geriatrics within 12 hours of referral and an initial visit from a geriatrician within 24 hours of referral. The same Comprehensive Geriatric Assessment–based protocol was applied in all patients, involving geriatricians, nurses, and physical and occupational therapists when necessary, with the support of social workers. Available diagnostic procedures included electrocardiography, laboratory tests, and imaging studies. Available medical procedures included intravenous antibiotics, corticosteroids, diuretics and fluids, and nebulizers for bronchodilator therapies, among others.

Patients in the HHU group received 1 to 3 individualized home visits from staff between 8 AM and 9 PM daily; outside this time frame, on-call physicians could be reached by phone. As a rule, patients were visited by a physician daily or every other day, and by a nurse twice a day or daily. In the ICGU, physicians and nurses were available 24 hours/d. Patients in both groups were discharged for primary care follow-up when therapeutic goals were met (ie, when the acute crisis was resolved). Patients whose condition failed to improve or worsened were referred to an acute hospital based on predefined protocols.

In calculating the sample size, we assumed 30% of patients would die or be referred to an acute hospital, 20% relative risk reduction, and a ratio of 2 ICGU patients per HHU patient (power of 90%; 5% alpha-error and 10% beta-error).<sup>13</sup> We recorded the following variables at

admission: age, sex, principal diagnosis (respiratory infection, acute heart failure, urinary tract infection, or other), referring medical team (emergency department or day hospital), place of residence (at home or nursing home), and length of emergency department stay (for patients referred from the emergency department). We recorded baseline functional status before the health crisis (Barthel Index score reported by patients or caregivers, considering functional status before the health crisis started), functional status at admission to the HHU or ICGU (Barthel Index score measured by unit professionals of the multidisciplinary team between 1 and 2 days after the health crisis started), presence of functional loss<sup>14</sup> (positive difference between baseline Barthel Index score and Barthel Index score at admission to the unit), morbidity (measured by Adjusted Morbidity Groups [AMG]),<sup>15</sup> and the presence of cognitive impairment and/or delirium. We recorded the following variables at discharge: functional status (Barthel Index), functional gain (Barthel Index at discharge minus Barthel Index at admission to the unit), relative functional gain (functional gain divided by functional loss),<sup>14</sup> length of stay in the unit, and destination (home, nursing home, acute hospital). We classified outcomes as recovery from the acute health crisis (discharged to primary care follow-up), referral to an acute care unit, or death. We also recorded readmission to an acute unit or death during the 30 days after discharge from the HHU or ICGU.

Categorical data are reported as frequencies and percentages; continuous data are reported as means and standard deviations. To compare the HHU and ICGU groups at baseline, we used chi-square tests or Fisher exact test, as appropriate, for categorical variables and independent sample *t* tests for quantitative variables, after verifying normality using the Kolmogorov-Smirnov test. To compare the outcome of relative functional gain, we used an analysis of covariance of repeated measures to quantify the magnitude of the effect. We used linear and binary logistic regression to identify explanatory variables associated with outcomes and intervention unit. In the bivariate analysis, we included statistically significant variables and those considered clinically relevant. Adjustment variables were age, diagnostic group, cognitive impairment, baseline Barthel Index, referral unit, and place of residence. We used a backward stepwise technique to avoid overfitting. All comparisons were 2-tailed, and  $P < .05$  was considered significant. We used SPSS, version 21 (IBM Corp, Armonk, NY), for all analyses.

## Results

We included 171 patients, 57 in the HHU group and in 114 the ICGU group [mean age 86.1 (6.8) years, 59% women, 34% residing in nursing homes]; 83.6% were referred from the emergency department (mean emergency department stay 19.1 hours). The most common acute diagnoses were respiratory infection ( $n = 90$ ; 52.6%), urinary tract infection ( $n = 39$ ; 22.8%), and acute heart failure ( $n = 30$ ; 17.5%); 12 (7%) patients had other acute conditions. At admission, 86 (50.3%) had cognitive impairment, 29 (17%) delirium, and 92 (53.8%) functional loss due to the acute crisis; 119 (69.6%) patients had an AMG score of 4 (high risk of readmission). Table 1 reports the baseline characteristics of the HHU and ICGU groups. Patients in both groups had high risk of readmission due to morbidity (measured by AMG score) and to acute geriatric syndromes. In the HHU group, the age of the sample was significantly lower, and the proportion of patients referred from day hospital was significantly higher. In the ICGU group, the proportion of respiratory infections as the main diagnosis, the living residence nursing home, and the presence of cognitive impairment as a baseline diagnosis was significantly higher. Among patients referred from the emergency department, the mean length of the emergency department stay was shorter in the HHU group (12.6 vs 22 hours,  $P = .02$ ).

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