

Patient-centred outcomes and cost-effectiveness of a hospital-at-home service model for older adults

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ABSTRACT

Introduction: Medical Home (MH) is a hospital-at-home (HaH) service model developed to deliver multidisciplinary acute medical care for patients in their homes. This study evaluated the patient-centred outcomes and cost-effectiveness of the MH service compared with usual care (UC).

Methods: This quasi-experimental study involved 250 patients recruited from July 2021 to May 2023. Data on costs, healthcare resource utilisation, and patient-centred outcomes were collected at index admission, discharge, and 90 days post-discharge. Regression analyses were employed to estimate the incremental differences in patient-centred outcomes and net monetary benefit (NMB) between MH and UC groups, while adjusting for confounders. A probabilistic sensitivity analysis (PSA) was conducted to evaluate the uncertainty surrounding the data inputs for cost-effectiveness analysis. Subgroups excluding U-turn patients (i.e. patients admitted to the hospital before discharge from MH) and deaths were analysed for patient-centred and cost-effectiveness outcomes.

Results: There was no statistically significant difference between the 2 groups in clinical, functional, and experience outcomes, except for length of stay and caregiver's overall experience in which the MH group had significantly better results compared with UC group. Compared to the UC group, the MH group showed a positive incremental NMB of SGD6895 (approximately USD5361; 95% confidence interval SGD1945–11,845) indicating the cost-effectiveness of the MH service. Results from the PSA showed that the MH group was cost-effective across a range of willingness-to-pay thresholds. Subgroup analyses were consistent with the base case for patient-centred and cost-effectiveness outcomes.

Conclusions: We conclude that an HaH care model like MH is a value-based and cost-effective alternative to admission to hospital for selected frail elderly patients, making it the preferred strategy.

Keywords: cost-effectiveness, geriatric medicine, hospital-at-home, older adults, patient-centred outcomes

CLINICAL IMPACT

What is New

- To the authors' knowledge, this study is the first to evaluate the hospital-at-home (HaH) care model for frail older adults in Singapore.
- Findings reveal that HaH is a cost-effective alternative to inpatient hospitalisation with positive benefits, such as shorter length of stay and better caregiver experiences.

Clinical Implications

- This study's findings will guide future healthcare planning and delivery and support the shift from hospital-centric to community-based care. This is especially relevant for Singapore, being one of the fastest-ageing nations globally.

INTRODUCTION

Singapore faces a significant demographic transition, with the proportion of residents aged 65 years and above projected to reach 25% by 2030.¹ This shift, coupled with an increased prevalence of multimorbidity, poses substantial challenges to healthcare sustainability through increased hospital utilisation and frequent readmissions.²

In response, innovative care models like hospital-at-home (HaH) programmes have emerged as alternatives to traditional acute hospital care, delivering hospital-level care in patients' homes. HaH not only offers potential cost savings through reduced bed occupancy but also mitigates hospitalisation-associated risks.³ This is relevant in Singapore, where 11.7% of adult patients in acute hospitals acquire

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healthcare-associated infections.⁴ Hospitalisation also contributes to functional decline in older patients.⁵

Previous research has demonstrated potential benefits of HaH programmes, including improved patient satisfaction⁶⁻⁸ and positive outcomes for caregivers.⁸⁻¹⁰ Studies from Western healthcare systems have shown promising clinical outcomes, including reduced hospital readmission rates, albeit with longer length of stay and higher costs.¹¹⁻¹⁵ However, the effectiveness and cost-effectiveness of such schemes in Asian healthcare contexts, particularly for older or frail patients, remain understudied. Moreover, the transferability of these findings to Asian populations, where family dynamics, living arrangements, and healthcare-seeking behaviours differ significantly from Western contexts, requires careful evaluation.

Khoo Teck Puat Hospital, a tertiary acute care hospital in Singapore, manages the national hospital-to-home programme through its Ageing-in-Place community care team (AIP-CCT). This post-discharge transitional home care service targets complex patients and older adults at risk of readmission. However, this model has limitations, particularly when patients develop new acute medical conditions that necessitate a return to the emergency department (ED).

To address these gaps, the hospital introduced the Medical Home (MH) service, a novel acute medical care model to deliver care by a multidisciplinary team in patients' homes. This service facilitates admission avoidance by accepting patients referred from the ED, specialist outpatient clinic (SOC), or AIP-CCT and early supported discharge for suitable inpatients who can safely continue treatment at home.

We hypothesised that the MH service would achieve comparable clinical and functional outcomes compared with usual care (UC), while providing better patient and caregiver experiences⁸ as well as generating cost savings for both patients and the healthcare system through reduced bed days, particularly among older adults. This aligns with Singapore's healthcare transformation efforts to promote value-based and patient-centred care, and to shift focus from hospital-centric to community-based care models.

This study evaluated the patient-centred outcomes and cost-effectiveness of the MH service compared with conventional inpatient ward care in Singapore's acute hospital setting.

The findings of this study have the potential to significantly influence healthcare policy and practice in Singapore and similar healthcare systems. By providing evidence on MH's effectiveness and cost-effectiveness, and synthesising insights from global HaH research and contextualising them to Singapore's healthcare landscape, this study aims to inform resource allocation and care delivery model decisions for the ageing

population, ultimately contributing to the development of more efficient and patient-centred care strategies.

METHODS

Design

This quasi-experimental prospective study was conducted at Khoo Teck Puat Hospital, Singapore. The MH intervention group included patients who met the inclusion criteria (Supplementary Annex S1) and were referred from several different sources: ED, SOC, or AIP-CCT patients, who would otherwise have required admission, as well as inpatients admitted for less than 48 hours in wards, deemed suitable for early supported discharge to continue care at home. The UC group consisted of patients who met the inclusion criteria but either declined MH service, resided outside the catchment area, or could not be enrolled due to capacity constraints, and were therefore subsequently admitted to the hospital itself. The primary caregiver was defined as the main nominated healthcare spokesperson who was overall in charge of the patient's care decisions and coordination, excluding live-in domestic helpers.

Sample size and recruitment

The study aimed to recruit 250 patient-caregiver dyads, comprising 125 pairs in each of the MH intervention and UC groups. Recruitment occurred from July 2021 to May 2023. MH nurses screened clinical notes to identify potential participants, followed by MH doctors' confirmation of eligibility based on predetermined criteria (detailed in Supplementary Annex S1). A total of 250 patients were recruited, comprising 125 patients in the MH group and 125 in the UC group. Additionally, 150 caregivers were recruited, with 100 for the MH group and 50 for the UC group. The recruitment disparity between patients and caregivers was attributed to 3 main factors: some patients did not have caregivers, some caregivers declined participation, and recruitment opportunities were limited by COVID-19 visiting restrictions, particularly for the control group. Informed consent was obtained from all participants in both MH and UC groups for study participation and data analysis. Patient flow is detailed in Supplementary Annex S2.

Data collection

The study collected comprehensive data encompassing patients' baseline characteristics and patient-centred outcomes, including clinical, functional, and patient and caregiver's experience outcomes. Additionally, health services utilisation, healthcare cost, and health-related quality of life were collected for cost-effectiveness outcomes. Detailed definitions and measurements are listed in Table 1.

Table 1. Definitions and measurements of outcomes.

Indicators	Definitions and measurements	Timepoints
Baseline characteristics		
CFS	Validated 9-point scale ranging from 1 (very fit) to 9 (terminally ill)	At admission
Patient Acuity Category Scale	Used to measure the severity of patients' health condition and level of care required in 4 categories, P1, P2, P3, and P4; only available for patients who presented through the ED	At admission
CCI	Used to measure comorbidity burden; validated tool that predicts mortality by weighting various comorbid conditions	At admission
Clinical outcomes		
90-day readmission	Readmission to hospital within 90 days post-index discharge	From discharge to 90 days post-index discharge
90-day mortality	Death within 90 days post-index discharge	From discharge to 90 days post-index discharge
Institutionalisation	Nursing home placement within 90 days post-index discharge	From discharge to 90 days post-index discharge
Duration of care	Length of stay during index admission (days)	From admission to discharge
Adverse events	Occurrence of any of the following during index admission: • Thrombophlebitis • Medication error • New pressure sores • Falls • Catheter-related urinary tract infection • Acute delirium	From admission to discharge
Functional outcomes		
MBI	Used to measure a person's independence in performing activities of daily living with a total score ranging from 0 to 100, higher scores indicate better function	At admission, discharge and 90 days post-index discharge
EQ-5D-5L	Used to measure health-related quality of life by asking about 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension has 5 levels of severity. Utility scores were calculated based on the Singapore value set.	At admission, discharge and 90 days post-index discharge ^a
Experience outcomes		
Patient's overall experience	Overall satisfaction rating by a single-item 4-point scale: 1=Excellent, 2=Good, 3=Poor, 4=Very Poor	At discharge
Caregiver's overall experience	Overall satisfaction rating by a single-item 4-point scale: 1=Excellent, 2=Good, 3=Poor, 4=Very Poor	At discharge
Caregiver burden	ZBI-12, a 12-item validated scale from 0 to 48; higher scores indicate greater burden	At admission, discharge and 90 days post-index discharge
Cost-effectiveness outcomes		
Health service utilisation	Data obtained from hospital databases consist of: • ED visits • Hospital readmissions • Specialist outpatient clinic visits	From index admission to 90 days post-index discharge
Healthcare costs	Healthcare costs obtained from hospital databases consisting of: • Index admission costs (professional visits, consultations, transport, treatment fees, medications, investigations for MH; ward charges and treatment fees for usual care) • Post-discharge costs (outpatient, inpatient, ED visits)	From index admission to 90 days post-index discharge
QALY	Calculated using EQ-5D-5L utility scores; time-weighted average (area under curve)	From index admission to discharge and 90 days post-index discharge ^a

CCI: Charlson Comorbidity Index; CFS: Clinical Frailty Scale; ED: emergency department; EQ-5D-5L: EuroQol-5 dimension-5 levels; MBI: modified Barthel index; MH: Medical Home; QALY: quality-adjusted life year; ZBI-12: Zarit-12 Burden Interview

^a For missing data due to lost to follow-up, it was assumed that utility scores remained as previously recorded. In cases of death, utility scores were assumed to be 0.

Statistical analyses

Baseline characteristics of participants in the 2 groups were obtained via descriptive statistics. Based on their distribution, continuous variables were expressed either as mean with standard deviation (SD) or median with interquartile range (IQR). Categorical variables were reported as absolute numbers and percentages. Tests for significance were performed using either independent t-test or Mann-Whitney U test as appropriate, depending on the distribution of the continuous variables. Categorical data were tested using Pearson chi-square tests.

Patient-centred outcomes: Clinical, functional, and experience outcomes

The efficacy of MH service measured in clinical, functional, and experience outcomes as outlined in Table 1 was further assessed by multiple logistic regressions and multiple linear regressions for dichotomous and continuous outcomes, respectively, with adjustment for potential confounders such as age, sex, education level, Charlson Comorbidity Index score, Clinical Frailty Scale (CFS) score at admission, and Patient Acuity Category Scale.

For outcomes with repeated measurements—such as modified Barthel index (MBI) score, EuroQol 5-dimension (EQ-5D) utility score and caregiver burden score—when there was no statistically significant difference between the 2 groups for the baseline results, balance was assumed for baseline. Therefore, MBI, EQ-5D, and caregiver burden scores at follow-up visits were directly used as outcomes in regression models instead of change scores. Subgroup analyses were explored by excluding U-turn (i.e. patients who had to be admitted to the hospital before being discharged from MH) patients and deaths.

Cost-effectiveness

A health system perspective was adopted for the cost-effectiveness analysis, covering costs from index admission to 90 days post-discharge. All costs were adjusted to 2024 values using Singapore's consumer price index¹⁶ and reported in Singapore dollars (SGD), with no discounting applied due to the follow-up period being within 1 year. The exchange rate for reference to United States dollars (USD) is at the prevailing rate at the time of publication.¹⁷

Cost-effectiveness was evaluated using incremental net monetary benefit (NMB), calculated by multiplying the quality-adjusted life year (QALY) by the willingness-to-pay (WTP) threshold and then subtracting the total cost between the 2 groups. A positive incremental NMB indicates cost-effectiveness when compared to the alternative. The WTP threshold was set at Singapore's 2024 gross domestic product per

capita,¹⁸ in line with the World Health Organization's recommendation.¹⁹

A multiple linear regression analysis estimated the incremental NMB of the MH group versus the UC group, adjusting for the same set of confounding factors as the analyses for patient-centred outcomes. Incremental costs and QALYs were estimated separately using regression models with the same adjustments.

To assess the uncertainty in costs and outcomes, 10,000 bootstrapping iterations were conducted in a probabilistic sensitivity analysis (PSA). Results were summarised by calculating the probability of the MH group being cost-effective across various WTP thresholds, plotted in a cost-effectiveness acceptability curve (CEAC). The same subgroup analyses by excluding U-turn patients and deaths were performed to assess the cost-effectiveness.

RESULTS

Table 2 shows the baseline characteristics of patients and associated outcomes from the study. Patients in the MH group were generally older (UC 78.1, SD 10.2; MH 81.0, SD 10.1; $P=0.022$), the majority had no formal education (UC 25%; MH 47%; $P=0.002$), and exhibited higher CFS at admission compared with those in the usual care group (UC 5.0, SD 1.4; MH 5.3, SD 1.2; $P=0.043$).

Patient-centred outcomes: Clinical, functional, and experience outcomes

Patient-centred outcomes are presented in Table 3. Clinical outcomes, including readmission, mortality, and adverse event rates within 90 days post-index discharge, did not reveal significant differences between the 2 groups. In contrast, the MH group had a statistically significant shorter length of stay, averaging 5.7 days (SD 2.8), compared with 6.8 days (SD 4.1) in the UC group. Multiple regression analysis, adjusted for confounders, showed a reduction of 1.81 days (standard error [SE] 0.51; $P<0.001$) in the MH group compared with the UC group.

Functional outcomes measured by MBI and EQ-5D scores revealed no significant differences between the 2 groups at admission, discharge, and 90 days post-index discharge.

The experience outcome that assessed caregiver burden showed a significant difference at 90 days post-index discharge, with an average score of 10.78 (SD 6.94) in the UC group versus 7.67 (SD 6.60) in the MH group. However, this statistically significant result did not persist after adjustment for confounders. Additionally, caregiver's overall experience score was statistically different between the 2 groups (UC 1.96, SD 0.50; MH 1.62, SD 0.53; $P<0.001$), with a lower score (indicating better experience) in the MH group after adjustment (-0.35 , SE 0.11; $P=0.002$).

Table 2. Baseline characteristics.

Characteristics	Usual care, n=125	Medical Home, n=125	P value
Age, mean (SD), years	78.1 (10.2)	81.0 (10.1)	0.022
Sex, no. (%)			
Male	49 (39)	49 (39)	>0.999
Female	76 (61)	76 (61)	
Ethnicity, no. (%)			
Chinese	73 (58)	76 (61)	0.735
Malay	27 (22)	30 (24)	
Indian	20 (16)	14 (11)	
Eurasian and others	5 (4)	5 (4)	
Education level, no. (%)	n=125	n=108	0.002
No formal education	31 (25)	51 (47)	
Primary school and below	44 (35)	31 (29)	
Secondary school/pre-university/polytechnic	49 (39)	25 (23)	
University	1 (0.8)	1 (0.9)	
CCI score, mean (SD)	n=125	n=117	
	7.3 (3.3)	7.4 (3.0)	0.805
CFS, mean (SD)	5.0 (1.4)	5.3 (1.2)	0.043
Patient Acuity Category Scale, no. (%)	n=117	n=87	0.181
P2	117 (100)	85 (98)	
P3	0 (0)	2 (2)	

CCI: Charlson Comorbidity Index; CFS: Clinical Frailty Scale; SD: standard deviation; UC: usual care
P values in bold indicate statistical significance.

There was no significant difference in the patients' overall experience scores.

Similar results were observed in the subgroup analyses (Supplementary Annexes S3 and S4). The MH group had a statistically significantly lower length of stay and better caregiver's overall experience score, after adjustment, compared with the UC group.

Cost-effectiveness

The base-case results of the cost-effectiveness analysis, spanning from index admission to 90 days post-index discharge, indicate that the MH group is more cost-effective than the UC group (Table 4). The UC group incurred costs of SGD11,111 (SE 3860), while the MH group incurred SGD6356 (SE 3660), yielding a cost saving of SGD4755 (95% confidence interval [CI] -SGD8053 to -SGD1456) for the MH group after adjusting for confounders. Furthermore,

the MH group achieved an incremental QALY gain of 0.02 (95% CI -0.01 to 0.04), demonstrating its dominance due to lower costs and higher QALY gains. The incremental NMB of SGD6895 (95% CI SGD1945 to SGD11,845) at the WTP of SGD121,161 further supports the cost-effectiveness of the MH group. The PSA, comprising 10,000 iterations of bootstrapping, demonstrated a 100% likelihood of MH group being cost-effective across all evaluated WTP thresholds, as illustrated in the CEAC in Fig. 1. The results from the sensitivity analysis are consistent with the base-case results, indicating the robustness of the base-case. The healthcare resource utilisation during index admission and 90 days post-index discharge are detailed in Supplementary Annexes S5 and S6, respectively.

Subgroup analyses, excluding U-turn cases and deaths, corroborate the base-case findings, showing positive incremental NMB of SGD7361 (95%

Table 3. Patient-centred outcomes: clinical, functional, and experience outcomes.

Patient-centred outcomes	Usual care, n=125	Medical Home, n=125	P value	Multiple regressions with adjustment ^a	
Clinical outcomes				OR (95% CI)	P value
Readmission up to 90 days post-discharge, no. (%)	45 (36.0)	44 (35.2)	>0.999	0.85 (0.42–1.69)	0.642
Mortality within 90 days post-discharge, no. (%)	7 (5.6)	10 (8.0)	0.617	0.29 (0.04–1.41)	0.160
Nursing home placement at 90 day post-discharge, no. (%)	0 (0)	0 (0)	>0.999	-	-
Length of stay during index admission, mean (SD)	6.8 (4.1)	5.7 (2.8)	0.011	Coefficient (SE) -1.81 (0.51)	<0.001
Length of stay during index admission, median (IQR)	6.0 (4.0–8.8)	5.0 (4.0–6.0)	0.053		
Adverse event, no. (%)	5 (4.0)	2 (1.6)	0.443	OR (95% CI) 0.23 (0.01–1.67)	0.203
Thrombophlebitis	1 (0.8)	0 (0)			
Medication error	0 (0)	0 (0)			
New pressure sores	0 (0)	0 (0)			
Falls	0 (0)	1 (0.8)			
Catheter-related urinary tract infection	0 (0)	1 (0.8)			
Acute delirium	4 (3.2)	0 (0)			
Functional outcomes					
Modified Barthel Index score				Coefficient (SE)	
Upon admission, mean (SD)	69.51 (27.81)	68.02 (33.61)	0.703	-	-
Upon discharge, mean (SD)	72.97 (27.04)	69.44 (33.01)	0.379	0.46 (2.88)	0.873
90-day post-discharge, mean (SD)	76.72 (26.81)	74.75 (29.39)	0.627	0.77 (3.09)	0.803
EQ-5D-5L utility score					
Upon admission, mean (SD)	0.34 (0.44)	0.38 (0.45)	0.461	-	-
Upon discharge, mean (SD)	0.52 (0.44)	0.46 (0.47)	0.357	0.06 (0.05)	0.229
90-day post-discharge, mean (SD)	0.48 (0.45)	0.51 (0.47)	0.628	0.10 (0.06)	0.067
Experience outcomes					
Caregiver burden score					
Upon admission, mean (SD)	12.90 (8.79)	12.32 (7.84)	0.685	-	-
Upon discharge, mean (SD)	12.19 (7.95)	10.77 (7.50)	0.301	0.24 (1.70)	0.890
90-day post-discharge, mean (SD)	10.78 (6.94)	7.67 (6.60)	0.020	-2.12(1.55)	0.177
Patient's overall experience, mean (SD)	1.77 (0.47)	1.66 (0.48)	0.153	-0.10 (0.09)	0.279
Caregiver's overall experience, mean (SD)	1.96 (0.50)	1.62 (0.53)	<0.001	-0.35 (0.11)	0.002

CCI: Charlson Comorbidity Index; CFS: Clinical Frailty Scale; CI: confidence interval; EQ-5D-5L: EuroQol-5 dimension-5 level; OR: odds ratio; IQR: interquartile range; SD: standard deviation; SE: standard error

^a Multiple logistic regressions for dichotomous outcome and multiple linear regression for continuous outcome, with adjustment for age, sex, education level, CCI score, CFS, and Patient Acuity Category Scale.

P values in bold indicate statistical significance.

CI SGD2423 to SGD12,299) and SGD5049 (95% CI SGD728 to SGD9370), respectively, shown in Supplementary Annexes S7 and S8.

DISCUSSION

Main findings

This study demonstrates that MH is a cost-effective alternative to conventional inpatient care, with an incremental NMB of SGD6895 (95% CI SGD1945 to SGD11,845) generated from cost savings of SGD4755 and QALY gain of 0.02 per patient at the WTP threshold of SGD121,161. These benefits were achieved while maintaining comparable clinical and functional outcomes, with no significant differences in 90-day readmission rates, mortality, institutionalisation, and adverse event rates. Notably, the MH group had shorter length of stay (5.7 versus [vs] 6.8 days; $P=0.011$ and adjusted $P<0.001$) with

better caregiver experiences (1.62 vs 1.96; $P<0.001$ and adjusted $P=0.002$), suggesting value-based care and more efficient resource utilisation.

Comparison with existing literature

This study's findings align with but extend beyond previous research in several ways. While an earlier study by Leff et al. demonstrated the feasibility of HaH programmes, it reported longer lengths of stay and higher costs.⁷ In contrast, this study observed both reduced length of stay and cost savings. The cost-effectiveness observed (incremental QALY gain: 0.02) is comparable to findings from Harris et al., who reported similar QALY gains in their randomised controlled trial, though in a younger population.⁹

Strengths and limitations of study

This study demonstrates several strengths. First, it focused on the impact of HaH on an older frail patient

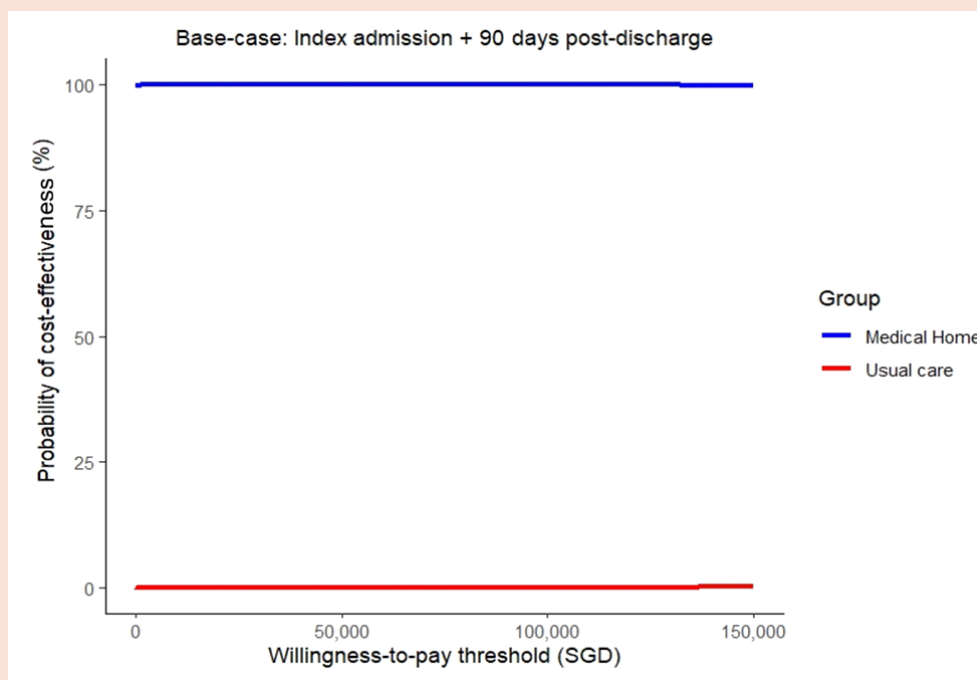
Table 4. Cost-effectiveness analysis results from index admission to 90 days post-index discharge.

Strategies	Cost (SE) ^a	Incremental Cost (95% CI) ^a	QALY (SE) ^a	Incremental QALY (95% CI) ^a	Incremental NMB (95% CI) ^a
Usual care	SGD11,111 (3860)	-	0.13 (0.03)	-	-
Medical Home	SGD6356 (3660)	-SGD4755 (-SGD8053 to -SGD1456)	0.15 (0.03)	0.02 (-0.01 to 0.04)	SGD6895 (SGD1945 to SGD11,845)

CI: confidence interval; NMB: net monetary benefit; QALY: quality-adjusted life year; SE: standard error

^aAdjusted for age, sex, education level, Charlson Comorbidity Index, Clinical Frailty Scale, and Patient Acuity Category Scale.

Fig. 1. Cost-effectiveness acceptability curve from a probabilistic sensitivity analysis of cost-effectiveness analysis.



population, which is currently under-studied. These patients are often admitted to the wards as they are considered unsafe for home treatment due to perceived higher risk of deterioration and complexity of care. However, this conventional approach increases the risk of iatrogenic complications such as acute delirium, falls, functional decline, and nosocomial infections leading to prolonged hospitalisation, consistent with the observation of longer length of stay and higher inpatient care episode costs in the UC group. This study's findings suggest that when appropriately selected, older frail patients with suitable medical conditions can be safely and effectively cared for under HaH, and reap the benefits of person-centred value-based care with shorter length of stay and improved caregiver satisfaction at lower costs.

A second key strength of this study lies in the extended 90 days post-discharge follow-up period, providing insight into longer-term outcomes, which were potentially missed in shorter evaluations. The study captured the full spectrum of healthcare utilisation patterns, showing comparable readmission rates between MH and UC (36% vs 35%; $P>0.999$). Additionally, this study demonstrated sustained functional outcomes through MBI scores and notably, revealed lasting benefits for caregivers, with significantly reduced caregiver burden scores at 90 days (MH vs UC: 7.67 vs 10.78; $P=0.02$). The loss of significance in the multiple regression analysis is likely the result of the small sample size.

Another strength of this study is its relevance in Asian healthcare contexts where family caregivers play a crucial role in long-term care arrangements, an area currently not well studied in the Asian HaH context. Contrary to perceived concerns, HaH care resulted in better caregiver experiences and lower caregiver stress levels at 90 days post-discharge. The positive outcomes could be attributed to the programme's focus on caregiver empowerment and education during MH care, resulting in improved caregiver confidence when caring for patients at home even in the longer term. HaH care also enables the care team to better understand and address caregiving concerns early, facilitating timely implementation of necessary community care support services.

This study had several limitations. The non-randomised design of the study may introduce selection bias, although it was adjusted for key confounders. Additionally, more robust tools such as the National Early Warning Score updated (NEWS2) could have been used to ensure better comparability of clinical acuity between the 2 groups of patients. The generalisability of the findings is limited by the small sample size and single-centre setting within Singapore's healthcare context.

Furthermore, the single-item 4-point scale used to assess overall patient and caregiver experiences was not a validated or internationally recognised tool. The authors analysed such discrete data as continuous data. While this approach is common and allows for the use of parametric statistical methods, it may not fully capture the ordinal nature of the data. Consequently, this simplification could affect the precision and interpretation of the results. The presence of live-in domestic helpers may reduce the physical caregiving burden on primary caregivers and could potentially influence their reported experiences. However, this does not invalidate the findings because the study aimed to evaluate empowerment, confidence, stress levels, and overall experiences among primary caregivers, which can remain significant even when some physical tasks are delegated. Future research should consider adopting validated satisfaction measures and explore the impact of household help on caregiver-reported outcomes to enhance comparability and robustness of findings.

In the cost-effectiveness analysis, the authors evaluated costs from the health system perspective only, due to the absence of data on the caregivers' and patients' productivity losses. Without these data, the authors were unable to incorporate broader societal costs. The exclusion of these indirect and informal care components may lead to an underestimation of the total economic burden associated with home care services. As such, future evaluations incorporating these indirect costs would offer a more comprehensive understanding of the true economic burden to society.

CONCLUSION

An HaH care model like MH is a value-based and cost-effective alternative to inpatient admission for selected frail older patients, who present with acute medical conditions. The model has comparable clinical and functional outcomes, achieved with shorter length of stay at reduced cost. Improved caregiver experiences as well as lower caregiver stress levels at 90 days post-discharge make HaH care the preferred strategy over conventional inpatient ward care for frail older adults in Singapore.

The results of this study, in an ageing population, lend great support to the move towards shifting care from hospitals to the community. The findings have crucial long-lasting implications for future healthcare system planning and care model delivery, especially to guide strategies to help the frail patient population avoid admission or prolonged hospitalisation.

Future research directions

There are several key areas for future investigation. Priority should be given to developing predictive

models to identify optimal patient selection criteria for HaH-type of services. Further research is also needed to evaluate cost-effectiveness across different healthcare settings and funding models, particularly in diverse Asian contexts. Additionally, studies examining the integration of remote monitoring technologies and qualitative research, further exploring patient and caregiver experiences, could inform service improvements and optimise the model's implementation in different cultural settings.

Ethics statement

Ethics approval was granted by the National Healthcare Group Domain Specific Review Board (2020/00326).

Declaration

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Supplementary materials

Annex S1. Medical home patient selection criteria: inclusion and exclusion criteria.

Annex S2. Patient flow.

Annex S3. Subgroup analysis by excluding U-turn patients: patient-centred outcomes.

Annex S4. Subgroup analysis by excluding deaths: patient-centred outcomes.

Annex S5. Healthcare resource utilisation and associated costs during index admission.

Annex S6. Healthcare resource utilisation and associated costs during 90 days post-index discharge.

Annex S7. Subgroup analysis by excluding U-turn patients: cost-effectiveness outcomes.

Annex S8. Subgroup analysis by excluding deaths: cost-effectiveness outcomes.

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