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Assessment of the Impact of Home-Based Hospitalization on Health Outcomes: An Observational Study

Avaliação do Impacto da Hospitalização Domiciliária nos Resultados em Saúde: Um Estudo Observacional

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ABSTRACT

Introduction: In Portugal, evidence of clinical outcomes within home-based hospitalization programs remains limited. Despite the adoption of home-based hospitalization services, it is still unclear whether these services represent an effective way to manage patients compared with inpatient hospital care. Therefore, the aim of this study was to evaluate the outcomes of home-based hospitalization compared with conventional hospitalization in a group of patients with a primary diagnosis of infectious, cardiovascular, oncological, or 'other' diseases.

Methods: An observational retrospective study using anonymized administrative data to investigate the outcomes of home-based hospitalization (n = 209) and conventional hospitalization (n = 192) for 401 Portuguese patients admitted to CUF hospitals (Tejo, Cascais, Sintra, Descobertas, and the Unidade de Hospitalização Domiciliária CUF Lisboa). Data on demographics and clinical outcomes, including Barthel index, Braden scale, Morse scale, mortality, and length of hospital stay, were collected. The statistical analysis included comparison tests and logistic regression.

Results: The study found no statistically significant differences between patients' admission and discharge for the Barthel index, Braden scale, and Morse scale scores, for both conventional and home-based hospitalizations. In addition, no statistically significant differences were found in the length of stay between conventional and home-based hospitalization, although patients diagnosed with infectious diseases had a longer stay than patients with other conditions. Although the mortality rate was higher in home-based hospitalization compared to conventional hospitalization, the mortality risk index (higher in home-based hospitalization) assessed at admission was a more important predictor of death than the type of hospitalization.

Conclusion: The study found that there were no significant differences in outcomes between conventional and home-based hospitalization. Home-based hospitalization was found to be a valuable aspect of patient- and family-centered care. However, it is noteworthy that patients with infectious diseases experienced longer hospital stays.

Keywords: Home Care Services, Hospital-Based; Hospitalization; Patient-Centered Care; Patient Safety

RESUMO

Introdução: Em Portugal, a evidência dos resultados clínicos dos programas de Hospitalização Domiciliária tem sido limitada. Apesar da adoção de serviços de hospitalização domiciliária, ainda não se sabe se estes representam uma forma eficaz de gerir os doentes em comparação com os cuidados hospitalares em regime de internamento. Por conseguinte, este estudo avaliou o impacto da hospitalização domiciliária em comparação com a hospitalização convencional em doentes que receberam um diagnóstico primário de doença infecciosa, cardiovascular, oncológica ou 'outro'.

Métodos: Foi realizado um estudo observacional retrospetivo com recurso a dados administrativos anonimizados para investigar os resultados da hospitalização domiciliária (n = 209) e da hospitalização convencional (n = 192) em 401 doentes portugueses internados em hospitais CUF (Tejo, Cascais, Sintra, Descobertas e Unidade de Hospitalização Domiciliária CUF Lisboa). Foram recolhidos dados demográficos e de resultados clínicos, nomeadamente índice de Barthel, escala de Braden, escala de Morse, mortalidade e tempo de internamento. A análise estatística incluiu testes de comparação e regressão logística.

Resultados: Neste estudo não foram encontradas diferenças estatisticamente significativas na variação no índice de Barthel, na escala de Braden e na escala de Morse entre a admissão e a alta hospitalar, tanto nos doentes em hospitalização domiciliária como hospitalização convencional. Não foram encontradas diferenças estatisticamente significativas no tempo de internamento entre a hospitalização domiciliária e hospitalização convencional, mas os doentes diagnosticados com doenças infeciosas apresentaram um tempo de internamento maior do que os restantes doentes. Embora a taxa de mortalidade tenha sido maior na hospitalização domiciliária do que na hospitalização convencional, o índice de risco de mortalidade (elevado na hospitalização domiciliária) avaliado na admissão revelou-se um preditor mais importante de morte do que o tipo de hospitalização.

Conclusão: Não foram observadas diferenças significativas nos resultados entre a hospitalização convencional e a domiciliária. A hospitalização domiciliária pode ser considerada um aspeto valioso dos cuidados centrados no doente e na família. No entanto, é de salientar que os doentes com doenças infecciosas tiveram estadias hospitalares mais longas.

Palavras-chave: Cuidados Centrados no Doente; Hospitalização; Segurança do Doente; Serviços Hospitalares de Assistência Domiciliar

INTRODUCTION

Home-based hospitalization (HBH) constitutes a model of care that provides person-centered active treatment in the homes of persons who require acute care.[1] It is a popular response to the increasing demand for acute hospital beds.[2,3] Caplan *et al* conducted a meta-analysis which included 61 randomized controlled trials of HBH models,

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indicating significant reductions in mortality and readmission rates, better patient and caregiver satisfaction, and decreased costs.[4] The central goals of such schemes are cutting costs by avoiding hospital admission and reducing hospital length of stay (LOS).[3]

Delivering acute HBH has been shown to be a safe, effective, and cost-effective alternative to conventional hospitalization (CH).[5,6] Home-based hospitalization can be crucial in decentralizing care, accelerating rapid ramp-ups in bed capacities, and controlling nosocomial infections.[7] The COVID-19 pandemic brought new necessities and motivation to the HBH research field.[3] It highlighted that this model could be viable in caring for inpatients with and without COVID-19 in one of the world's regions with the highest burden, i.e., New York City.[8] Moreover, with the growing aging population worldwide, more extended living can lead to increased demand for care.[9,10] Growing public health care expenditure raises concerns about its long-term sustainability. The European Union's (EU) public health expenditure was 6.6% of the gross domestic product (GDP) in 2019. The projections show that expenditure may only grow to 7.7% of GDP in 2070 due to demographic aging. Therefore, alternatives are needed.[11]

The impact and efficiency of HBH have been widely researched in previous studies for distinct conditions: cancer,[2] chronic obstructive pulmonary disease,[12-17] COVID-19,[3,8] stroke,[18,19] neuromuscular diseases,[20] heart failure,[17,21-25] diabetes,[26] among others.[7,27,28] The impact and efficiency of HBH were also analyzed in different groups (e.g., geriatric,[5,28-30], adult[17] and pediatric[31] populations) and various countries (e.g., Italy,[25] Spain,[21,32] Sweden,[23] Singapore,[33] United Kingdom,[30,34] the United States[3,6,17]), with a focus on specific clinical issues (e.g., ulcer area,[26] changes in forced expiratory volume in one second[13]) and diverse outcomes (e.g., mortality,[4,24,35] LOS[5,7,30]), as well as costs.[4,17,29,34]

Although HBH has been associated with saving costs and improved health outcomes, this model does not seem to represent the change in care burden.[4] A recent meta-analysis suggests that patients with chronic conditions who presented to the emergency department and were treated with HBH interventions had a reduced risk of hospital readmission and long-term care admission compared to those who received CH.[27] Conversely, findings from the meta-analysis revealed that HBH increased the time to readmission, reduced index costs, and improved health-related quality of life among patients requiring hospital-level care for heart failure. However, larger randomized control trials were needed to confirm the effect of HBH on readmissions, mortality, and long-term costs.[24]

Recently, Leong *et al* investigated the safety and effectiveness of HBH according to program type (early supported discharge *versus* admission avoidance) using secondary studies. The early supported discharge reviews generally revealed comparable readmissions to inpatient care, shorter hospital LOS, and unclear cost findings. In contrast, admission avoidance reviews reflected a trend towards lower mortality, costs, and comparable or lower readmissions. In summary, HBH commonly results in similar or enhanced clinical outcomes for proper patients compared with inpatient treatment. It demonstrates greater attention in healthcare systems confronting capacity constraints and rising costs. Finally, when comparing the program type, the prioritization of admission avoidance models over early supported discharge was suggested due to potential advantages in costs and clinical outcomes.[7]

Despite the increasing attention given to early discharge HBH services as a cost-effective alternative to inpatient care, it remains to be seen whether patients receiving personalized care at home have better or comparable health outcomes to those receiving inpatient care.[36] Recent systematic reviews provide evidence of economic benefits, such as reduced LOS or improved health outcomes for patients receiving HBH services.[35] However, patients who receive care at home may experience greater satisfaction with their personalized care because they are often in a more comfortable and relaxed environment.[37] Home-based care enables patients to receive care in a familiar setting, with individualized attention from caregivers who can better understand their unique needs and preferences. As a result, this may lead to increased patient satisfaction and improved quality of care. Therefore, it is evident that personalized healthcare in home-based hospitalization requires further research and evaluation to understand its potential benefits and limitations fully.

Future research should clarify the clinical outcomes of HBH programs given the current low-quality evidence and address evidence gaps on clinical outcomes and adverse events under HBH care[7] in Portugal. The aim of this observational study was to contribute to the limited evidence of HBH services in Portugal by comparing their impact with CH using samples of adult patients. We hypothesized that HBH does not represent a method with clinical inferiority compared to CH regarding clinical outcomes (namely, dependence, ulcers, and falls). The primary aim of this study was to explore the impact and effectiveness of HBH, compared with CH, in the Portuguese adult population for three specific outcomes (dependence, ulcers, and falls). The secondary aim was to compare the LOS and mortality between patients admitted to HBH and CH.

METHODS

Design and database

An observational retrospective study was conducted among patients receiving HBH and CH care from 2020 to

2022. We analyzed data from patients admitted to CUF Hospitals, which originates from the facilities of Tejo, Cascais, Sintra, and Descobertas and the Unidade de Hospitalização Domiciliária CUF Lisboa.

Procedures for data use and storage were in compliance with the General Data Protection Regulation rules and conducted under the Declaration of Helsinki. Data was fully anonymized before being accessed. The study was approved by the Hospital CUF Tejo Ethics Committee (No. 2023310).

The inclusion criteria were: (a) hemodynamically stable medical condition, (b) family member or accompanying person at home, (c) residence during hospitalization in the catchment area of a CUF hospital unit, and (d) patient and caregiver expressed the desire to be accompanied at home. The exclusion criteria were: (a) acute psychiatric condition and suicidal ideation, (b) intravenous drug users, (c) indigent and homeless, and (d) children.

The patients in the study were categorized into four groups: oncological, cardiovascular, infectious, or other diseases. The patients were classified based on their main diagnosis, which was determined using the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). Patients with a primary diagnosis of infection (such as urinary tract infection) were placed in the infectious diseases group, while patients with a primary diagnosis of circulatory system condition (such as heart failure) were placed in the cardiovascular diseases group. Patients with an active cancer diagnosis (such as uncontrolled cancer pain) were placed in the oncological group, while all other patients were grouped under 'other diseases'.

Patient outcome measures

The primary outcomes were the risk of developing ulcer pressure, level of (in)dependence, and fall risk. These clinical outcome measures were collected during the admission (baseline) and discharge and reported by the clinical team. The secondary outcomes were LOS and mortality.

Data collection

The following instruments were used for data collection:

All-patient refined diagnosis-related groups' severity of illness and risk of mortality

It provides a more accurate predictor of resource use by assigning a severity of illness subclass and risk of mortality subclass to each episode in addition to the Diagnosis-Related Groups. It is important to note that the severity of illness and mortality are Diagnosis-Related Groups-specific and depend on other underlying characteristics of patients (comorbidities). All-Patient Refined Diagnosis-Related Groups' are divided into four Severity of Illness and Risk of Mortality subclasses, ranging from 1 to 4 (1 = 'minor' to 4 = 'extreme'). Risk of Mortality and Severity of Illness are calculated separately based on secondary diagnoses and their interaction with age, primary diagnosis, and procedures. According to the extent of physiological decomposition or loss of organ system function, the severity of illness determines the overall patient condition. At the same time, the risk of mortality estimates the likelihood of in-hospital mortality.[38]

Braden scale

The risk of developing ulcer pressure was evaluated by the Braden scale, a standardized, evidence-based assessment tool commonly used in health care to assess and document a patient's risk of developing pressure injuries. The Braden scale seems to offer the best balance between sensitivity and specificity and the best risk estimate.[39] The Braden scale comprises six subscales. Each subscale assesses the following dimensions: sensory perception, skin humidity, mobility, nutrition, and friction/shear forces. Each subscale has an attributed value and varies between one and four: the lower the value, the more prone to developing ulcer pressure. The Portuguese guidelines support the implementation of regular pressure ulcer risk assessments by applying the Braden scale. It also recommends the patients' categorization into two levels of risk (low and high), defined by a cut-off point of 16. Hence, patients with an evaluation of the Braden scale score lower or equal to 16 have an increased risk of developing pressure ulcers, and patients with a score higher than 16 have a lower risk of developing pressure ulcers.[40,41]

Barthel index

The Barthel index is a tool that can measure a subject's level of (in)dependence to perform ten basic life activities. It includes eating, chair transfer to bed, bathing, gait, and stair climbing.[42] The scoring varies between 0 and 100 (with intervals of five points), where the lowest score corresponds to the highest level of dependence on all activities of daily living and vice-versa. Previous research reports the validity of the Portuguese version as high internal consistency, supported by the α Cronbach = 0.96.[43,44]

Morse fall scale

The likelihood of falling (or falls risk) was analyzed by the Morse fall scale, which consists of six items reflecting risk factors: previous history of falls; the existence of a secondary diagnosis; walking support; intravenous therapy; posture during walking and transference and mental status. The total score of the scale ranges between 0 and 125, and the individuals are classified according to the risk presented as no risk (0 - 24), low risk (25 - 50), and high risk (≥ 51).[45] In 2011, the European Portuguese version of the Morse scale was developed, which revealed that reliability was tested through the degree of agreement of the scores provided by nurses. It demonstrated a high agreement between the

evaluators using the scale.[46]

Data analysis

We present descriptive statistics for HBH and CH (frequency and percentages for categorical and continuous medians and interquartile ranges, as appropriate). Based on the sample size, Shapiro-Wilk was used to verify the normality of the continuous variables. Mann-Whitney U and analysis of covariance (ANCOVA) tests were used to calculate the average differences and the chi-square test for categorical variables. When a significant effect was found, the Tukey-Kramer test detected significant mean differences ($p < 0.05$). During the period of hospitalization between the initial assessment and the time of discharge, various clinical outcomes were evaluated using standardized measures, including the Barthel index, Braden scale, and Morse scale.

By comparing the scores at the time of discharge to those at the time of admission, we could determine the magnitude of improvement or decline in the patient's condition. In the Braden and Barthel scales, a positive difference between scores indicated an improvement in clinical outcomes, while in the Morse scale, a positive difference indicated a decline. Therefore, we calculated the interquartile range (IQR) to determine the extent of improvement or decline and classified the outcomes as worse, equal, or better. Appropriate statistical tests were employed for categorical variables to analyze the data. We conducted an ANCOVA to test the interaction of LOS with the type of hospitalization, primary diagnosis, mortality index, and severity index, with age adjustment. Through logistic regression, secondary exploratory analyses examined the association between the primary outcome measures and the selected predictive variables (including the patient's age, type of hospitalization, severity index, mortality index, and primary diagnosis). We hypothesized that most of these variables could influence patients' mortality in both programs. Analyses were performed using Python (Jupyter notebook), and *p*-values under 0.05 were considered significant.

RESULTS

Demographics

Four hundred and one patients were included from HBH (n = 209) and CH (n = 192). There was no statistically significant difference between the type of hospitalization groups regarding gender, and there was a statistically significant difference in age (Table 1). Regarding the primary diagnosis, the infectious diseases were more prevalent than the other diagnoses in the sample (HBH 74.6% *vs* CH 39.1%; $p < 0.001$) (Table 1). Oncological and cardiovascular were the second and third most reported conditions in the HBH group (12.4% and 7.7%, respectively). In the HC group, cardiovascular, and oncological were the second and third most

Table 1 – Baseline patient characteristics and outcomes, n (%)

Outcome measure	Home-based n = 209	Conventional n = 192	*p*-value
Age (years), median (IQR)	84 (16)	77 (20)	**< 0.001**
Sex (female), n (%)	98 (46.9)	92 (47.9)	0.916
Group primary diagnosis, n (%)			
Cardiovascular	16 (7.7)	44 (22.9)	**< 0.001**
Oncological	26 (12.4)	42 (21.9)	
Infectious	156 (74.6)	75 (39.1)	
Other	11 (5.3)	31 (16.1)	
LOS (days), median (IQR)	9 (7)	7 (10)	**0.002**
Mortality, n (%)	60 (28.7)	23 (12.0)	**< 0.001**
Severity index			
1	37 (17.7)	34 (17.7)	0.918
2	90 (43.1)	88 (45.8)	
3	73 (34.9)	61 (31.8)	
4	9 (4.3)	9 (4.7)	
Mortality index			
1	53 (25.4)	58 (30.2)	0.671
2	87 (41.6)	73 (38.0)	
3	60 (28.7)	55 (28.6)	
4	9 (4.3)	6 (3.1)	

LOS: length of stay; IQR: interquartile range

reported conditions (22.9% and 21.9%, respectively). In terms of mortality, the HBH group had a higher prevalence (p = 0.001) and LOS (p = 0.002) than CH for participants who died during the program. Concerning the Severity and Mortality indexes, there was no difference between the programs (p > 0.05) (Table 1).

Clinical outcomes

Table 2 documents comparative analyses of clinical outcomes regarding distribution, using chi-squared tests. The Braden scale showed significant differences in distribution between groups for both baseline and discharge (p < 0.05) regarding the risk of developing ulcers. The Barthel index at baseline was also significantly different (p < 0.007), measuring the level of independence. Furthermore, the Morse scale differed significantly in distribution between groups at baseline and discharge (p < 0.05) in terms of risk of falls. Table 3 presents a comparison of patient clinical outcomes during different types of hospitalizations, using U Mann-Whitney and chi-squared tests. The table provides insights into the scores, differences between the scores at the time of discharge and admission, and the attributed categories. This analysis aimed to determine if there were any differences in outcomes between baseline and discharge, categorized as worse, equal, or better (as described in the 'Data analysis' section). The results showed that there were no statistically significant differences in the clinical outcomes variation (Barthel index, Braden scale, and Morse scale) between admission and discharge for CH and HBH (p > 0.005), as illustrated in Table 3. These findings suggest no significant variation in patient outcomes between the two types of hospitalizations.

Length of stay

We performed an ANCOVA to test the relationship between the type of hospitalization, age, severity index, mortality index, and primary disease in terms of LOS (Table 4). Significant differences regarding the primary diagnosis

Table 2 – Comparison of patient clinical outcomes in terms of distribution, n (%)

Clinical outcome measures	Home-based	Conventional	*p*-value
Braden at baseline, n (%)			
Low risk	38 (48.1)	78 (67.2)	**0.012**
High risk	41 (51.9)	34 (32.8)	
Braden at discharge, n (%)			
Low risk	90 (49.7)	130 (72.2)	**< 0.001**
High risk	91 (50.3)	50 (27.8)	
Barthel at baseline, n (%)			
Independent	19 (18.8)	14 (23.7)	
Slight dependency	18 (17.8)	24 (40.7)	
Moderate dependency	12 (11.9)	5 (8.5)	**0.007**
Severe dependency	16 (15.9)	7 (11.9)	
Total dependency	36 (35.6)	9 (15.3)	
Barthel at discharge, n (%)			
Independent	20 (26.7)	16 (33.3)	
Slight dependency	18 (24.0)	17 (35.4)	
Moderate dependency	10 (13.3)	3 (6.3)	0.308
Severe dependency	10 (13.3)	6 (12.5)	
Total dependency	17 (22.7)	6 (12.5)	
Morse at baseline, n (%)			
Low risk	13 (15.7)	34 (28.1)	
Slight risk	38 (45.8)	58 (48.0)	**0.032**
High risk	32 (15.7)	29 (24.0)	
Morse at discharge, n (%)			
Low risk	37 (23.4)	48 (36.9)	
Slight risk	72 (45.6)	61 (46.9)	**0.004**
High	49 (31.0)	21 (16.1)	

LOS: length of stay

Table 3 – Comparison of patient clinical outcomes in terms of patient evolution

Clinical outcomes	Barthel		Braden		Morse	
Type of program	HBH	CH	HBH	CH	HBH	CH
N patients	52	41	72	110	70	81
Median entry	55	70	16.5	19	50	35
Median discharge	55	75	16	19	42.5	35
Differences score median	0.0	0.0	0.0	0.0	12.5	0.0
Differences score IQR	[-6.25 – 5.0]	[-5.0 – 0.0]	[-2.0 – 1.0]	[-1.0 – 1.75]	[-20.0 – 10.0]	[-20.0 – 0.0]
Differences score *p*-value	0.694		0.513		0.515	
Clinical outcomes (%)						
Worse	21.2	14.6	8.3	10.9	30	27.2
Equal	65.4	65.9	81.9	79.1	55.7	58
Better	13.5	19.5	9.7	10.0	14.3	14.8
***p*-value**	0.590		0.843		0.928	

HBH: Home-base hospitalization; CH: Conventional hospitalization

($p < 0.001$) and the severity index ($p < 0.001$) were found, including the interaction effect between them, which was also significant ($p < 0.001$). Patients with infectious diseases demonstrated the highest LOS compared to the other groups. In the specific analysis by groups, it was observed that the LOS was significantly longer for patients with infectious diseases [cardio-infectious ($p < 0.05$), oncological-infectious ($p < 0.001$), and other-infectious ($p < 0.05$)].

In terms of severity, we found significant differences between levels 1 and 3 ($p < 0.05$), levels 1 and 4 ($p < 0.05$), and levels 2 and 3 ($p < 0.05$). The post hoc analysis revealed that the LOS was lower in level 1 than in 3 ($p < 0.05$) and 4 ($p < 0.05$), and it was lower in level 2 than in 3 ($p < 0.05$). The LOS was significantly higher in the infectious diseases group (cardiovascular $p < 0.05$, oncological $p < 0.001$, other diagnoses $p < 0.005$). On the other hand, the type of hospitalization and mortality index did not influence the LOS ($p < 0.082$). Therefore, not surprisingly, the interaction between the type of hospitalization jointly with primary diagnosis was not statistically significant ($p > 0.05$). Finally, age did not demonstrate an influence on LOS ($p > 0.05$) (Table 4).

Mortality

An exploratory analysis was conducted using logistic regression to determine which factors might influence death – coded 0 as the reference = did not die during the program and 1 = dead during the stay (Table 5). In summary, the model indicated that the type of hospitalization (HBH) and mortality index (at levels 3 and 5) were significant predictors of death ($p < 0.001$), as well as with increasing age ($p < 0.05$). Moreover, none of the other independent variables demonstrated an influence regarding mortality ($p > 0.05$).

DISCUSSION

The present study investigated patients from two different hospitalization programs (HBH and CH) and evaluated the population in terms of clinical outcomes. To our knowledge, this is the first Portuguese study, including the patient's primary diagnosis as infectious, cardiovascular, oncological, or 'other' diseases in the aforementioned field. In summary, the Morse score was not equally distributed between the groups. Falls were also the second most common adverse event during hospitalization, which can cause critical complications, such as fractures (skull,

Table 4 – Analysis of covariance

Length of stay	Sum SQ	F	*p*-value	Omega SQ
Intercept	37.860	61.120	**< 0.001**	0.101
Type of hospitalization	1.884	3.041	0.082	0.003
Severity index	7.854	4.226	**0.006**	0.016
Primary diagnosis	31.962	17.199	**< 0.001**	0.082
Mortality index	3.267	1.758	0.155	0.004
Type of hospitalization: Primary diagnosis	2.192	1.180	0.317	0.001
Severity index: Primary diagnosis	47.373	8.497	**< 0.001**	0.114
Age	0.009	0.015	0.902	-0.002

Dependent variable (length of stay)

Table 5 – Logistic regression model determining the association between mortality (dependent variable) and selected domains

Inputs	Coeff	Odds ratio	*p*-value	Lower CI	Higher CI
Age	0.030	1.031	**0.026**	1.004	1.058
Type hospitalization					
CH	1.000	1.000	1.000	1.000	1.000
HBH	1.276	3.582	**0.001**	1.893	6.775
Severity index					
1	1.000	1.000	1.000	1.000	1.000
2	0.411	1.508	0.471	0.494	4.602
3	-0.058	0.944	0.927	0.272	3.272
4	-1.669	0.188	0.139	0.021	1.715
Mortality index					
1	1.000	1.000	1.000	1.000	1.000
2	0.948	2.581	0.084	0.881	7.557
3	2.394	10.958	**0.001**	3.318	36.187
4	4.339	76.629	**0.001**	9.607	611.252
Primary diagnosis					
Cardiovascular	1.000	1.000	1.000	1.000	1.000
Infectious	-0.282	0.754	0.518	0.321	1.773
Oncological	0.893	2.443	0.071	0.926	6.445
Other	-0.392	0.676	0.572	0.174	2.629

hips, shoulders, and ribs), while other symptoms, like depression and loss of self-confidence, increase the LOS and medical costs.[47]

Our main results suggested there were no differences in terms of Braden and Barthel's scales regarding the type of hospitalization and between admission and discharge. Regarding the clinical outcomes, namely, the risk of developing ulcers, previous research compared the home care service *versus* hospital-based care in patients with diabetic foot ulcers, concluding that rate of ulcer size reduction in CH was significant ($p < 0.003$) compared with HBH. The study of Sardo *et al* included 8147 Portuguese hospitalized adults, the participants with significantly lower Braden scale scores were older, hospitalized in medical units, admitted for emergency services, with longer hospital stays, and/or had vascular, traumatic injuries, respiratory, infection or cardiac diseases.[41] Like our results,[22] changes in Barthel scores, i.e., levels of (in)dependence over the follow-up period, were negligible. However, it suggested that HBH allows a critical decline in costs during the index episode compared with hospital care whilst preserving equivalent outcomes concerning cardiovascular mortality and morbidity and quality of life at one-year follow-up in patients with cardiovascular disease.[22]

As the primary diagnosis, patients with infectious diseases had a higher LOS compared to patients with other conditions. When comparing the type of program, there was no relationship between LOS. Moreover, the mortality index did not seem to influence the LOS even when associated with the primary diagnosis, which could help explain the variance. Our study suggested that the mortality risk index is a more important predictor of death than the type of hospitalization. While we found that HBH was associated with a higher risk of death compared to CH, it is essential to note that the mortality index may serve as a more robust indicator of future mortality. Despite similar severity indexes and mortality risks, there was a clear predominance of infectious diseases in the HBH group, which may have contributed to the higher mortality. The mortality rate among patients in the HBH group was 3.582, which is higher than that of the CH group. Our results regarding mortality are consistent with those of previous studies[12,13,22,25] but differ from others.[30] For instance, Tibaldi *et al* found no significant difference in mortality between patients receiving care at the geriatric home hospitalization service and those in the general medical ward. However, only geriatric home hospitalization service patients experienced improvements in depression, nutritional status, and quality-of-life scores.[25]

A study conducted by Tierney *et al* used a one-year retrospective design to examine the admission and post-discharge clinical outcomes of patients in a Northern Ireland care of the elderly ward (n = 191) and a consultant-led acute care at home service (n = 314). The study found that HBH was a viable alternative to hospitals for older patients

and could prevent functional decline and the need for domiciliary care or nursing home placement.[30] Albeit, in terms of end-of-life, a Cochrane review reported that HBH end-of-life care increased the likelihood of dying at home compared with conventional care.[36] Although our study did not examine readmissions, previous research has suggested that recurrent readmissions may be linked to a higher mortality rate in certain patient populations.[48] Therefore, future studies should continue to explore the role of various factors, including mortality level and readmission rates, in predicting patient outcomes and mortality.

In the present study, since limited information was available, its findings should be interpreted cautiously due to limited information and the absence of risk adjustment for variables identified as significant in the comparison between groups. This may restrict the generalizability of results to different populations. Risk adjustment was not performed due to limited data availability, which could increase the risk of overfitting. Future research should include risk adjustment to enhance the precision and robustness of findings. Further studies are needed to identify medical conditions suited for home treatment. Patients' multimodal information, such as (e)Health literacy, must be assessed to judge whether a treatment-compliant behavior can be expected. It is also important to highlight that there is a lack of information on the quality of the patient's home. Future studies should consider the quality of the home environment and assess it appropriately. Implementing standard operating procedures would help to standardize patient inspection and ensure patient safety. Patient safety is crucial in healthcare settings, where research is required to carefully select which patients should be treated at home.

Patient selection for HBH should consider the clinical parameters and social and cognitive aspects of each patient, resulting in a more patient-centered approach, therefore, increasing patient safety and satisfaction.[9] The study involved a restricted population and a small sample of patients with some specific primary diagnosis. Additionally, the study was conducted within a private setting at CUF Hospitals, which may limit generalizability. Patients with infectious diseases, especially the elderly, represent a heavy burden for hospitals and, therefore, indirectly to society. Although the present study was not designed to evaluate and compare the economic effects of these approaches, i.e., HBH or CH, previous research suggests that HBH may be cost-effective and have a place in reducing the pressure on hospital beds. Therefore, one limitation of the current study is that it did not evaluate the costs and satisfaction levels of the users involved. However, it has been reported that patients and their families usually express high levels of satisfaction with HBH services.[5,7,9,12,14,17,20,24,35] Future studies should focus on costs and satisfaction with HBH programs in the Portuguese population.

CONCLUSION

The patients analyzed in this study have a high degree of complexity, and the inferiority in outcomes in HBH compared to CH was not found. Interestingly, our results show that the hospitalization type was not associated with the Barthel, Braden, and Morse scores and LOS. However, we found that patients with infectious diseases had longer LOS, even after adjusting for age. The study did not find statistically differences between CH and HBH for the assessed outcomes. In addition, no statistically significant differences were found in the LOS between CH and HBH.

The present study has important implications for healthcare providers and stakeholders. It highlights that more attention needs to be given to HBH, particularly in healthcare systems that face capacity constraints and rising costs. Home-based hospitalization is a service that may be considered part of an integrated response in the inpatient journey, not just for complex patients but as a practice to provide a more humanized healthcare service according to the preferences of patients and their families.

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AUTHOR CONTRIBUTIONS

PCA: Study design, data collection and writing of the manuscript.

CR, MS: Study design, data collection and critical review of the manuscript.

RG: Study design and data collection.

FGF, EO: Data analysis and writing of the manuscript.

All authors approved the final version to be published.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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