BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041964
Article Type:	Original research
Date Submitted by the Author:	22-Jun-2020
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Keywords:	HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Title

Comparison of Care Utilization and Institutional Death Rates among Older Adults according to Different Types of Home Care Facilities: a retrospective cohort study in Fukuoka, Japan

Abstract

Objective: We compared the use of various care services and institutional deaths in older adults among these facility types.

Setting: This was a retrospective cohort study utilizing administrative claim data from April 2014 to March 2017.

Participants: The participants comprised Fukuoka Prefecture residents in Japan, aged 75 and older with certified care needs of level 3 or more, and who received home care services during the study period.

Methods: Participants were divided into 4 groups according to the facility type from which they received home care: General Clinics, Home Care Support Clinics and hospitals (HCSCs), Enhanced HCSCs with beds and Enhanced HCSCs without beds. We analyzed the data using generalized linear regression models. The evaluated potential risk factors were sex, age, care needs levels, and Charlson comorbidity index scores.

Primary and secondary outcome measures: The utilization of care services and the incidence of institutional deaths.

Results: The numbers of inpatient care days were 54.3 days, 70.0 days, 64.7 days, and 75.1 days for users of enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics, respectively. While the number of home care days were 63.8 days, 50.9 days, 57.8 days, and 29.0 days, respectively. The odds of institutional death in general clinic users were 2.32 times higher ($P<0.001$) than users of enhanced HCSCs with beds.

Conclusions: Participants who used enhanced HCSCs with beds had reduced inpatient care utilization, increased home care utilization, increased home-based end-of-life care utilization, and fewer institutional deaths. These findings suggest that hospitalizations and institutional deaths could be reduced by further expanding the role of enhanced HCSCs with beds. Our study provides useful information for further investigations of home care as part of community-based integrated care.

Trial registration: This study was approved by the Kyushu University Institutional Review Board for Clinical Research (Approval No. 20209).

Strengths and limitations of this study

1. This was a retrospective cohort study including 18,347 participants.
2. We followed up participants for 3 years.
3. We considered the level of care needs and Charlson comorbidity index as confounders. Despite that, the inclusion of these variables did not provide detailed information about living conditions that reflect family structure and characteristics of living.
4. We calculated the number of years that participants lived during the study period, and the annual utilization rates per person-year of observation were estimated.
5. There were no clinical data for individual participants because this study focused on the types of healthcare facilities that provide home care.

INTRODUCTION

In 2012, approximately 800 million adults, comprising 11% of the global population, were aged 65 and older.[1] This demographic is projected to reach 1.4 billion by 2030, and will exceed 2 billion around 2050.[2] Japan is presently the world's most aged society with adults aged 65 and older accounting for 22.6% of its population in 2010, and this proportion is expected to surpass 30% in 2025.[3] Notably, the post-World War II baby-boomer generation in Japan will reach the age of 75 in 2025, thereby imposing a heavy financial burden on the nation's social security system.[4,5]

Japan's health insurance system categorizes older adults aged 65–74 as "early-stage elderly" and those aged 75 and older as "latter-stage elderly", and their out-of-pocket copayment rates are set at 20% and 10%, respectively.[6] The average annual medical expenditure in 2018 was 553,000 yen for early-stage elderly patients and 910,000 yen (1.6 times higher) for latter-stage elderly patients.[7] In contrast, the average annual long-term care (LTC) expenditure was 50,000 yen for early-stage elderly patients and 480,000 yen (over 10 times higher) for latter-stage elderly patients.[7] Latter-stage elderly patients tend to be relatively frail and have multiple chronic conditions that require the use of both medical and LTC services.[8,9] In order to efficiently provide integrated care for these individuals, Japan implemented the Community-based Integrated Care System (CICS) with the aim of changing the conventional hospital-centered healthcare delivery system to one that is focused on patient residences and local facilities.[10] The CICS comprehensively provides home care, medical care, and LTC services in addition to preventive care and daily living support to enable older adults to age in place until the end of life, even when they become increasingly care dependen.[11] There is therefore a need to ensure the availability of 24-hour, 365-day care services to monitor and manage any sudden changes in these older adults' health statuses.

The proportion of home deaths in Japan exceeded 80% in 1951, with only 9% of deaths occurring at medical institutions.[12] This trend was reversed in 1976, with the institutional death rate reaching 75.8% in 2016.[12] With current trends, almost half a million people will be unable to receive end-of-life care at a medical institution in 2030, even if the number of home deaths increases by a factor of 1.5.[13]

To resolve this issue, Japan introduced Home Care-Support Clinics/Hospitals (HCSCs) that provide 24-hour home care and home-visit nursing care in 2006.[14] Furthermore, 2012 saw the institutionalization of "enhanced HCSCs", which fulfill more stringent criteria such as having 3 or more full-time doctors on staff, 5 or more cases of emergency home care treatments, and 2 or more cases of end-of-life care within the past year.[14] HCSCs that qualify for this "enhanced" designation receive higher reimbursements than conventional HCSCs.[14] At present, general clinics, HCSCs, and enhanced HCSCs are authorized to provide insurance-covered home care. As enhanced HCSCs are further subcategorized into those with beds and those without beds,[14] there are currently 4 types of home care facilities available in Japan.

The proportion of adults aged 75 and older in Japan is expected to reach 18.1% in 2025,[3] and optimizing the CICS may help to provide solutions for problems faced by aging societies in Japan and throughout the world. To improve the circumstances where older adults can continue living at home, it is necessary to first ascertain how different facilities in the current home care delivery system influence the use of medical and LTC services. Previous studies have shown that increasing integrated care and home care can reduce hospitalization durations in older patients.[15-22] However, it remains unclear as to whether specific measures to strengthen the home care delivery system, such as the introduction of HCSCs and enhanced HCSCs, have affected the places where older adults receive end-of-life care or their utilization of various care services.

This study examined the influence of the home care delivery system on end-of-life care in adults aged 75 and older. We comparatively examined home-based end-of-life care utilization, institutional deaths, and the use of medical and LTC services among older adults who received home care services from 4 different facility types (enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics).

METHODS

Database

The study was conducted using data from a medical claims database and an LTC insurance claims database provided by the Fukuoka Prefecture Association of Latter-stage Elderly Healthcare. Medical claims include information on patient characteristics, medical treatments, disease diagnoses, and medical expenditures of all individuals who have received insurance-covered care.[23] LTC insurance refers to public insurance for older adults aged 65 and older, and adults aged 40 and older with specific diseases. These claims include information on LTC service utilization and the corresponding expenditures for all individuals with certified care needs. Under the LTC insurance system, care needs are categorized into 7 levels (support needs levels 1–2 and, care needs levels 1–5), with increasing levels signifying higher degrees of dependence.[23]

Administrative claim data was de-identified by constructing specific databases using a work station with no connection to any networks.

Study Design

This retrospective cohort study used data from April 2014 to March 2017. The study participants consisted of Fukuoka Prefecture residents aged 75 and older with certified care needs of level 3 or more in April 2014, and who received home care services during the study period. Participants were divided into 4 groups according to the facility type from which they received home care services: Group A (enhanced HCSCs with beds), Group B (enhanced HCSCs without beds), Group C (HCSCs), and Group D (general clinics).

We analyzed the participants who died during the 3-year study period to compare their home-based end-of-life care utilization and place of death among the groups. The use of home-based end-of-life care was identified using claims records of additional fees specifically for these services. The place of death was categorized as “medical institution” for participants who had been recorded as having died in a hospital or clinic in the claims data. The institutional death rate was calculated

as the percentage of participants who died in a medical institution among all participants who died during the study period.

Next, we examined the number of days that participants received inpatient care, outpatient care, and home care among the groups. The expenditures for inpatient care, outpatient care, home care, and LTC services were also calculated for each group.

Information was obtained on participant sex, age, care needs levels, and Charlson comorbidity index (CCI) scores. Age was divided into 4 categories (75–79, 80–84, 85–89, and ≥90 years). The care needs levels included in our analysis were levels 3, 4, and 5 (with level 5 representing the highest level of dependence). CCI scores, which indicate the weighted number of concomitant diseases in an individual, were divided into 3 categories (0–2, 3–4, and ≥5).

Patient and Public Involvement

We used administrative claim data and did not involve patients in this study.

Statistical Analysis

The distributions of sex, age, care needs levels, CCI, and death were examined across the groups. In addition, the inter-group differences in home-based end-of-life care utilization and institutional death among those who died during the study period were examined. One-way analysis of variance (ANOVA) was used to compare these differences.

We constructed multivariable logistic regression models to evaluate the influence of home care facility type on home-based end-of-life care utilization and institutional death. The models' dependent variables were the use or non-use of home-based end-of-life care and death at a medical institution or another location. The exposure of interest was the home care facility type, with Group A (enhanced HCSCs with beds) as the reference category. The covariates were sex, age, care needs levels, and CCI. The odds ratios (ORs) and 95% confidence intervals were estimated.

Next, we calculated the mean annual days of inpatient care, outpatient care, and home care, as

well as the mean annual expenditures for inpatient care, outpatient care, home care, and LTC among the groups. The inter-group differences were compared using analysis of variance. Each participant's service utilization was calculated over the number of years that he/she lived during the study period, and the annual utilization rates per person-year of observation were estimated. This method allowed the inclusion of data from participants who had died, which was useful because of the study population comprised individuals with an elevated mortality risk due to advanced age and high care needs.

To evaluate the influence of home care facility type on the use of medical and LTC services, we constructed generalized linear regression models. The models' dependent variables were the days of inpatient care, outpatient care, and home care, as well as the expenditures for inpatient care, outpatient care, home care, and LTC. The exposure of interest was the home care facility type. The covariates were sex, age, care needs levels, CCI, death, and the number of years the participants lived. The marginal means of the dependent variables were calculated to indicate the estimated values of the care days and expenditures of the various care services. These were calculated by substituting the means of the estimates into the generalized linear regression models on the assumption that the value of each covariate is a mean.

SQL server 2014 was used to extract the data and STATA version 14.2 was used for all analyses.

RESULTS

The participants' characteristics are summarized in Table 1. There were 18,347 participants, with 2,509 in Group A, 825 in Group B, 6,218 in Group C, and 8,795 in Group D. We observed significant inter-group differences in sex (P=0.002), age (P<0.001), and CCI (P<0.008). However, there were no significant differences in care needs levels (P=0.816) and death (P<0.669). Groups A and B tended to have higher CCI and older age than Groups C and D. During the 3-year study period, 54% of the participants died; Group A had the highest proportion of deaths (59.9%). Among the participants who died, there were significant inter-group differences in home-based end-of-life care utilization and institutional deaths. Group A had the highest home-based end-of-life care utilization rate (57.4%) and

the lowest institutional death rate (25.6%). The home-based end-of-life care utilization rate increased (in order) across Groups A, B, C, and D, but this order was reversed for the institutional death rate.

Table 2 shows the multivariate logistic regression analysis results of the associations of home care facility type with home-based end-of-life care utilization and institutional death among participants who died during the study period. Relative to Group A, Group D had the lowest odds of using home-based end-of-life care (OR = 0.13; $P<0.001$) and the highest odds of institutional death (OR = 2.32; $P<0.001$).

The distribution of medical and LTC service utilization per person-year across the groups is shown in Table 3. The mean total numbers of care days used by the participants were similar among the groups. However, there were significant inter-group differences when these numbers of days were categorized into inpatient care, outpatient care, and home care. The mean annual number of inpatient care days was highest in Group D (34.0 days), followed by Group B (33.0 days), Group C (29.6 days), and Group A (26.6 days). The mean annual number of outpatient care days was also highest in Group D (18.5 days), followed by Group A (10.1 days), Group C (9.8 days), and Group B (8.5 days). The mean annual number of home care days was highest in Group A (31.1 days), followed by Group C (27.2 days), Group B (24.9 days), and Group D (13.3 days). The mean annual inpatient care expenditure was highest in Group B ($9,822.8) and lowest in Group A ($7,661.7). The mean annual outpatient care expenditure was highest in Group D ($1,109.3) and lowest in Group C ($675.2). The mean annual home care expenditure was highest in Group A ($6,122.2) and lowest in Group D ($1,627.7). The mean annual LTC expenditure was highest in Group A ($30,252.7) and lowest in Group D ($26,688.6).

Table 4 shows the marginal means estimated from the generalized linear regression models that evaluated the associations of home care facility type with medical and LTC service utilization. The number of inpatient care days was highest in Group D (75.1 days), followed by Group B (70.0 days), Group C (64.7 days), and Group A (54.3 days). The number of outpatient care days was also highest in Group D (40.4 days), followed by Group C (21.2 days), Group A (21.1 days), and Group B (17.0

days). In contrast, the number of home care days was highest in Group A (63.8 days), followed by Group C (57.8 days), Group B (50.9 days), and Group D (29.0 days). Inpatient care expenditure was highest in Group B ($20,767.7), followed by Group D ($20,413.7), Group C ($17,606.3), and Group A ($15,523.3). Outpatient care expenditure was highest in Group D ($2,332.9), followed by Group A ($1,522.8), Group C ($1,500.6), and Group B ($1,455.5). Home care expenditure was highest in Group A ($12,747.4), followed by Group B ($10,790.1), Group C ($9,551.4), and Group D ($3,440.9). LTC expenditure was highest in Group A ($64,192.7), followed by Group C ($64,147.1), Group B ($62,003.3), and Group D ($58,186.0).

DISCUSSION

In this retrospective study of older home care service users with high care needs levels residing in Fukuoka Prefecture, we compared the utilization of medical and LTC services among 4 types of home care facilities. Participants who used enhanced HCSCs with beds had the highest number of home care days and the lowest number of inpatient care days per person-year. In contrast, participants who used general clinics had the lowest number of home care days and the highest number of inpatient and outpatient care days per person-year. These results corroborate previous findings that the integration of home care into community care by specialized clinics is effective in reducing hospitalization durations in older adults.[18,24]

A novel finding of this study is that the participants who used home care services from enhanced HCSCs with beds were most likely to receive end-of-life care at home and least likely to die at a medical institution. Specifically, the odds of institutional death in participants who used general clinics were 2.32 times higher than those who used enhanced HCSCs with beds, indicating that the latter are associated with reductions in institutional deaths. The Ministry of Health, Labour and Welfare of Japan reported that the national institutional death rate in 2016 was 75.8%,[25] which was substantially higher than the corresponding rate of all our subjects (36.6%) and even the general clinic user group (44.3%). This suggests that older adults who use home care services are more likely to die at places

other than medical institutions, such as at home or an LTC facility. Promoting the use of home care could, therefore, help to reduce the institutional death rate, as shown in a previous study.[26] Similarly, Sadamura and Babazono examined the correlation between LTC resources and place of death, and found that collaborations among clinics to provide home-based medical and LTC services reduced institutional deaths.[27] Accordingly, this form of integrated care may be effective in providing home-based end-of-life care for older adults.

It is noteworthy that participants who used enhanced HCSCs with beds had a substantially lower number of inpatient care days, but a higher number of home care days than participants who used enhanced HCSCs without beds. This suggests that the presence or absence of beds in enhanced HCSCs affected the use of care, despite these facilities being otherwise functionally identical. Another notable result is that conventional HCSCs appeared to be more effective in providing home care than enhanced HCSCs without beds in the metrics of inpatient care and home care days. These findings indicate a need to review the current insurance system that reimburses enhanced HCSCs without beds more than conventional HCSCs for the same services.[14] In our study population, the users of enhanced HCSCs with beds had a higher utilization of home-based end-of-life care and a lower utilization of inpatient care despite having relatively high care needs levels. Among the home care facility types, those well-equipped to manage sudden changes in their patients' conditions may be able to provide high-quality home-based daily living support and reduce the length of hospitalizations. A point of concern is that there was no significant difference in inpatient care days between general clinics and enhanced HCSCs without beds, as the latter are not equipped with beds for stay. The prerequisites for receiving this status can be met not only by the home care facility itself, but also by collaborating with other clinics.[14] It is, therefore, possible that a proportion of the enhanced HCSCs without beds are not individual facilities, but instead comprise 2 or more clinics that have collaborated to satisfy the relevant criteria. Consequently, decisions on treatment strategies (such as hospitalization) at these facilities may involve several doctors rather than one doctor. Bynum et al. examined the effects of different primary care types on hospitalizations in a continuing care retirement

community, and found that individuals who received primary care by doctors with 24-hour medical coverage had significantly fewer hospitalizations and emergency department visits than those who were served by external non-specific doctors.[24] In other words, the decentralization of healthcare provision can be reduced when one doctor is in charge of providing primary care for older community-dwelling adults. This can improve the quality of care and lower the number of hospitalizations and overall healthcare utilization rates. Based on these findings, we propose that the home care delivery system should limit the "enhanced" status to clinics with beds. However, there are no differences in home care fees between facilities with and without collaborations under Japan's current medical fee schedule. In order to expand the role of enhanced HCSCs, it is necessary to not only consider the presence or absence of beds, but also the presence or absence of collaborations with other clinics when examining the differences among HCSCs.

This study has several limitations. First, the study was conducted using only Fukuoka Prefecture residents, thereby limiting the generalizability of our findings. However, this prefecture has a high number of hospital beds and high medical expenditures per person, and the results of this study may be overestimated. Second, our data did not include detailed information about living conditions that reflect family structure and characteristics of living, which can influence the choice of home care facilities. Third, although the statistical analyses incorporated characteristics such as sex, age, care needs levels, and CCI, the diseases of each participant were not taken into consideration. Moreover, there were no clinical data (e.g., disease progression or laboratory test results) for individual participants because this study focused on the types of healthcare facilities that provide home care. Finally, we used care needs levels as a covariate, but could not account for any changes in these levels during the study period. However, using the care needs levels and CCI at the start of the study provided insight into the participants' baseline disease severity.

Here, we examined the effects of home care in Japan's CICS on the use of medical and LTC services, the use of home-based end-of-life care, and the place of death in older community-dwelling adults. We also confirmed the important role of enhanced HCSCs with beds in providing home care

services. Currently, there are 7,629 clinics with beds in Japan, and approximately 100,000 beds are in operation. Of these, 46% are used for emergency care and 37% provide transitional care for hospital-discharged patients before being transferred to home or an LTC facility.[28] Approximately 60% of those occupying these beds are aged 75 and older.[28] In order to optimize the provision of home care in a CICS, there is a need to consider functional changes in clinics with beds. The promotion of integrated community care is regarded as a viable solution for aging societies in many countries. To support this increasing need for community care, the World Health Organization published *Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity* in 2017.[29] These guidelines emphasize a need for comprehensive community-based strategies and primary care-level interventions to prevent diminishing capacity, and are consistent with our study's conclusion that HCSCs with beds play an integral role as the main healthcare facilities for providing home care within a region. Japan is considering the further dissemination of CICS as a national policy. This would involve the construction of a large system by coordinating the resources from acute care hospitals, rehabilitation hospitals, LTC facilities, clinics with beds, primary healthcare clinics, and comprehensive support centers within a region. Consequently, there would be a need to clarify each facility's role in this system. Our study provides useful information for further investigations of home care for older adults as part of community-based integrated care.

Acknowledgements The authors thank the Fukuoka Prefecture Association of Latter-Stage Elderly Healthcare for provision of the healthcare claims database.

Contributors SK lead the study design, conducted the literature search, extracted and analyzed the data, and wrote the manuscript. AB contributed to the study design, analysis and manuscript revision. AJ, YL and NL contributed to the study design and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Institutional Review Board of Kyushu University (Clinical Bioethics Committee of the Graduate School of Healthcare Sciences, Kyushu University). (Approval No. 20209).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

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REFERENCES

1. Hope P, Bamford SM, Beales S, et al. Creating sustainable health and care system in ageing societies. Report of the Ageing Societies Working Group 2012. The Global Health Policy Summit; 2012.
2. United Nations. World population ageing 2015. New Work: United Nations, Department of Economic and Social Affairs Population Division. 2015;ST/ESA/SER.A/390.
3. Cabinet Office. Heisei29nenban Koureishakai Hakusho. Koreikano jyoukyo (Annual Report on the Aging Society in 2017. The aging situation). https://www8.cao.go.jp/kourei/whitepaper/w-2017/zenbun/pdf/1s1s_01.pdf (Accessed May 20, 2020).
4. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age and Ageing. 2006;35 Suppl 2:ii37-ii41.
5. National Institute of Population and Social Security Research. Nihonno Shouraisuikei jinkou - Heisei29nen Suikei (The future population estimates in 2017). http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_gaiyou.pdf (Accessed May 20, 2020).
6. Ministry of Health, Labour and Welfare. Wagakunino Kokuminminahoken Seido (The overview of Medical insurance system for elderly). 2006. https://www.mhlw.go.jp/content/12400000/000377686.pdf (Accessed May 20, 2020).
7. Ministry of Finance. Shakaihoshouni tsuite (About Social Security). 2018. https://www.mof.go.jp/about_mof/councils/fiscal_system_council/sub-of_fiscal_system/proceedings/material/zaiseia301009/01.pdf (Accessed May 20, 2020).
8. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011;10(4):430-9.
9. World Health Organization. Global status report on noncommunicable diseases 2014. World Health Organization Geneva. 2014.
10. Ministry of Health, Labour and Welfare. 2015nenno Koureisha Kaigo -Koureishano Sonchouwo Sasaeru Keano Kakuritsuni Mukete (Elderly Care in 2015 -Toward the Establishment of Care to

Support the Dignity of Elderly Persons-). 2003. https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/3.html (Accessed May 20, 2020).

11. Ministry of Health, Labour and Welfare. Chiikihoukatsukea Kenkyukai Houkokusho (The study report of community-based integrated care systems).2019. https://www.mhlw.go.jp/houdou/2009/05/dl/ h0522-1.pdf (Accessed May 20, 2020).
12. Ministry of Health, Labour and Welfare. Jaitakuiryouno Genjyou (Current status of Homecare). 2016. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000129546.pdf. (Accessed May 20, 2020).
13. Miura H. Homecare for the Elderly. The Japan Geriatrics Society. 2013;50:164-7.
14. Ohta H. Current conditions and issues for home care support clinics. Japan Medical Association Journal. 2015;58:6-9.
15. Johri M, Beland F, Bergman H. International experiments in integrated care for the elderly: a synthesis of the evidence. Int J Geriatric Psychiatry. 2003;18(3):222-35.
16. Eklund K, Wilhelmson K. Outcomes of coordinated and integrated interventions targeting frail elderly people: a systematic review of randomised controlled trials. Health Soc Care Community. 2009;17(5):447-58.
17. Stewart MJ, Georgiou A, Westbrook JI. Successful integrating aged care services: a review of the evidence and tools emerging from a long-term care program. International journal of integrated care. 2013;13(1).
18. Rosenberg T. Acute hospital use, nursing home placement, and mortality in a frail community-dwelling cohort managed with Primary Integrated Interdisciplinary Elder Care at Home. J Am Geriatr Soc. 2012;60(7):1340-6.
19. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. BMJ Open. 2016;6(11):e011952.
20. Di Pollina L, Guessous I, Petoud V, et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. BMC

Geriatr. 2017;17(1):53.

21. Ellis G, Whitehead MA, Robinson D, et al. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. BMJ. 2011;343:d6553.
22. Baxter S, Johnson M, Chambers D, et al. The effects of integrated care: a systematic review of UK and international evidence. BMC Health Serv Res. 2018;18(1):350.
23. Olivares-Tirado P, Tamiya N. Trends and Factors in Japan's Long-Term Care Insurance System: Japan's 10-year Experience. Springer. 2014.
24. Bynum J, Andrews A, Sharp S, et al. Fewer hospitalizations result when primary care is highly integrated into a continuing care retirement community. Health Affairs. 2011;30(5):975-84.
25. Ministry of Health, Labour and Welfare. Heisei28nen Jinkoudoutaitoukeino Gaikyou (Vital Statistics of Japan in 2018). https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei16/index.html (Accessed May 20, 2020).
26. Kishida K, Tanigaki S. Jaitakushienshinryoujyoniyoru Mitorikazuni Eikyousuru Chiikitokusei (Regional characteristics that affect the number of end-of-life care provided by home care support clinics). Journal of health and welfare statistics. 2011;58:27-30.
27. Sadamura M, Babazono A. Kaigohokenseidouniyoru Kaigoshigenno Shihyouto siboubashotono Kanren (Relationship between long-term Care resource indicators by long-term Care insurance system and place of death. Journal of health and welfare statistics). 2005;52:8-14.
28. Ministry of Health, Labour and Welfare. Dai55kai Shakaihoshousingikai Iryoubukai: Yushoushinryoujyono Genjyouto Kadai (55th Social Security Council Medical Section: Current status and issues of clinics with beds). 2017. https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000184304.pdf (Accessed May 20, 2020).
29. World Health Organization. Integrated care for older people guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization Geneva; 2017.

Table 1. Participant characteristics according to home care facility type

	Total	Group A	Group B	Group C	Group D	*P* value
Number of participants	18,347	2,509 (13.7)	825 (4.5)	6,218 (33.9)	8,795 (47.9)	
Sex						
Men (%)	4,709 (25.7)	645 (25.7)	204 (24.7)	1,473 (23.7)	2,387 (27.1)	0.002
Women (%)	13,638 (74.3)	1,864 (74.3)	621 (75.3)	4,745 (76.3)	6,408 (72.9)	
Age, years						
Mean [SD]	87.5 [6.2]	87.8 [6.1]	88.1 [6.1]	87.7 [6.1]	87.1 [6.3]	
75–79 (%)	2,051 (11.2)	226 (9.0)	70 (8.5)	605 (9.7)	1,150 (13.1)	
80–84 (%)	4,035 (22.0)	542 (21.6)	167 (20.2)	1,388 (22.3)	1,938 (22.0)	<0.001
85–89 (%)	5,394 (29.4)	746 (29.7)	258 (31.3)	1,876 (30.2)	2,514 (28.6)	
≥90 (%)	6,867 (37.4)	955 (39.7)	330 (40.0)	2,349 (37.8)	3,193 (36.3)	
Care needs levels						
Level 3 (%)	5,081 (27.7)	582 (23.2)	227 (27.5)	1,739 (28.0)	2,533 (28.8)	
Level 4 (%)	6,804 (37.1)	882 (35.2)	281 (34.1)	2,341 (37.6)	3,300 (37.5)	0.816
Level 5 (%)	6,462 (35.2)	1,045 (41.6)	317 (38.4)	2,138 (34.4)	2,962 (33.7)	
Charlson comorbidity index						
0–2 (%)	4,115 (22.4)	507 (20.2)	144 (17.4)	1,331 (21.4)	2,133 (24.2)	
3–4 (%)	6,629 (36.1)	873 (34.8)	295 (35.8)	2,385 (38.4)	3,076 (35.0)	0.008
≥5 (%)	7,603 (41.5)	1,129 (45.0)	386 (46.8)	2,502 (40.2)	3,586 (40.8)	
Death						
Yes (%)	9,919 (54.1)	1,502 (59.9)	471 (57.1)	3,271 (52.6)	4,675 (53.2)	0.699
No (%)	8,428 (45.9)	1,007 (40.1)	354 (42.9)	2,947 (47.4)	4,120 (46.8)	
Number of deaths	9,919	1,502 (15.1)	471 (4.8)	3,271 (33.0)	4,675 (47.1)	
Home-based end-of-life care						
Yes (%)	3,103 (31.3)	862 (57.4)	220 (46.7)	1,285 (39.3)	736 (15.7)	<0.001
No (%)	6,816 (68.7)	640 (42.6)	251 (53.3)	1,986 (60.7)	3,939 (84.3)	
Institutional death						
Yes (%)	3.633 (36.6)	384 (25.6)	137 (29.1)	1,039 (31.8)	2,073 (44.3)	<0.001
No (%)	6,286 (63.4)	1,118 (74.4)	334 (70.9)	2,232 (68.2)	2,602 (55.7)	

Table 2. Associations of home care facility type with home-based end-of-life care utilization and institutional death

	Home-based end-of-life care		Institutional death	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Home care facility type				
Group A	Reference			
Group B	0.66 (0.53–0.82)	<0.001	1.17 (0.93–1.47)	0.19
Group C	0.47 (0.41–0.54)	<0.001	1.35 (1.18–1.56)	<0.001
Group D	0.13 (0.11–0.15)	<0.001	2.32 (2.03–2.65)	<0.001
Sex				
Men	Reference			
women	1.36 (1.22–1.51)	<0.001	0.75 (0.68–0.82)	<0.001
Age, years				
75–79 (%)	Reference			
80–84 (%)	1.11 (0.89–1.38)	0.34	1.05 (0.88–1.25)	0.58
85–89 (%)	1.34 (1.09–1.65)	<0.001	0.95 (0.81–1.13)	0.58
≥90 (%)	1.96 (1.61–2.39)	<0.001	0.74 (0.63–0.87)	<0.001
Care needs levels				
Level 3 (%)	Reference			
Level 4 (%)	1.31 (1.15-1.49)	<0.001	0.88 (0.79–0.98)	0.02
Level 5 (%)	1.94 (1.71–2.20)	<0.001	0.71 (0.63–0.79)	<0.001
Charlson comorbidity index				
0–2 (%)	Reference			
3–4 (%)	0.74 (0.65–0.84)	<0.001	1.25 (1.10–1.41)	<0.001
≥5 (%)	0.57 (0.50–0.64)	<0.001	1.51 (1.35–1.70)	<0.001

Table 3. Medical and long-term care utilization and expenditure per person-year according to home care facility type

	Group A	Group B	Group C	Group D	*P* value
Person-year	4955.1	1703.5	13667.8	18564.3	
Mean [SD]	2.0 [1.1]	2.1 [1.1]	2.2 [1.0]	2.1 [1.0]	
Rate per person-year					
Care days					
Inpatient care	26.6	33.0	29.6	34.0	<0.001
Outpatient care	10.1	8.5	9.8	18.5	<0.001
Home care	31.1	24.9	27.2	13.3	<0.001
Care expenditure					
Inpatient care	7661.7	9822.8	8024.9	9382.9	<0.001
Outpatient care	709.0	696.2	675.2	1109.3	<0.001
Home care	6122.2	5172.5	4365.2	1627.7	<0.001
Long-term care	30252.7	29153.8	29457.1	26688.6	<0.001

Table 4. Effect of home care facility type on medical and long-term care utilization and expenditure

	Group A	Group B	Group C	Group D
Care days				
Inpatient care	54.3 (50.2–58.3)	70.0 (61.0–78.9)	64.7 (61.6–67.8)	75.1 (71.9–78.3)
Outpatient care	21.1 (19.6–22.6)	17.0 (14.8–19.1)	21.2 (20.2–22.2)	40.4 (38.7–42.0)
Home care	63.8 (61.0–66.6)	50.9 (47.1–54.7)	57.8 (56.2–59.4)	29.0 (28.3–29.7)
Care expenditure				
Inpatient care	15523.3 (14558.7-16487.9)	20767.7 (18552.0–22983.3)	17606.3 (16898.2–18314.5)	20413.7 (19696.5–21131.0)
Outpatient care	1522.8 (1347.3-1698.3)	1455.5 (1170.8–1740.1)	1500.6 (1387.6–1613.5)	2332.9 (2180.7–2485.6)
Home care	12747.4 (12015.6–13479.1)	10790.1 (9730.2–11850.1)	9551.4 (9200.6–9902.2)	3440.9 (3322.2–3549.7)
Long-term care	64192.7 (63145.0–65240.4)	62003.3 (60279.2–63727.5)	64147.1 (63474.9–64819.3)	58186.0 (57652.6–58719.5)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3, 4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5, 6 (Database, Study Design)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5, 6 (Database, Study Design)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6 (Database, Study Design)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 7 (Statistical Analysis)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7 (Statistical Analysis)
Bias	9	Describe any efforts to address potential sources of bias	6, 7 (Statistical Analysis)
Study size	10	Explain how the study size was arrived at	7 (Results)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6, 7 (Statistical Analysis)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6, 7 (Statistical Analysis)
		(*b*) Describe any methods used to examine subgroups and interactions	6, 7 (Statistical Analysis)

		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7 (Results)
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5, 6 (Database, Study Design) Table 1
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	5 (Study Design)
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2, Table 3, and Table 4
		(*b*) Report category boundaries when continuous variables were categorized	9 line16-20
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			6 (Study Design)
Key results	18	Summarise key results with reference to study objectives	9, 10 (Discussion)
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10, 11 (Discussion)
Generalisability	21	Discuss the generalisability (external validity) of the study results	11, 12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041964.R1
Article Type:	Original research
Date Submitted by the Author:	31-Oct-2020
Complete List of Authors:	Kim, Sung-A; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Babazono, Akira; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Jamal, Aziz; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management; Universiti Teknologi MARA, International Business & Management Li, Yunfei; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Liu, Ning; University of Occupational and Environmental Health Japan, Preventive Medicine and Community Health
Primary Subject Heading:	Health policy
Secondary Subject Heading:	Health economics
Keywords:	HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Title:

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

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Words counts: Main text 3,927 words, 4 exhibits and 2 figures; Abstract 300 words

Abstract

Objectives: We compared the use of care services and medical institutional deaths among older adults across four home care facility types.

Design: This was a retrospective cohort study.

Setting: We used administrative claims data from April 2014 to March 2017.

Participants: Participants were residents of Fukuoka Prefecture, Japan, aged ≥75 years with certified care needs of at least level 3 who received home care during the study period. Participants were categorized according to their home care facility type: general clinics, Home Care Support Clinics/Hospitals (HCSCs), enhanced HCSCs with beds, and enhanced HCSCs without beds.

Primary and secondary outcome measures: We used generalized linear regression models for estimates utilization of care services and the incidence of medical institutional death, and to evaluate the potential risk factors of sex, age, care needs level, and Charlson comorbidity index.

Results: The numbers of inpatient care days were 53.3, 67.4, 63.9, and 72.6 for users of enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics, respectively. In contrast, the corresponding numbers of home care days were 64.0, 51.6, 57.9, and 28.4. The medical institutional death rate among the 9,919 participants who died during the study period was 2.32 times higher (P<0.001) for general clinic users than for users of enhanced HCSCs with beds (relative risks=1.69, P<0.001).

Conclusions: Participants using enhanced HCSCs with beds had relatively low inpatient care utilization and medical institutional deaths and relatively high utilization of home care and home-based end-of-life care. These findings suggest that hospitalizations and medical institutional deaths could be reduced by further expanding the role of enhanced HCSCs with beds. Our study provides useful information for further investigations of home care as part of community-based integrated care.

Trial registration: This study was approved by the Kyushu University Institutional Review Board for Clinical Research (Approval No. 20209).

Keyword:

Home care, integrated care, hospitalizations, place of death, aging in place

Strengths and limitations of this study

1. This was a retrospective cohort study including data on 18,347 individuals.
2. This study was designed to suggest the kind of healthcare system that will be needed in the future in aging societies by examining the associations of the type of home care provision system with end-of-life care and place of death for older adults.
3. We calculated the number of years that participants lived during the study period and estimated the annual utilization rates per person-year of observation.
4. This study was conducted using data only on residents of Fukuoka Prefecture in Japan, which limits the generalizability of our findings
5. There were no clinical data for individual participants because this study focused on the types of healthcare facilities that provide home care.

INTRODUCTION

In 2012, approximately 800 million adults—11% of the global population—were aged 65 years or older.[1] This age group is projected to reach 1.4 billion people by 2030 and to exceed 2 billion around 2050.[2] Japan is presently the world's most aged society, with adults aged 65 years and older accounting for 22.6% of the country's population in 2010, and this percentage is expected to surpass 30% in 2025.[3] Notably, the post-World War II baby-boom generation in Japan will reach the age of 75 years in 2025, imposing a heavy financial burden on the nation's social security system.[4, 5]

The present of care for the older adults in Japan

Japan's health insurance system categorizes older adults aged 65–74 years as "early-stage elderly" and those aged 75 years and older as "latter-stage elderly," and these age groups' out-of-pocket copayment rates are set at 20% and 10%, respectively.[6] The average annual medical expenditure in 2018 was 553,000 Japanese yen (US$5,247) for early-stage elderly patients and 910,000 Japanese yen (US$8,634 and this is 1.6 times higher) for latter-stage elderly patients.[7] In contrast, the average annual long-term care (LTC) expenditure was 50,000 Japanese yen (US$474) for early-stage elderly patients and 480,000 yen (US$4,554 and this is over 10 times higher) for latter-stage elderly patients.[7] Latter-stage elderly patients tend to be relatively frail and to have multiple chronic conditions that require the use of both medical and LTC services.[8, 9] To efficiently provide integrated care for these individuals, Japan has implemented the Community-based Integrated Care System (CICS), with the aim of moving away from the conventional hospital-centered healthcare delivery system toward a system that is focused on patients' residences and local facilities.[10] The CICS comprehensively provides medical care that provided at medical facilities, home care that provided at patient's own house or nursing home by medical professional and LTC services such as day care at LTC facilities or home visiting by nurses in addition to preventive care and daily living support to enable older adults to age in place until the end of life, even when they become increasingly care dependen.[11] It is necessary to ensure the availability of 24-hour, 365-day care services to monitor and manage any sudden changes in these older adults' health status.

Why is home-based end-of-life care necessary?

The percentage of deaths occurring at home in Japan exceeded 80% in 1951, with only 9% of deaths occurring at medical institutions such as hospitals.[12] This trend began to reverse in 1976, and 75.8% of deaths occurred in medical institutions in 2016,[12] despite approximately 70% of people reporting that they would prefer to spend the end of their lives at home rather than in a medical institution.[13] If the current trends continue, almost half a million people in Japan will be unable to receive end-of-life care at a medical institution in 2030, even if the number of home deaths increases by a factor of 1.5.[14] To resolve this issue, in 2006, Japan introduced Home Care-Support Clinics/Hospitals (HCSCs), which provide 24-hour home care and home-visit nursing care.[15] Furthermore, in 2012, Japan established "enhanced HCSCs," which fulfill more stringent criteria such as having three or more full-time doctors on staff and having handled at least five cases of emergency home care treatment and at least two cases of end-of-life care within the past year.[15] HCSCs that qualify for this "enhanced" designation receive higher reimbursements compared with conventional HCSCs.[15] At present, general clinics, HCSCs, and enhanced HCSCs are authorized to provide insurance-covered home care. Enhanced HCSCs are further categorized into those with beds and those without beds,[16] yielding a current total of four types of home care facilities available in Japan.

What affects the end-of-life care of older adults?

The percentage of adults aged 75 years and older in Japan is expected to reach 18.1% in 2025,[3] and optimizing community-based care systems may help to provide solutions for problems faced by aging populations in Japan and throughout the world. To improve the circumstances allowing older adults to continue living at home, it is necessary to first ascertain how different types of facilities in the current home care delivery system influence the use of medical and LTC services. Previous studies have shown that strengthening home care services has contributed to reducing patient hospitalization.[17-24] However, it remains unclear whether specific measures to strengthen the home care delivery system, such as the introduction of HCSCs and enhanced HCSCs, have affected where older adults receive end-of-life care or their utilization of various care services.

This study examined the influence of the home care delivery system on end-of-life care in adults aged 75 years and older. We comparatively examined home-based end-of-life care utilization, deaths in medical institutions, and the use of medical and LTC services among older adults who received home care services from four different types of facilities (enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics).

METHODS

Database

The study was conducted using data from a medical claims database and an LTC insurance claims database provided by the Fukuoka Prefecture Association of Latter-stage Elderly Healthcare. Medical claims included information on patient characteristics, medical treatments, disease diagnoses, and medical expenditures for all individuals who received insurance-covered care.[25] LTC insurance refers to the public insurance for older adults aged ≥65 years and adults aged ≥40 years with specific diseases. These claims include information on LTC service utilization and the corresponding expenditures for all individuals with certified care needs. Under the LTC insurance system, care needs are categorized into seven levels (support needs levels 1–2 and care needs levels 1–5), with increasing levels signifying higher degrees of dependence.[25]

The administrative claims data were de-identified by constructing specific databases using a work station with no connection to any networks.

Study Design

This retrospective cohort study used data from April 2014 to March 2017. The study participants were Fukuoka Prefecture residents aged 75 years and older with certified care needs of level 3 or higher in April 2014 who received home care services during the study period. The participants were divided into four groups according to the facility type providing them with home care services: Group A (enhanced HCSCs with beds), Group B (enhanced HCSCs without beds), Group C

(HCSCs), and Group D (general clinics).

We analyzed the participants who died during the 3-year study period to compare their home-based end-of-life care utilization and place of death across the four groups. The use of home-based end-of-life care was identified using claims records of additional fees specifically for these services. Place of death was categorized as medical institution for participants who were recorded as dying at a hospital or a clinic in the claims data. The medical institutional death rate was calculated as the percentage of all participants who died during the study period whose death occurred in a medical institution.

We also examined the number of days that participants received inpatient care, outpatient care, and home care across the four groups. Expenditures for inpatient care, outpatient care, home care, and LTC services were also calculated for each group.

Information was obtained on participant sex, age, care needs level, and Charlson comorbidity index (CCI) score.[26] Age was divided into four categories (75–79, 80–84, 85–89, and ≥90 years). The care needs levels included in our analysis were levels 3, 4, and 5 (with level 5 representing the highest level of dependence). CCI scores, which indicate the weighted number of concomitant diseases in an individual, were divided into three categories (0–2, 3–4, and ≥5).

Patient and Public Involvement

We used administrative claims data and did not involve patients in this study.

Statistical Analysis

The distributions of sex, age, care needs level, CCI, and death were examined across the four facility type groups. Additionally, inter-group differences in home-based end-of-life care utilization and institutional death among those who died during the study period were examined. One-way analysis of variance was used to compare these differences.

We constructed multivariable logistic regression models to evaluate the influence of home care

facility type on home-based end-of-life care utilization and medical institutional death. In these models, the dependent variables were the use of home-based end-of-life care and death at a medical institution. The exposure of interest was the home care facility type, with Group A (enhanced HCSCs with beds) as the reference category. The covariates were sex, age, care needs level, and CCI. Odds ratios (ORs) and 95% confidence intervals were estimated.

Next, we calculated the mean annual days of inpatient care, outpatient care, and home care, as well as the mean annual expenditures for inpatient care, outpatient care, home care, and LTC for each facility type group. The inter-group differences were compared using analysis of variance. Each participant's service utilization was calculated over the number of years he/she lived during the study period, and annual utilization rates per person-year of observation were estimated. This method allowed the inclusion of data from participants who died during the study period, which was useful because the study population comprised individuals with an elevated mortality risk because of advanced age and high care needs.

To evaluate the influence of home care facility type on the use of medical and LTC services, we constructed generalized linear regression models using Poisson analysis. Here, the dependent variables were the numbers of days of inpatient care, outpatient care, and home care, as well as the expenditures for inpatient care, outpatient care, home care, and LTC. The exposure of interest was the home care facility type. The covariates were sex, age, care needs level, CCI, death, and the number of years the participant lived. The marginal means of the dependent variables were calculated to indicate the estimated values of numbers of care days and expenditures for the examined care services. These were calculated by substituting the means of the estimates into the generalized linear regression models.

SQL Server 2014 was used to extract the data, and Stata, 14.2 was used for all analyses.

RESULTS

The participants' characteristics are summarized in table 1. There were 18,347 participants, with

2,509 in Group A, 825 in Group B, 6,218 in Group C, and 8,795 in Group D. We observed significant inter-group differences in sex (P=0.002), age (P<0.001), and CCI (P<0.008). However, there were no significant differences in care needs level (P=0.816) or death (P<0.669). Groups A and B tended to have higher CCI scores and older ages than did Groups C and D. During the 3-year study period, 54% of the participants died; Group A had the highest percentage of deaths (59.9%). Among the participants who died, there were significant inter-group differences in home-based end-of-life care utilization and in medical institutional death. Group A had the highest home-based end-of-life care utilization rate (57.4%) and the lowest rate of medical institutional death (25.6%). The home-based end-of-life care utilization rate in Group A, was followed (in order) by Groups B, C, and D, but this order was reversed for the rate of medical institutional death.

Table 2 shows the multivariate logistic regression analysis results for the associations of home care facility type with home-based end-of-life care utilization and medical institutional death among the participants who died during the study period. Relative to Group A, Group D had the lowest odds of using home-based end-of-life care (OR=0.13; P<0.001) and the highest odds of institutional death (OR=2.32; P<0.001).

The distribution of medical and LTC service utilization per person-year across the groups is shown in table 3. The mean total number of care days used by the participants was similar across the four groups. However, there were significant inter-group differences when the number of days was categorized into inpatient care, outpatient care, and home care. The mean annual number of inpatient care days was highest in Group D (34.0 days), followed by Group B (33.0 days), Group C (29.6 days), and Group A (26.6 days). The mean annual number of outpatient care days was also highest in Group D (18.5 days), followed by Group A (10.1 days), Group C (9.8 days), and Group B (8.5 days). The mean annual number of home care days was highest in Group A (31.1 days), followed by Group C (27.2 days), Group B (24.9 days), and Group D (13.3 days). The mean annual inpatient care expenditure was highest in Group B (US$9,822.80) and lowest in Group A (US$7,661.70). The mean annual outpatient care expenditure was highest in Group D (US$1,109.30) and lowest in Group C

(US$675.20). The mean annual home care expenditure was highest in Group A (US$6,122.20) and lowest in Group D (US$1,627.70). The mean annual LTC expenditure was highest in Group A (US$30,252.70) and lowest in Group D (US$26,688.60).

Table 4 shows the marginal means estimated from the generalized linear Poisson regression models evaluating the associations of home care facility type with medical and LTC service utilization. The number of inpatient care days was highest in Group D (72.6 days), followed by Group B (67.4 days), Group C (63.9 days), and Group A (53.3 days). The number of outpatient care days was also highest in Group D (39.1 days), followed by Group A (21.3 days), Group C (21.0 days), and Group B (17.9 days). In contrast, the number of home care days was highest in Group A (64.0 days), followed by Group C (57.9 days), Group B (51.6 days), and Group D (28.4 days). Inpatient care expenditure was highest in Group B (US$20,093.9), followed by Group D (US$19,949.5), Group C (US$17,389.7), and Group A (US$153,36.00). Outpatient care expenditure was highest in Group D (US$2,302.00), followed by Group A (US$1,508.90), Group B (US$1,491.3), and Group C (US$1,470.10). Home care expenditure was highest in Group A (US$12,519.50), followed by Group B (US$10,709.90), Group C (US$9,371.8), and Group D (US$3,459.40). LTC expenditure was highest in Group A (US$63,246.00), followed by Group C (US$62,417.40), Group B (US$60,995.60), and Group D (US$56,868.90). The results of the marginal means are also presented visually in figures 1 and 2.

DISCUSSION

In this retrospective study of older adult home care service users with high care needs levels residing in Fukuoka Prefecture, we compared the utilization of medical and LTC services among patients treated by four types of home care facilities. Participants who used enhanced HCSCs with beds had the highest number of home care days and the lowest number of inpatient care days per person-year. In contrast, participants who used general clinics had the lowest number of home care days and the highest number of inpatient and outpatient care days per person-year. These results corroborate previous findings showering that the integration of home care into community care by specialized

clinics is effective in reducing hospitalization duration among older adults.[20, 27]

A novel finding of the present study is that participants who used home care services from enhanced HCSCs with beds were the most likely to receive end-of-life care at home and the least likely to die in a medical institution. Specifically, the odds of institutional death were 2.32 times higher for participants who used general clinics than for those who used enhanced HCSCs with beds, indicating that treatment by the latter type of facility is associated with a reduction in medical institutional deaths. The Ministry of Health, Labour and Welfare of Japan reported that the national medical institutional death rate in 2016 was 75.8%,[28] which was substantially higher than the corresponding rate observed among the patients in our study (36.6%) and even among the general clinic user group alone (44.3%). This suggests that older adults who use home care services are more likely to die outside of medical institutions, in places such as their homes or an LTC facility. Promoting the use of home care could, therefore, help to reduce the medical institutional death rate, as has also been demonstrated in a previous study.[29] Similarly, Sadamura and Babazono examined the correlation between LTC resources and place of death, finding that collaborations among clinics to provide home-based medical and LTC services reduced medical institutional deaths.[30] This form of integrated care may be effective in providing home-based end-of-life care for older adults.

It is noteworthy that participants who used enhanced HCSCs with beds had a substantially lower number of inpatient care days and expenditures but a higher number of home care days and expenditures, compared with participants who used enhanced HCSCs without beds. This suggests that the presence of beds in enhanced HCSCs affected the use of care, despite HCSCs with and without beds being otherwise functionally identical. Another notable result is that conventional HCSCs appeared to be more effective in providing home care, compared with enhanced HCSCs without beds in terms of the metrics of inpatient care, home care days, and home care expenditures. These findings indicate a need to review the current insurance system, which reimburses enhanced HCSCs without beds at a higher rate for the same services, compared with conventional HCSCs.[15] In our study population, the users of enhanced HCSCs with beds had a higher utilization of home-based end-of-

life care and a lower utilization of inpatient care, despite having relatively high care needs levels. Among the home care facility types, those that are well equipped to manage sudden changes in their patients' conditions may be able to provide high-quality home-based daily living support and reduce the length of hospitalization. A point of concern is that there was no significant difference in the number of inpatient care days between general clinics and enhanced HCSCs without beds. The prerequisites for receiving enhanced HCSC status may be met by a home care facility through collaboration with other clinics.[15] Therefore, it is possible that some of the enhanced HCSCs without beds were not individual facilities but instead comprised two or more clinics collaborating to satisfy the relevant criteria. Consequently, decisions on treatment strategies (such as hospitalization) at these facilities may involve several doctors rather than one doctor. Bynum et al. examined the effects of different types of primary care on hospitalizations in a continuing care retirement community, finding that individuals with 24-hour primary care availability from physicians providing care only at that site had significantly fewer hospitalizations and emergency department visits than did those who were served by external non-site-specific doctors.[27] This suggests that the decentralization of healthcare provision may be reduced when one doctor is in charge of providing primary care for older adults living in a community, which can improve the quality of care and reduce the number of hospitalizations and overall healthcare utilization rates. On the basis of our findings and those from previous studies, we propose that the home care delivery system in Japan should limit the "enhanced" status to clinics with beds. Under Japan's current medical fee schedule, there are no differences in home care fees between enhanced facilities operating independently and those working in collaboration with other facilities. To expand the role of enhanced HCSCs, when examining the differences among HCSCs, it is necessary to consider whether the facility works in collaboration with other clinics in addition to considering whether the facility has beds.

This study has several limitations. First, the study was conducted using data only on Fukuoka Prefecture residents, which limits the generalizability of our findings.[31] This prefecture has a relatively high number of hospital beds and relatively high medical expenditures per person, and this

study's results therefore may be overestimated. Second, our data did not include detailed information about living conditions reflecting the participants' family structure or characteristics of living, which may influence the choice of a home care facility. Third, although the statistical analyses incorporated characteristics such as sex, age, care needs level, and CCI, the specific diseases of each participant were not taken into consideration. Moreover, no clinical data (e.g., disease progression or laboratory test results) for individual participants were included because this study focused on the types of healthcare facilities providing home care. Finally, we used care needs level as a covariate, but we were unable to account for any changes in this level over the study period. Nevertheless, considering the care needs level and CCI at the start of the study provided insight into the participants' baseline disease severity.

In this study, we examined the effects of home care in Japan's CICS on the use of medical and LTC services, the use of home-based end-of-life care, and the place of death among older community-dwelling adults. We also confirmed the important role of enhanced HCSCs with beds in providing home care services. Currently, there are 7,629 clinics with beds in Japan, and approximately 100,000 beds are available. Of these beds, 46% are used for emergency care and 37% provide transitional care for hospital-discharged patients before they are transferred to home or to an LTC facility.[32] Approximately 60% of the patients occupying the available beds are aged 75 years and older.[32] To optimize the provision of home care through a community-based care system, it is necessary to consider functional changes in clinics with beds. The promotion of integrated community care is regarded as a viable solution for aging societies in many countries. To support the increasing need for community care, the World Health Organization published *Integrated Care for Older People: Guidelines on Community-level Interventions to Manage Declines in Intrinsic Capacity* in 2017.[33] These guidelines, which emphasize the need for comprehensive community-based strategies and primary care-level interventions to prevent diminishing capacity, are consistent with our study's conclusion that HCSCs with beds play an integral role in Japan, as the main healthcare facilities providing home care. As part of its national policy, Japan is considering a further expansion of the

CICS. This expansion would involve the construction of a large system by coordinating the resources of acute care hospitals, rehabilitation hospitals, LTC facilities, clinics with beds, primary healthcare clinics, and comprehensive support centers within each region of the country. Consequently, there would be a need to clarify each facility's role in this expanded system. Our study provides useful information for further investigations of home care for older adults as part of community-based integrated care.

Acknowledgements The authors thank the Fukuoka Prefecture Association of Latter-Stage Elderly Healthcare for provision of the healthcare claims database. We also thank Jennifer Barrett, PhD, from Edanz Group (https://en-author-services.edanzgroup.com/ac) for editing a draft of this manuscript.

Contributors SK lead the study design, conducted the literature search, extracted and analyzed the data, and wrote the manuscript. AB contributed to the study design, analysis and manuscript revision. AJ, YL and LN contributed to the study design and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Institutional Review Board of Kyushu University (Clinical Bioethics Committee of the Graduate School of Healthcare Sciences, Kyushu University). (Approval No. 20209).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

Open access

REFERENCES

1. Hope P, Bamford SM, Beales S, et al. Creating sustainable health and care system in ageing societies. Report of the Ageing Societies Working Group 2012. The Global Health Policy Summit; 2012.
2. United Nations. World population ageing 2015. New Work: United Nations, Department of Economic and Social Affairs Population Division. 2015;ST/ESA/SER.A/390.
3. Cabinet Office. Heisei29nenban Koureishakai Hakusho. Koreikano jyoukyo (Annual Report on the Aging Society in 2017. The aging situation). https://www8.cao.go.jp/kourei/whitepaper/w-2017/zenbun/pdf/1s1s_01.pdf (Accessed May 20, 2020).
4. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age and Ageing. 2006;35 Suppl 2:ii37-ii41.
5. National Institute of Population and Social Security Research. Nihonno Shouraisuikei jinkou - Heisei29nen Suikei (The future population estimates in 2017). http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_gaiyou.pdf (Accessed May 20, 2020).
6. Ministry of Health, Labour and Welfare. Wagakunino Kokuminminahoken Seido (The overview of Medical insurance system for elderly). 2006. https://www.mhlw.go.jp/content/12400000/000377686.pdf (Accessed May 20, 2020).
7. Ministry of Finance. Shakaihoshouni tsuite (About Social Security). 2018. https://www.mof.go.jp/about_mof/councils/fiscal_system_council/sub-of_fiscal_system/proceedings/material/zaiseia301009/01.pdf (Accessed May 20, 2020).
8. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011;10(4):430-9.
9. World Health Organization. Global status report on noncommunicable diseases 2014. World Health Organization Geneva. 2014.
10. Ministry of Health, Labour and Welfare. 2015nenno Koureisha Kaigo -Koureishano Sonchouwo Sasaeru Keano Kakuritsuni Mukete (Elderly Care in 2015 -Toward the Establishment of Care to

Support the Dignity of Elderly Persons-). 2003. https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/3.html (Accessed May 20, 2020).

11. Ministry of Health, Labour and Welfare. Chiikihoukatsukea Kenkyukai Houkokusho (The study report of community-based integrated care systems).2019. https://www.mhlw.go.jp/houdou/2009/05/dl/ h0522-1.pdf (Accessed May 20, 2020).
12. Ministry of Health, Labour and Welfare. Jaitakuiryouno Genjyou (Consciousness survey of end-of-life care). 2016. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000129546.pdf. (Accessed May 20, 2020).
13. Ministry of Health, Labour and Welfare. Jinseino Saishudankaino Iryouniokeru Kouseiroudoshono Torikumi (Ministry of Health, Labor and Welfare's efforts in medical care at the end-of life). 2017. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000200749.pdf. (Accessed May 20, 2020).
14. Miura H. Homecare for the Elderly. The Japan Geriatrics Society. 2013;50:164-7.
15. Ohta H. Current conditions and issues for home care support clinics. Japan Medical Association Journal. 2015;58:6-9.
16. Ministry of Health, Labour and Welfare. Zaitakuiryono Kouchikunitsuite (The construction of home medical care system).2018. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000170234.pdf (Accessed May 20, 2020).
17. Johri M, Beland F, Bergman H. International experiments in integrated care for the elderly: a synthesis of the evidence. Int J Geriatric Psychiatry. 2003;18(3):222-35.
18. Eklund K, Wilhelmson K. Outcomes of coordinated and integrated interventions targeting frail elderly people: a systematic review of randomised controlled trials. Health Soc Care Community. 2009;17(5):447-58.
19. Stewart MJ, Georgiou A, Westbrook JI. Successful integrating aged care services: a review of the evidence and tools emerging from a long-term care program. International journal of integrated care. 2013;13(1).

20. Rosenberg T. Acute hospital use, nursing home placement, and mortality in a frail community-dwelling cohort managed with Primary Integrated Interdisciplinary Elder Care at Home. J Am Geriatr Soc. 2012;60(7):1340-6.
21. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. BMJ Open. 2016;6(11):e011952.
22. Di Pollina L, Guessous I, Petoud V, et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. BMC Geriatr. 2017;17(1):53.
23. Ellis G, Whitehead MA, Robinson D, et al. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. BMJ. 2011;343:d6553.
24. Baxter S, Johnson M, Chambers D, et al. The effects of integrated care: a systematic review of UK and international evidence. BMC Health Serv Res. 2018;18(1):350.
25. Olivares-Tirado P, Tamiya N. Trends and Factors in Japan's Long-Term Care Insurance System: Japan's 10-year Experience. Springer. 2014.
26. D'Hoore W, Sicotte C, Tilquin C. Risk Adjustment in Outcome Assessment: the Charlson Comorbidity Index. Methods Inf Med. 1993;32(05):382-387
27. Bynum J, Andrews A, Sharp S, et al. Fewer hospitalizations result when primary care is highly integrated into a continuing care retirement community. Health Affairs. 2011;30(5):975-84.
28. Ministry of Health, Labour and Welfare. Heisei28nen Jinkoudoutaitoukeino Gaikyou (Vital Statistics of Japan in 2016). https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei16/index.html (Accessed May 20, 2020).
29. Kishida K, Tanigaki S. Jaitakushienshinryoujyoniyoru Mitorikazuni Eikyousuru Chiikitokusei (Regional characteristics that affect the number of end-of-life care provided by home care support clinics). Journal of health and welfare statistics. 2011;58:27-30.
30. Sadamura M, Babazono A. Kaigohokenseidouniyoru Kaigoshigenno Shihyouto siboubashotono Kanren (Relationship between long-term Care resource indicators by long-term Care insurance

system and place of death. Journal of health and welfare statistics). 2005;52:8-14.

31. Ministry of Health, Labour and Welfare. Iryouhino Chiikisa Bunseki (Regional difference analysis of medical expenses). 2017. https://www.mhlw.go.jp/content/iryohi_h29.pdf (Accessed May 20, 2020).
32. Ministry of Health, Labour and Welfare. Dai55kai Shakaihoshousingikai Iryoubukai: Yushoushinryoujyono Genjyouto Kadai (55th Social Security Council Medical Section: Current status and issues of clinics with beds). 2017. https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000184304.pdf (Accessed May 20, 2020).
33. World Health Organization. Integrated care for older people guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization Geneva; 2017.

Table 1. Participant characteristics by home care facility type

	Total	Group A	Group B	Group C	Group D	*P* value
Number of participants	18,347	2,509 (13.7)	825 (4.5)	6,218 (33.9)	8,795 (47.9)	
Sex						
Men (%)	4,709 (25.7)	645 (25.7)	204 (24.7)	1,473 (23.7)	2,387 (27.1)	0.002
Women (%)	13,638 (74.3)	1,864 (74.3)	621 (75.3)	4,745 (76.3)	6,408 (72.9)	
Age						
Mean [SD]	87.5 [6.2]	87.8 [6.1]	88.1 [6.1]	87.7 [6.1]	87.1 [6.3]	
75–79 (%)	2,051 (11.2)	226 (9.0)	70 (8.5)	605 (9.7)	1,150 (13.1)	
80–84 (%)	4,035 (22.0)	542 (21.6)	167 (20.2)	1,388 (22.3)	1,938 (22.0)	<0.001
85–89 (%)	5,394 (29.4)	746 (29.7)	258 (31.3)	1,876 (30.2)	2,514 (28.6)	
≥90 (%)	6,867 (37.4)	955 (39.7)	330 (40.0)	2,349 (37.8)	3,193 (36.3)	
Care needs levels						
Level 3 (%)	5,081 (27.7)	582 (23.2)	227 (27.5)	1,739 (28.0)	2,533 (28.8)	
Level 4 (%)	6,804 (37.1)	882 (35.2)	281 (34.1)	2,341 (37.6)	3,300 (37.5)	0.816
Level 5 (%)	6,462 (35.2)	1,045 (41.6)	317 (38.4)	2,138 (34.4)	2,962 (33.7)	
Charlson comorbidity index						
0–2 (%)	4,115 (22.4)	507 (20.2)	144 (17.4)	1,331 (21.4)	2,133 (24.2)	
3–4 (%)	6,629 (36.1)	873 (34.8)	295 (35.8)	2,385 (38.4)	3,076 (35.0)	0.008
≥5 (%)	7,603 (41.5)	1,129 (45.0)	386 (46.8)	2,502 (40.2)	3,586 (40.8)	
Death						
Yes (%)	9,919 (54.1)	1,502 (59.9)	471 (57.1)	3,271 (52.6)	4,675 (53.2)	0.699
No (%)	8,428 (45.9)	1,007 (40.1)	354 (42.9)	2,947 (47.4)	4,120 (46.8)	
Number of deaths	9,919	1,502 (15.1)	471 (4.8)	3,271 (33.0)	4,675 (47.1)	
Home-based end-of-life care						
Yes (%)	3,103 (31.3)	862 (57.4)	220 (46.7)	1,285 (39.3)	736 (15.7)	<0.001
No (%)	6,816 (68.7)	640 (42.6)	251 (53.3)	1,986 (60.7)	3,939 (84.3)	
Medical Institutional death						
Yes (%)	3.633 (36.6)	384 (25.6)	137 (29.1)	1,039 (31.8)	2,073 (44.3)	<0.001
No (%)	6,286 (63.4)	1,118 (74.4)	334 (70.9)	2,232 (68.2)	2,602 (55.7)	

NOTES: Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics. "Number of deaths" refers to participants who died during the study period.

Table 2. Associations of home care facility type with home-based end-of-life care utilization and medical institutional death

	Home-based end-of-life care		Medical Institutional death	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Home care facility type				
Group A	Reference			
Group B	0.66 (0.53–0.82)	<0.001	1.17 (0.93–1.47)	0.19
Group C	0.47 (0.41–0.54)	<0.001	1.35 (1.18–1.56)	<0.001
Group D	0.13 (0.11–0.15)	<0.001	2.32 (2.03–2.65)	<0.001
Sex				
Men	Reference			
Women	1.36 (1.22–1.51)	<0.001	0.75 (0.68–0.82)	<0.001
Age				
75–79 (%)	Reference			
80–84 (%)	1.11 (0.89–1.38)	0.34	1.05 (0.88–1.25)	0.58
85–89 (%)	1.34 (1.09–1.65)	<0.001	0.95 (0.81–1.13)	0.58
≥90 (%)	1.96 (1.61–2.39)	<0.001	0.74 (0.63–0.87)	<0.001
Care needs levels				
Level 3 (%)	Reference			
Level 4 (%)	1.31 (1.15-1.49)	<0.001	0.88 (0.79–0.98)	0.02
Level 5 (%)	1.94 (1.71–2.20)	<0.001	0.71 (0.63–0.79)	<0.001
Charlson comorbidity index				
0–2 (%)	Reference			
3–4 (%)	0.74 (0.65–0.84)	<0.001	1.25 (1.10–1.41)	<0.001
≥5 (%)	0.57 (0.50–0.64)	<0.001	1.51 (1.35–1.70)	<0.001

NOTES: This table shows the results of multivariate logistic regression analyses that adjusted for the following covariates: sex, age, care needs level, and Charlson comorbidity index. The dependent variables were home-based end-of-life care utilization and medical institutional death. The exposure of interest was the home care facility type, with Group A as the reference category. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 3. Medical and long-term care utilization and expenditure per person-year by home care facility type

	Group A	Group B	Group C	Group D	*P* value
Person-year	4955.1	1703.5	13667.8	18564.3	
Mean [SD]	2.0 [1.1]	2.1 [1.1]	2.2 [1.0]	2.1 [1.0]	
Rate per person-year					
Care days					
Inpatient care	26.6	33.0	29.6	34.0	<0.001
Outpatient care	10.1	8.5	9.8	18.5	<0.001
Home care	31.1	24.9	27.2	13.3	<0.001
Care expenditure					
Inpatient care	7661.7	9822.8	8024.9	9382.9	<0.001
Outpatient care	709.0	696.2	675.2	1109.3	<0.001
Home care	6122.2	5172.5	4365.2	1627.7	<0.001
Long-term care	30252.7	29153.8	29457.1	26688.6	<0.001

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The values were calculated over the number of years each participant lived during the study period and are reported here as the annual rates per person-year of observation. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 4. Comparison of medical and long-term care utilization and expenditure by home care facility type

	Care days			Care expenditure			
	Inpatient	Outpatient	Home care	Inpatient	Outpatient	Home care	Long-term care
Home care facility type							
Group A	53.3	21.3	64.0	15336.0	1508.9	12519.5	63246.0
Group B	67.4	17.9	51.6	20093.9	1491.3	10709.9	60995.6
Group C	63.9	21.0	57.9	17389.7	1470.1	9371.8	62417.4
Group D	72.6	39.1	28.4	19949.5	2302.0	3459.4	56868.9
Sex							
Men	74.5	30.4	44.3	20876.9	2147.8	7824.5	56401.8
Women	63.8	29.3	44.4	17493.9	1774.5	6789.8	60804.3
Age							
75–79	83.1	33.5	42.2	23668.6	2777.0	7721.0	56152.5
80–84	75.5	31.4	42.8	21345.5	2247.6	7051.8	59279.4
85–89	65.4	29.9	45.4	18082.4	1829.2	6884.8	60797.8
≥90	56.9	26.5	45.4	15236.8	1277.4	6918.9	60723.1
Care needs levels							
Level 3	62.0	30.2	41.2	18348.2	2107.6	6466.3	53156.8
Level 4	66.5	30.9	43.1	18325.8	2010.0	6461.2	59693.2
Level 5	71.0	27.5	48.7	18685.5	1508.1	8154.3	66189.3
Charlson comorbidity index							
0–2	48.0	26.7	41.7	12753.4	1231.1	6066.1	60933.6
3–4	64.2	28.7	43.9	17367.4	1570.8	6665.9	60587.3
≥5	78.5	32.0	46.4	22240.1	2491.1	7878.7	58454.6
Death							
No	45.3	27.1	41.6	12671.9	1725.9	6377.4	56859.9
Yes	106.1	34.8	49.4	28248.7	2205.3	8215.0	66685.5

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The table shows the results (marginal means) of generalized linear regression analyses with family (Poisson) and the following dependent variables: inpatient care days, outpatient care days, home care days, inpatient care expenditures, outpatient care expenditures, home care expenditures, and long-term care expenditures. The exposure of interest was the homecare facility type. The models adjusted for the following covariates: sex, age, care needs level, Charlson comorbidity index, death, and the number of years the participants lived during the study period. The marginal means of the dependent variables were calculated by substituting the means of the estimates into the generalized linear regression models. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

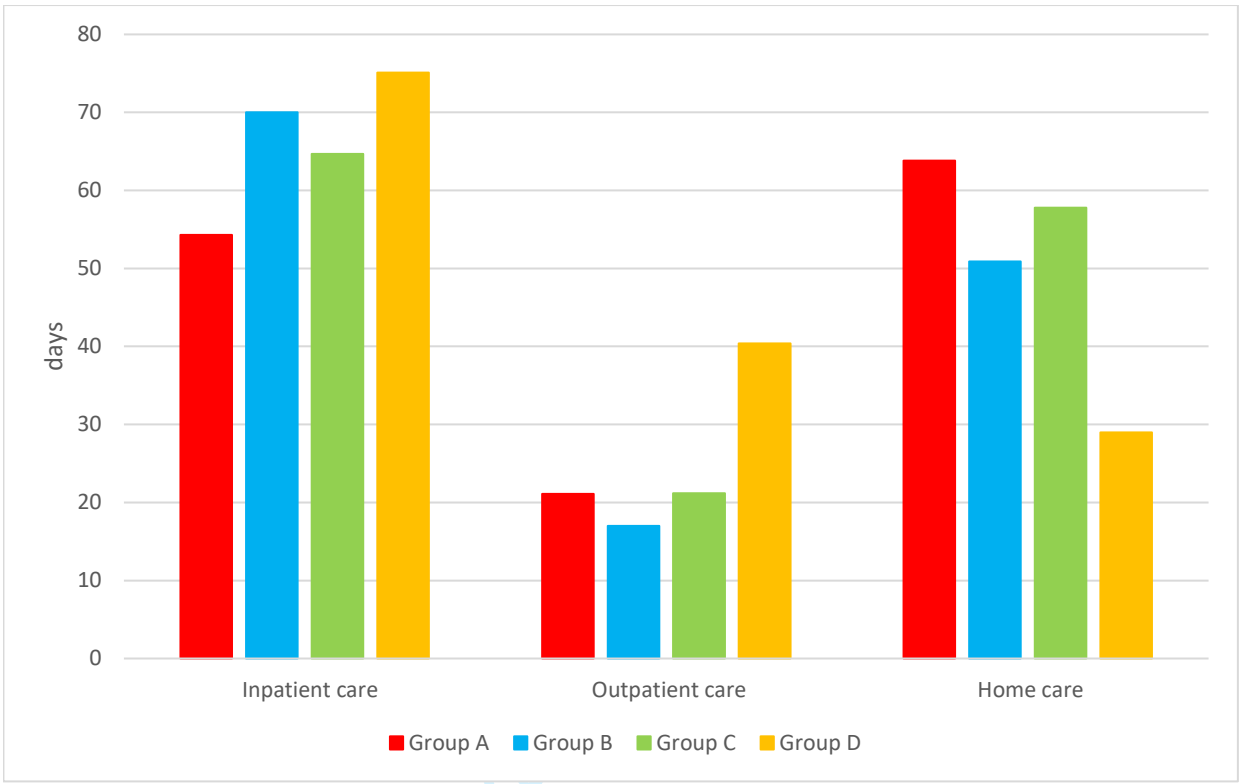
Figure legends

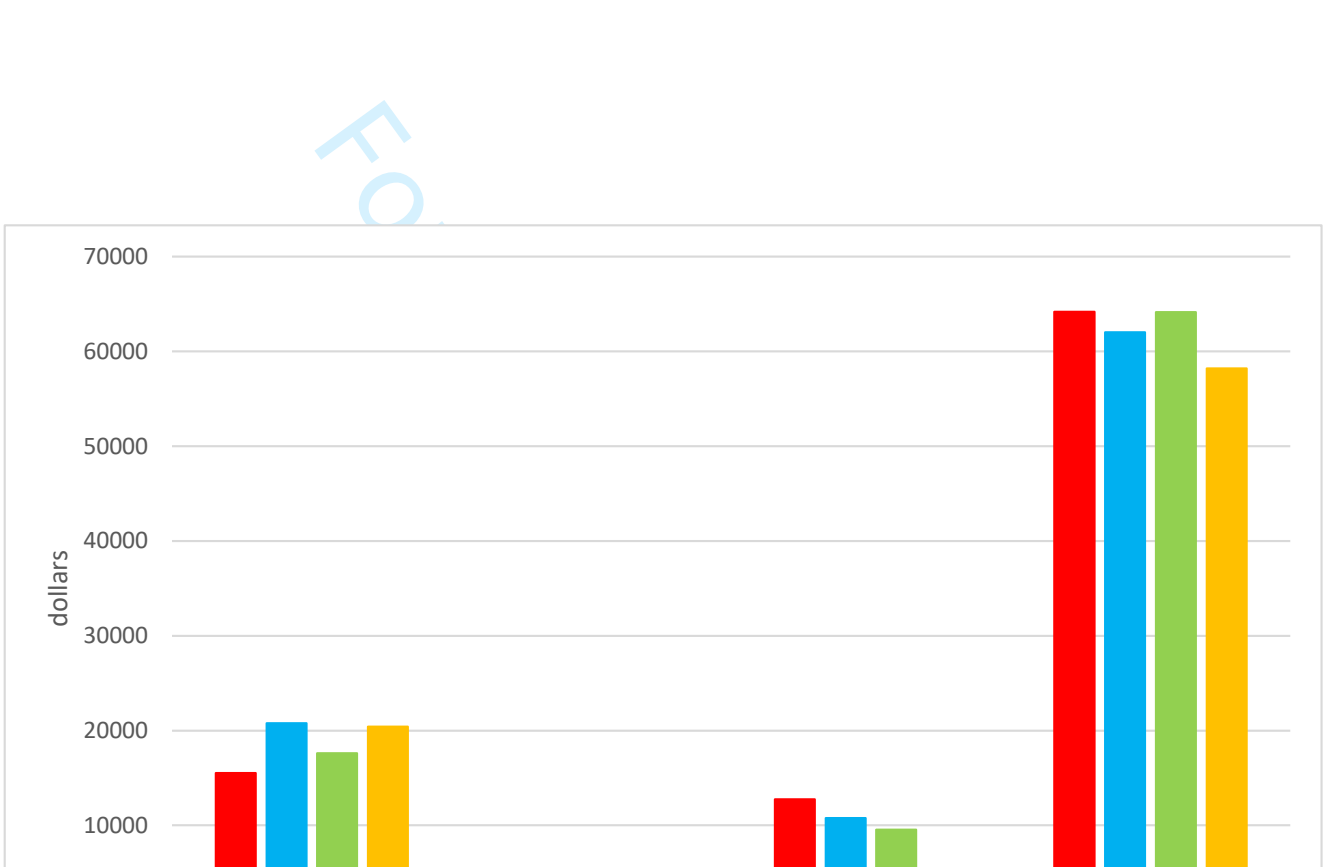
Image1: Figure1

The title is “Comparison of medical utilization using marginal means by home care facility type”. This shows the care days by home care facility, which is the result of Table 4.

Image2: Figure2

The title is “Comparison of medical and long-term care expenditures using marginal means by home care facility type”. This shows the care expenditures by home care facility, which is the result of Table 4.

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dollars
Inpatient care
Outpatient care
Home care
Long-term care
Group A
Group B
Group C
Group D

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3, 4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5, 6 (Database, Study Design)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5, 6 (Database, Study Design)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	5, 6 (Database, Study Design)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6, 7 (Statistical Analysis)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6, 7 (Statistical Analysis)
Bias	9	Describe any efforts to address potential sources of bias	6, 7 (Statistical Analysis)
Study size	10	Explain how the study size was arrived at	7 (Results)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6, 7 (Statistical Analysis)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6, 7 (Statistical Analysis)
		(*b*) Describe any methods used to examine subgroups and interactions	6, 7 (Statistical Analysis)

		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7 (Results)
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5, 6 (Database, Study Design) Table 1
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	5 (Study Design)
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2, Table 3, and Table 4
		(*b*) Report category boundaries when continuous variables were categorized	9 line16-20
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			6 (Study Design)
Key results	18	Summarise key results with reference to study objectives	9, 10 (Discussion)
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9, 10, 11 (Discussion)
Generalisability	21	Discuss the generalisability (external validity) of the study results	11, 12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	13

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041964.R2
Article Type:	Original research
Date Submitted by the Author:	01-Mar-2021
Complete List of Authors:	Kim, Sung-A; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Babazono, Akira; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Jamal, Aziz; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management; Universiti Teknologi MARA, International Business & Management Li, Yunfei; Kyushu University Faculty of Medicine Graduate School of Medical Science, Healthcare Administration and Management Liu, Ning; University of Occupational and Environmental Health Japan, Preventive Medicine and Community Health
Primary Subject Heading:	Health policy
Secondary Subject Heading:	Health economics, Health services research
Keywords:	HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Title:

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

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Words counts: Main text 4,403 words, 4 exhibits and 2 figures; Abstract 294 words

Abstract

Objectives: We compared the care services use and medical institutional deaths among older adults across four home care facility types.

Design: This was a retrospective cohort study.

Setting: We used administrative claims data from April 2014 to March 2017.

Participants: We included 18,347 residents of Fukuoka Prefecture, Japan, who received home care during the period, and aged ≥75 years with certified care needs of at least level 3. Participants were categorized based on home care facility use (i.e., general clinics, Home Care Support Clinics/Hospitals (HCSCs), enhanced HCSCs with beds, and enhanced HCSCs without beds).

Primary and secondary outcome measures: We used generalized linear models to estimate care utilization and the incidence of medical institutional death, as well as the potential influence of sex, age, care needs level, and Charlson comorbidity index as risk factors.

Results: The results of generalized linear models showed the inpatient days were 54.3, 69.9, 64.7, and 75.0 for users of enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics, respectively. Correspondingly, the numbers of home care days were 63.8, 51.0, 57.8, and 29.0. Our multivariable logistic regression model estimated medical institutional death rate among participants who died during the study period (n = 9919) was 2.32 times higher (P<0.001) for general clinic users than enhanced HCSCs with beds users (relative risks=1.69, P<0.001).

Conclusions: Participants who used enhanced HCSCs with beds had a relatively low inpatient utilization, medical institutional deaths, and a high utilization of home care and home-based end-of-life care. Findings suggest enhanced HCSCs with beds could reduce hospitalization days and medical institutional deaths. Our study warrants further investigations of home care as part of community-based integrated care.

Trial registration: This study was approved by the Kyushu University Institutional Review Board for Clinical Research (Approval No. 20209).

Keyword:

Home care, integrated care, health care cost, long-term care, aging in place

Strengths and limitations of this study

1. This was a retrospective cohort study including data on 18,347 individuals.
2. This study was designed to suggest the kind of healthcare system that will be needed in the future in aging societies by examining the associations of the type of home care provision system with end-of-life care and place of death for older adults.
3. We calculated the number of years that participants lived during the study period and estimated the annual utilization rates per person-year of observation.
4. This study was conducted using data only on residents of Fukuoka Prefecture in Japan, which limits the generalizability of our findings
5. There were no clinical data for individual participants because this study focused on the types of healthcare facilities that provide home care.

INTRODUCTION

In 2012, approximately 800 million adults—11% of the global population—were aged 65 years or older.[1] This age group is projected to reach 1.4 billion people by 2030 and to exceed 2 billion around 2050.[2] Japan is presently the world's most aged society, with adults aged 65 years and older accounting for 22.6% of the country's population in 2010, and this percentage is expected to surpass 30% in 2025.[3] Notably, the post-World War II baby-boom generation in Japan will reach the age of 75 years in 2025, imposing a heavy financial burden on the nation's social security system.[4, 5]

The present of care for the older adults in Japan

Japan's health insurance system categorizes older adults aged 65–74 years as "early-stage elderly" and those aged 75 years and older as "latter-stage elderly," and these age groups' out-of-pocket copayment rates are set at 20% and 10%, respectively.[6] The average annual medical expenditure in 2018 was 553,000 Japanese yen (US$5,247) for early-stage elderly patients and 910,000 Japanese yen (US$8,634 and this is 1.6 times higher) for latter-stage elderly patients.[7] In contrast, the average annual long-term care (LTC) expenditure was 50,000 Japanese yen (US$474) for early-stage elderly patients and 480,000 yen (US$4,554 and this is over 10 times higher) for latter-stage elderly patients.[7] Latter-stage elderly patients tend to be relatively frail and to have multiple chronic conditions that require the use of both medical and LTC services.[8, 9] To efficiently provide integrated care for these individuals, Japan has implemented the Community-based Integrated Care System (CICS), with the aim of moving away from the conventional hospital-centered healthcare delivery system toward a system that is focused on patients' residences and local facilities.[10] The CICS comprehensively provides medical care that provided at medical facilities, home care that provided at patient's own house or nursing home by medical professional and LTC services such as day care at LTC facilities or home visiting by care workers in addition to preventive care and daily living support. These services enable older adults to age in place until the end of life, even when they become increasingly care-dependent.[11] It is necessary to ensure the

availability of 24-hour, 365-day care services to monitor and manage any sudden changes in these older adults' health status.

Why is home-based end-of-life care necessary?

The percentage of deaths occurring at home in Japan exceeded 80% in 1951, with only 9% of deaths occurring at medical institutions such as hospitals.[12] This trend began to reverse in 1976, and 75.8% of deaths occurred in medical institutions in 2016,[12] despite approximately 70% of people reporting that they would prefer to spend the end of their lives at home rather than in a medical institution.[13] If the current trends continue, almost half a million people in Japan will be unable to receive end-of-life care at a medical institution in 2030, even if the number of home deaths increases by a factor of 1.5.[14] To resolve this issue, in 2006, Japan introduced Home Care-Support Clinics/Hospitals (HCSCs), which provide 24-hour home care and home-visit nursing care.[15] Furthermore, in 2012, Japan established "enhanced HCSCs," which fulfill more stringent criteria such as having three or more full-time doctors on staff and having handled at least five cases of emergency home care treatment and at least two cases of end-of-life care within the past year.[15] HCSCs that qualify for this "enhanced" designation receive higher reimbursements compared with conventional HCSCs.[15] At present, general clinics, HCSCs, and enhanced HCSCs are authorized to provide insurance-covered home care. Enhanced HCSCs are further categorized into those with beds and those without beds,[16] yielding a current total of four types of home care facilities available in Japan.

What affects the end-of-life care of older adults?

The percentage of adults aged 75 years and older in Japan is expected to reach 18.1% in 2025,[3] and optimizing community-based care systems may help to provide solutions for problems faced by aging populations in Japan and throughout the world. To improve the circumstances allowing older adults to continue living at home, it is necessary to first ascertain how different types of facilities in the current home care delivery system influence the use of medical and LTC services. Previous studies have shown that strengthening home care services has contributed to reducing

patient hospitalization.[17-24] However, it remains unclear whether specific measures to strengthen the home care delivery system, such as the introduction of HCSCs and enhanced HCSCs, have affected where older adults receive end-of-life care or their utilization of various care services.

This study examined the influence of the home care delivery system on end-of-life care in adults aged 75 years and older. We comparatively examined home-based end-of-life care utilization, deaths in medical institutions, and the use of medical and LTC services among older adults who received home care services from four different types of facilities (enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics). In this study, general clinics refer to facilities other than HCSCs that provide home medical care services. Unlike HCSCs, these facilities are not eligible for insurance claims reimbursement due to establishment status.

METHODS

Database

The study was conducted using data from a medical claims database and an LTC insurance claims database provided by the Fukuoka Prefecture Association of Latter-stage Elderly Healthcare. Medical claims included information on patient characteristics, medical treatments, disease diagnoses, and medical expenditures for all individuals who received insurance-covered care.[25] LTC insurance refers to the public insurance for older adults aged ≥65 years and adults aged ≥40 years with specific diseases. These claims include information on LTC service utilization and the corresponding expenditures for all individuals with certified care needs. Under the LTC insurance system, care needs are categorized into seven levels (support needs levels 1–2 and care needs levels 1–5), with increasing levels signifying higher degrees of dependence.[25]

The administrative claims data were de-identified by constructing specific databases using a work station with no connection to any networks.

Study Design

This retrospective cohort study used data from April 2014 to March 2017. The study participants were Fukuoka Prefecture residents aged 75 years and older with certified care needs of level 3 or higher in April 2014 who received home care services between April and June 2014. Residents who migrated to other Prefectures between April 2014 and March 2017 were excluded. The participants were divided into four groups according to the facility type providing them with home care services: Group A (enhanced HCSCs with beds), Group B (enhanced HCSCs without beds), Group C (HCSCs), and Group D (general clinics).

We conducted pooled cross-sectional study for participants who died during the 3-year study period to compare their home-based end-of-life care utilization and place of death across the four groups. The use of home-based end-of-life care was identified using claims records of additional fees specifically for these services. Place of death was categorized as medical institution for participants who were recorded as dying at a hospital or a clinic in the claims data. The medical institutional death rate was calculated as the percentage of all participants who died during the study period whose death occurred in a medical institution.

We also examined the number of days that participants received inpatient care, outpatient care, and home care across the four groups. Expenditures for inpatient care, outpatient care, home care, drug prescription and LTC services were also calculated for each group. Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = JP¥105.4).

Information was obtained on participant sex, age, care needs level, and Charlson comorbidity index (CCI) score as of April 2014.[26] Age was divided into four categories (75–79, 80–84, 85–89, and ≥90 years). The care needs levels included in our analysis were levels 3, 4, and 5 (with level 5 representing the highest level of dependence). CCI scores, which indicate the weighted number of concomitant diseases in an individual, were divided into three categories (0–2, 3–4, and ≥5).

Patient and Public Involvement

We used administrative claims data and did not involve patients in this study.

Statistical Analysis

The distributions of sex, age, care needs level, CCI, and death were examined across the four facility type groups. Additionally, inter-group differences in home-based end-of-life care utilization and institutional death among those who died during the study period were examined. One-way analysis of variance was used to compare these differences.

We constructed multivariable logistic regression models to evaluate the influence of home care facility type on home-based end-of-life care utilization and medical institutional death. In these models, the dependent variables were the use of home-based end-of-life care and death at a medical institution. The exposure of interest was the home care facility type, with Group A (enhanced HCSCs with beds) as the reference category. The covariates were sex, age, care needs level, and CCI. Odds ratios (ORs) and 95% confidence intervals were estimated.

Next, we calculated the mean annual days of inpatient care, outpatient care, and home care, as well as the mean annual expenditures for inpatient care, outpatient care, home care, drug prescription and LTC services for each facility type group. The inter-group differences were compared using analysis of variance. Each participant's service utilization was calculated over the number of years he/she lived during the study period, and annual utilization rates per person-year of observation were estimated. This method allowed the inclusion of data from participants who died during the study period, which was useful because the study population comprised individuals with an elevated mortality risk because of advanced age and high care needs.

To evaluate the influence of home care facility type on the use of medical and LTC services, we constructed generalized linear models (GMLs). Here, the dependent variables were the numbers of days of inpatient care, outpatient care, and home care, as well as the expenditures for inpatient care, outpatient care, home care, drug prescription and LTC services. The exposure of interest was the

home care facility type. The covariates were sex, age, care needs level, CCI, death, and the number of years the participant lived.

The dependent variables data were highly skewed and over-dispersed. Thus, analyzing these data using a conventional regression method might violate the data normality assumption. Furthermore, the data containing the number of days is commonly regarded as a 'count' variable, and the use of statistical techniques based on normal distribution might not be appropriate [27,28]. Many researchers have suggested the use of the generalized linear model (GLM) by assuming such data has a negative binomial or a Poisson distribution. [29,30,31]. In contrast, the use of GLM with a gamma distribution is recommended when analyzing data involving health care costs [32,33]. In our preliminary analyses, dependent variables containing the number of days were fitted in two separate models: GLM with a negative binomial distribution, and GLM with a Poisson distribution. Diagnostic statistics, however, identified GLM with a negative binomial distribution provides better estimates than the model with an assumed Poisson distribution. The results of the analysis presented in this study are therefore, based on the estimates of GLM with a negative binomial distribution with log-link function and robust standard errors, for the analyses involving the number of days. On the other hand, for the results of analyses involving care expenditure, the estimates of GLM with a gamma distribution with log-link and robust standard errors are presented.

The marginal means of the dependent variables were calculated to indicate the estimated values of numbers of care days and expenditures for the examined care services. These were calculated by substituting the mean of the estimates into GLMs with a negative binomial distribution for care days and a gamma distribution for care expenditure.

SQL Server 2014 was used to extract the data, and Stata, 14.2 was used for all analyses.

RESULTS

The participants' characteristics are summarized in table 1. The included participants were 18,347 Fukuoka Prefecture residents who used home care at any of the four facilities categorized in this

study, between April and June 2014. Participants with a care of needs lower than 3 as of April 2014 and those who emigrated to other Prefectures during the follow-up period were excluded. The participants were comprising Group A with 2,509, Group B with 825, Group C with 6,218 and Group D with 8,795 participants who had both medical claims data and an LTC insurance claims data. We observed significant inter-group differences in sex (P=0.002), age (P<0.001), and CCI (P<0.008). However, there were no significant differences in care needs level (P=0.816) or death (P<0.669). Groups A and B tended to have higher CCI scores and older ages than did Groups C and D. During the 3-year study period, 54% of the participants died; Group A had the highest percentage of deaths (59.9%). Among the participants who died, there were significant inter-group differences in home-based end-of-life care utilization and in medical institutional death. Group A had the highest home-based end-of-life care utilization rate (57.4%) and the lowest rate of medical institutional death (25.6%). The home-based end-of-life care utilization rate in Group A, was followed (in order) by Groups B, C, and D, but this order was reversed for the rate of medical institutional death.

Table 2 shows the multivariate logistic regression analysis results for the associations of home care facility type with home-based end-of-life care utilization and medical institutional death among the participants who died during the study period. Relative to Group A, Group D had the lowest odds of using home-based end-of-life care (OR=0.13; P<0.001) and the highest odds of institutional death (OR=2.32; P<0.001).

The distribution of medical and LTC service utilization per person-year across the groups is shown in table 3. The mean total number of care days used by the participants was similar across the four groups. However, there were significant inter-group differences when the number of days was categorized into inpatient care, outpatient care, and home care. The mean annual number of inpatient care days was highest in Group D (34.0 days), followed by Group B (33.0 days), Group C (29.6 days), and Group A (26.6 days). The mean annual number of outpatient care days was also highest in Group D (18.5 days), followed by Group A (10.1 days), Group C (9.8 days), and Group B (8.5 days). The mean annual number of home care days was highest in Group A (31.1 days),

followed by Group C (27.2 days), Group B (24.9 days), and Group D (13.3 days). The mean annual inpatient care expenditure was highest in Group B (US$9,822.8) and lowest in Group A (US$7,661.7). The mean annual outpatient care expenditure was highest in Group D (US$1,109.3) and lowest in Group C (US$675.2). The mean annual home care expenditure was highest in Group A (US$6,122.2) and lowest in Group D (US$1,627.7). The mean annual prescription expenditure was highest in Group A (US$2,393.7) and lowest in Group D (US$1,722.2). The mean annual LTC expenditure was highest in Group A (US$30,252.7) and lowest in Group D (US$26,688.6).

Table 4 shows the marginal means estimated from the GLMs evaluating the associations of home care facility type with medical and LTC service utilization. The number of inpatient care days was highest in Group D (75.0 days), followed by Group B (69.9 days), Group C (64.7 days), and Group A (54.3 days). The number of outpatient care days was also highest in Group D (40.2 days), followed by Group C (21.2 days), Group A (21.1 days), and Group B (17.1 days). In contrast, the number of home care days was highest in Group A (63.8 days), followed by Group C (57.8 days), Group B (51.0 days), and Group D (29.0 days). Inpatient care expenditure was highest in Group B (US$20,767.7), followed by Group D (US$20,413.7), Group C (US$17,606.3), and Group A (US$15,523.3). Outpatient care expenditure was highest in Group D (US$2,332.9), followed by Group A (US$1,522.8), Group C (US$1,500.6), and Group B (US$1,455.8). Home care expenditure was highest in Group A (US$12,747.4), followed by Group B (US$10,790.1), Group C (US$9,551.4), and Group D (US$3,440.9). Prescription expenditure was highest in Group A (US$5,183.1), followed by Group C (US$4,766.9), Group B (US$4,753.0), and Group D (US$3,715.1). LTC expenditure was highest in Group A (US$64,192.7), followed by Group C (US$64,147.1), Group B (US$62,003.3), and Group D (US$58,186.0). The results of the marginal means are also presented visually in figures 1 and 2.

DISCUSSION

In this retrospective study of older adult home care service users with high care needs levels residing

in Fukuoka Prefecture, we compared the utilization of medical and LTC services among patients treated by four types of home care facilities. Participants who used enhanced HCSCs with beds had the highest number of home care days and the lowest number of inpatient care days per person-year. In contrast, participants who used general clinics had the lowest number of home care days and the highest number of inpatient and outpatient care days per person-year. These results corroborate previous findings showering that the integration of home care into community care by specialized clinics is effective in reducing hospitalization duration among older adults.[20, 34]

A novel finding of the present study is that participants who used home care services from enhanced HCSCs with beds were the most likely to receive end-of-life care at home and the least likely to die in a medical institution. Specifically, the odds of institutional death were 2.32 times higher for participants who used general clinics than for those who used enhanced HCSCs with beds, indicating that treatment by the latter type of facility is associated with a reduction in medical institutional deaths. The Ministry of Health, Labour and Welfare of Japan reported that the national medical institutional death rate in 2016 was 75.8%,[35] which was substantially higher than the corresponding rate observed among the patients in our study (36.6%) and even among the general clinic user group alone (44.3%). This suggests that older adults who use home care services are more likely to die outside of medical institutions, in places such as their homes or an LTC facility. Promoting the use of home care could, therefore, help to reduce the medical institutional death rate, as has also been demonstrated in a previous study.[36] Similarly, Sadamura and Babazono examined the correlation between LTC resources and place of death, finding that collaborations among clinics to provide home-based medical and LTC services reduced medical institutional deaths.[37] This form of integrated care may be effective in providing home-based end-of-life care for older adults.

It is noteworthy that participants who used enhanced HCSCs with beds had a substantially lower number of inpatient care days and expenditures but a higher number of home care days and expenditures, compared with participants who used enhanced HCSCs without beds. This suggests

that the presence of beds in enhanced HCSCs affected the use of care, despite HCSCs with and without beds being otherwise functionally identical. This suggests that enhanced HCSCs with beds are more likely identified as hospitals rather than privately owned clinics, that are focused on providing home care despite having an abundance of health care resoures for providing inpatient care. Another notable result is that conventional HCSCs appeared to be more effective in providing home care, compared with enhanced HCSCs without beds in terms of the metrics of inpatient care, home care days, and home care expenditures. These findings indicate a need to review the current insurance system, which reimburses enhanced HCSCs without beds at a higher rate for the same services, compared with conventional HCSCs.[15] In our study population, the users of enhanced HCSCs with beds had a higher utilization of home-based end-of-life care and a lower utilization of inpatient care, despite having relatively high care needs levels. Among the home care facility types, those that are well equipped to manage sudden changes in their patients' conditions may be able to provide high-quality home-based daily living support and reduce the length of hospitalization. A point of concern is that there was no significant difference in the number of inpatient care days between general clinics and enhanced HCSCs without beds. The prerequisites for receiving enhanced HCSC status may be met by a home care facility through collaboration with other clinics.[15] Therefore, it is possible that some of the enhanced HCSCs without beds were not individual facilities but instead comprised two or more clinics collaborating to satisfy the relevant criteria. Consequently, decisions on treatment strategies (such as hospitalization) at these facilities may involve doctors working at several facilities rather than only one facility. Bynum et al. examined the effects of different types of primary care on hospitalizations in a continuing care retirement community, finding that individuals with 24-hour primary care availability from physicians providing care only at that site had significantly fewer hospitalizations and emergency department visits than did those who were served by external non-site-specific doctors.[34] This suggests that the decentralization of healthcare provision may be reduced when one facility is in charge of providing primary care for older adults living in a community, which can improve the quality of care and reduce the number of hospitalizations and overall

healthcare utilization rates. On the basis of our findings and those from previous studies, we propose that the home care delivery system in Japan to encourage the development of "enhanced" status to clinics with beds. Under Japan's current medical fee schedule, there are no differences in home care fees between enhanced facilities operating independently and those working in collaboration with other facilities. To expand the role of enhanced HCSCs, when examining the differences among HCSCs, it is necessary to consider whether the facility works in collaboration with other clinics in addition to considering whether the facility has beds.

This study has several limitations. First, the study was conducted using data only on Fukuoka Prefecture residents, which limits the generalizability of our findings.[38] This prefecture has a relatively high number of hospital beds and relatively high medical expenditures per person, and this study's results therefore may be overestimated. Second, our data did not include detailed information about living conditions reflecting the participants' family structure or characteristics of living, which may influence the choice of a home care facility. Third, although the statistical analyses incorporated characteristics such as sex, age, care needs level, and CCI, the specific diseases of each participant were not taken into consideration. Fourth, no clinical data (e.g., disease progression or laboratory test results) for individual participants were included because this study focused on the types of healthcare facilities providing home care. Moreover, the issue related to the possibility of participants who moved from home to a long-term care facility such as a nursing home during the follow-up period was not addressed. Finally, we used care needs level as a covariate, but we were unable to account for any changes in this level over the study period. Nevertheless, considering the care needs level and CCI at the start of the study provided insight into the participants' baseline disease severity.

In this study, we showed the difference of home care system in Japan's CICS on the use of medical and LTC services, the use of home-based end-of-life care, and the place of death among older community-dwelling adults. We also confirmed the important role of enhanced HCSCs with beds in providing home care services. Currently, there are 7,629 clinics with beds in Japan, and approximately 100,000 beds are available. Of these beds, 46% are used for emergency care and

37% provide transitional care for hospital-discharged patients before they are transferred to home or to an LTC facility.[39] Approximately 60% of the patients occupying the available beds are aged 75 years and older.[39] To optimize the provision of home care through a community-based care system, it is necessary to consider functional changes in clinics with beds. The promotion of integrated community care is regarded as a viable solution for aging societies in many countries. To support the increasing need for community care, the World Health Organization published *Integrated Care for Older People: Guidelines on Community-level Interventions to Manage Declines in Intrinsic Capacity* in 2017.[40] These guidelines, which emphasize the need for comprehensive community-based strategies and primary care-level interventions to prevent diminishing capacity, are consistent with our study's conclusion that HCSCs with beds play an integral role in Japan, as the main healthcare facilities providing home care. As part of its national policy, Japan is considering a further expansion of the CICS. This expansion would involve the construction of a large system by coordinating the resources of acute care hospitals, rehabilitation hospitals, LTC facilities, clinics with beds, primary healthcare clinics, and comprehensive support centers within each region of the country. Consequently, there would be a need to clarify each facility's role in this expanded system. Our study provides useful information for further investigations of home care for older adults as part of community-based integrated care.

Acknowledgements The authors thank the Fukuoka Prefecture Association of Latter-Stage Elderly Healthcare for provision of the healthcare claims database. We also thank Jennifer Barrett, PhD, from Edanz Group (https://en-author-services.edanzgroup.com/ac) for editing a draft of this manuscript.

Contributors SK lead the study design, conducted the literature search, extracted and analyzed the data, and wrote the manuscript. AB contributed to the study design, analysis and manuscript revision. AJ, YL and LN contributed to the study design and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Institutional Review Board of Kyushu University (Clinical Bioethics Committee of the Graduate School of Healthcare Sciences, Kyushu University). (Approval No. 20209).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

Open access

REFERENCES

1. Hope P, Bamford SM, Beales S, et al. Creating sustainable health and care system in ageing societies. Report of the Ageing Societies Working Group 2012. The Global Health Policy Summit; 2012.
2. United Nations. World population ageing 2015. New Work: United Nations, Department of Economic and Social Affairs Population Division. 2015;ST/ESA/SER.A/390.
3. Cabinet Office. Heisei29nenban Koureishakai Hakusho. Koreikano jyoukyo (Annual Report on the Aging Society in 2017. The aging situation). https://www8.cao.go.jp/kourei/whitepaper/w-2017/zenbun/pdf/1s1s_01.pdf (Accessed May 20, 2020).
4. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age and Ageing. 2006;35 Suppl 2:ii37-ii41.
5. National Institute of Population and Social Security Research. Nihonno Shouraisuikei jinkou -Heisei29nen Suikei (The future population estimates in 2017). http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_gaiyou.pdf (Accessed May 20, 2020).
6. Ministry of Health, Labour and Welfare. Wagakunino Kokuminminahoken Seido (The overview of Medical insurance system for elderly). 2006. https://www.mhlw.go.jp/content/12400000/000377686.pdf (Accessed May 20, 2020).
7. Ministry of Finance. Shakaihoshouni tsuite (About Social Security). 2018. https://www.mof.go.jp/about_mof/councils/fiscal_system_council/sub-of_fiscal_system/proceedings/material/zaiseia301009/01.pdf (Accessed May 20, 2020).
8. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011;10(4):430-9.
9. World Health Organization. Global status report on noncommunicable diseases 2014. World Health Organization Geneva. 2014.
10. Ministry of Health, Labour and Welfare. 2015nenno Koureisha Kaigo -Koureishano Sonchouwo

Sasaeru Keano Kakuritsuni Mukete (Elderly Care in 2015 -Toward the Establishment of Care to Support the Dignity of Elderly Persons-). 2003. https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/3.html (Accessed May 20, 2020).

11. Ministry of Health, Labour and Welfare. Chiikihoukatsukea Kenkyukai Houkokusho (The study report of community-based integrated care systems).2019. https://www.mhlw.go.jp/houdou/2009/05/dl/ h0522-1.pdf (Accessed May 20, 2020).
12. Ministry of Health, Labour and Welfare. Jaitakuiryouno Genjyou (Consciousness survey of end-of-life care). 2016. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000129546.pdf. (Accessed May 20, 2020).
13. Ministry of Health, Labour and Welfare. Jinseino Saishudankaino Iryouniokeru Kouseiroudoshono Torikumi (Ministry of Health, Labor and Welfare's efforts in medical care at the end-of life). 2017. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000200749.pdf. (Accessed May 20, 2020).
14. Miura H. Homecare for the Elderly. The Japan Geriatrics Society. 2013;50:164-7.
15. Ohta H. Current conditions and issues for home care support clinics. Japan Medical Association Journal. 2015;58:6-9.
16. Ministry of Health, Labour and Welfare. Zaitakuiryono Kouchikunitsuite (The construction of home medical care system).2018. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000170234.pdf (Accessed May 20, 2020).
17. Johri M, Beland F, Bergman H. International experiments in integrated care for the elderly: a synthesis of the evidence. Int J Geriatric Psychiatry. 2003;18(3):222-35.
18. Eklund K, Wilhelmson K. Outcomes of coordinated and integrated interventions targeting frail elderly people: a systematic review of randomised controlled trials. Health Soc Care Community.

2009;17(5):447-58.

19. Stewart MJ, Georgiou A, Westbrook JI. Successful integrating aged care services: a review of the evidence and tools emerging from a long-term care program. International journal of integrated care. 2013;13(1).
20. Rosenberg T. Acute hospital use, nursing home placement, and mortality in a frail community-dwelling cohort managed with Primary Integrated Interdisciplinary Elder Care at Home. J Am Geriatr Soc. 2012;60(7):1340-6.
21. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. BMJ Open. 2016;6(11):e011952.
22. Di Pollina L, Guessous I, Petoud V, et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. BMC Geriatr. 2017;17(1):53.
23. Ellis G, Whitehead MA, Robinson D, et al. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. BMJ. 2011;343:d6553.
24. Baxter S, Johnson M, Chambers D, et al. The effects of integrated care: a systematic review of UK and international evidence. BMC Health Serv Res. 2018;18(1):350.
25. Olivares-Tirado P, Tamiya N. Trends and Factors in Japan's Long-Term Care Insurance System: Japan's 10-year Experience. Springer. 2014.
26. D'Hoore W, Sicotte C, Tilquin C. Risk Adjustment in Outcome Assessment: the Charlson Comorbidity Index. Methods Inf Med. 1993;32(05):382-387.
27. Agresti, A. (2001) Categorical Data Analysis (2nd ed). New York: Wiley.
28. Long, S. J. & Freese, J. (2001) Regression Models for Categorical Dependent Variables using Stata. College Station, TX: Stata Press.
29. Austin PC, Rothwell DM, Tu JV. A comparison of statistical modeling strategies for analyzing length of stay after CABG surgery. Health Services & Outcomes Research Methodology. 2002,

3: 107-133.

30. Carter EM, Potts HW. Predicting length of stay from an electronic patient record system: a primary total knee replacement example. BMC Med Inform Decis Mak. 2014;14:26. Published 2014 Apr 4. doi:10.1186/1472-6947-14-26.
31. Marazzi A, Paccaud F, Ruffieux C, et al. Fitting the distributions of length of stay by parametric models. Medical care. 1998;36(6):915–27.
32. Mihaylova B, Briggs A, O'Hagan A, et al. Review of statistical methods for analysing healthcare resources and costs. Health Econ. 2011;20:897–916.
33. Dodd S, Bassi A, Bodger K, et al. A comparison of multivariable regression models to analyse cost data. J Eval Clin Pract. 2006;12:76–86.
34. Bynum J, Andrews A, Sharp S, et al. Fewer hospitalizations result when primary care is highly integrated into a continuing care retirement community. Health Affairs. 2011;30(5):975-84.
35. Ministry of Health, Labour and Welfare. Heisei28nen Jinkoudoutaitoukeino Gaikyou (Vital Statistics of Japan in 2016). https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei16/index.html (Accessed May 20, 2020).
36. Kishida K, Tanigaki S. Jaitakushienshinryoujyoniyoru Mitorikazuni Eikyousuru Chiikitokusei (Regional characteristics that affect the number of end-of-life care provided by home care support clinics). Journal of health and welfare statistics. 2011;58:27-30.
37. Sadamura M, Babazono A. Kaigohokenseidouniyoru Kaigoshigenno Shihyouto siboubashotono Kanren (Relationship between long-term Care resource indicators by long-term Care insurance system and place of death. Journal of health and welfare statistics). 2005;52:8-14.
38. Ministry of Health, Labour and Welfare. Iryouhino Chiikisa Bunseki (Regional difference analysis of medical expenses). 2017. https://www.mhlw.go.jp/content/iryohi_h29.pdf (Accessed May 20, 2020).
39. Ministry of Health, Labour and Welfare. Dai55kai Shakaihoshousingikai Iryoubukai: Yushoushinryoujyono Genjyouto Kadai (55th Social Security Council Medical Section: Current

status and issues of clinics with beds). 2017. https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000184304.pdf (Accessed May 20, 2020).

40. World Health Organization. Integrated care for older people guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization Geneva; 2017.

Table 1. Participant characteristics by home care facility type

	Total	Group A	Group B	Group C	Group D	*P* value
Number of participants	18,347	2,509 (13.7)	825 (4.5)	6,218 (33.9)	8,795 (47.9)	
Sex						
Men (%)	4,709 (25.7)	645 (25.7)	204 (24.7)	1,473 (23.7)	2,387 (27.1)	0.002
Women (%)	13,638 (74.3)	1,864 (74.3)	621 (75.3)	4,745 (76.3)	6,408 (72.9)	
Age						
Mean [SD]	87.5 [6.2]	87.8 [6.1]	88.1 [6.1]	87.7 [6.1]	87.1 [6.3]	
75–79 (%)	2,051 (11.2)	226 (9.0)	70 (8.5)	605 (9.7)	1,150 (13.1)	
80–84 (%)	4,035 (22.0)	542 (21.6)	167 (20.2)	1,388 (22.3)	1,938 (22.0)	<0.001
85–89 (%)	5,394 (29.4)	746 (29.7)	258 (31.3)	1,876 (30.2)	2,514 (28.6)	
≥90 (%)	6,867 (37.4)	955 (39.7)	330 (40.0)	2,349 (37.8)	3,193 (36.3)	
Care needs levels						
Level 3 (%)	5,081 (27.7)	582 (23.2)	227 (27.5)	1,739 (28.0)	2,533 (28.8)	
Level 4 (%)	6,804 (37.1)	882 (35.2)	281 (34.1)	2,341 (37.6)	3,300 (37.5)	0.816
Level 5 (%)	6,462 (35.2)	1,045 (41.6)	317 (38.4)	2,138 (34.4)	2,962 (33.7)	
Charlson comorbidity index						
0–2 (%)	4,115 (22.4)	507 (20.2)	144 (17.4)	1,331 (21.4)	2,133 (24.2)	
3–4 (%)	6,629 (36.1)	873 (34.8)	295 (35.8)	2,385 (38.4)	3,076 (35.0)	0.008
≥5 (%)	7,603 (41.5)	1,129 (45.0)	386 (46.8)	2,502 (40.2)	3,586 (40.8)	
Death						
Yes (%)	9,919 (54.1)	1,502 (59.9)	471 (57.1)	3,271 (52.6)	4,675 (53.2)	0.699
No (%)	8,428 (45.9)	1,007 (40.1)	354 (42.9)	2,947 (47.4)	4,120 (46.8)	
Number of deaths	9,919	1,502 (15.1)	471 (4.8)	3,271 (33.0)	4,675 (47.1)	
Home-based end-of-life care						
Yes (%)	3,103 (31.3)	862 (57.4)	220 (46.7)	1,285 (39.3)	736 (15.7)	<0.001
No (%)	6,816 (68.7)	640 (42.6)	251 (53.3)	1,986 (60.7)	3,939 (84.3)	
Medical Institutional death						
Yes (%)	3.633 (36.6)	384 (25.6)	137 (29.1)	1,039 (31.8)	2,073 (44.3)	<0.001
No (%)	6,286 (63.4)	1,118 (74.4)	334 (70.9)	2,232 (68.2)	2,602 (55.7)	

NOTES: Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics. "Number of deaths" refers to participants who died during the study period.

Table 2. Associations of home care facility type with home-based end-of-life care utilization and medical institutional death

	Home-based end-of-life care		Medical Institutional death	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Home care facility type				
Group A	Reference			
Group B	0.66 (0.53–0.82)	<0.001	1.17 (0.93–1.47)	0.19
Group C	0.47 (0.41–0.54)	<0.001	1.35 (1.18–1.56)	<0.001
Group D	0.13 (0.11–0.15)	<0.001	2.32 (2.03–2.65)	<0.001
Sex				
Men	Reference			
Women	1.36 (1.22–1.51)	<0.001	0.75 (0.68–0.82)	<0.001
Age				
75–79 (%)	Reference			
80–84 (%)	1.11 (0.89–1.38)	0.34	1.05 (0.88–1.25)	0.58
85–89 (%)	1.34 (1.09–1.65)	<0.001	0.95 (0.81–1.13)	0.58
≥90 (%)	1.96 (1.61–2.39)	<0.001	0.74 (0.63–0.87)	<0.001
Care needs levels				
Level 3 (%)	Reference			
Level 4 (%)	1.31 (1.15-1.49)	<0.001	0.88 (0.79–0.98)	0.02
Level 5 (%)	1.94 (1.71–2.20)	<0.001	0.71 (0.63–0.79)	<0.001
Charlson comorbidity index				
0–2 (%)	Reference			
3–4 (%)	0.74 (0.65–0.84)	<0.001	1.25 (1.10–1.41)	<0.001
≥5 (%)	0.57 (0.50–0.64)	<0.001	1.51 (1.35–1.70)	<0.001

NOTES: This table shows the results of multivariate logistic regression analyses that adjusted for the following covariates: sex, age, care needs level, and Charlson comorbidity index. The dependent variables were home-based end-of-life care utilization and medical institutional death. The exposure of interest was the home care facility type, with Group A as the reference category. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 3. Medical and long-term care utilization and expenditure per person-year by home care facility type

	Group A	Group B	Group C	Group D	*P* value
Person-year	4955.1	1703.5	13667.8	18564.3	
Mean [SD]	2.0 [1.1]	2.1 [1.1]	2.2 [1.0]	2.1 [1.0]	
Rate per person-year					
Care days					
Inpatient care	26.6	33.0	29.6	34.0	<0.001
Outpatient care	10.1	8.5	9.8	18.5	<0.001
Home care	31.1	24.9	27.2	13.3	<0.001
Care expenditure					
Inpatient care	7661.7	9822.8	8024.9	9382.9	<0.001
Outpatient care	709.0	696.2	675.2	1109.3	<0.001
Home care	6122.2	5172.5	4365.2	1627.7	<0.001
Prescription	2393.7	2157.0	2151.9	1722.2	<0.001
Long-term care	30252.7	29153.8	29457.1	26688.6	<0.001

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The values were calculated over the number of years each participant lived during the study period and are reported here as the annual rates per person-year of observation. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 4. Comparison of medical and long-term care utilization and expenditure by home care facility type

	Care days			Care expenditure				
	Inpatient	Outpatient	Home care	Inpatient	Outpatient	Home care	Prescription	Long-term care
Home care facility type								
Group A	54.3	21.1	63.8	15523.3	1522.8	12747.4	5183.1	64192.7
Group B	69.9	17.1	51.0	20767.7	1455.8	10790.1	4753.0	62003.3
Group C	64.7	21.2	57.8	17606.3	1500.6	9551.4	4766.9	64147.1
Group D	75.0	40.2	29.0	20413.7	2332.9	3440.9	3715.1	58186.0
Sex								
Men	77.6	30.8	44.6	21639.5	2143.2	7867.3	4542.4	57792.6
Women	64.9	29.9	44.7	17681.4	1811.9	6885.3	4238.6	62216.6
Age								
75–79	86.4	34.1	42.0	24272.6	2800.2	8101.9	5316.7	56446.0
80–84	76.2	32.2	43.3	21405.5	2271.6	7308.3	4789.7	60468.6
85–89	67.3	30.3	45.7	18527.4	1838.7	6957.2	4292.0	62223.8
≥90	58.3	26.9	45.6	15569.4	1326.0	6805.5	3598.5	62691.4
Care needs levels								
Level 3	64.2	30.7	41.0	18907.6	2161.7	6706.5	4518.9	53625.4
Level 4	68.7	31.5	43.4	18701.5	2023.9	6622.3	4238.5	60912.2
Level 5	71.6	28.0	49.2	18829.2	1516.9	8029.8	4202.8	68709.6
Charlson comorbidity index								
0–2	49.2	28.5	41.3	12987.0	1351.7	5854.5	3405.7	62673.7
3–4	65.0	29.6	44.4	17513.9	1648.3	6610.3	4109.3	62362.6
≥5	81.0	31.5	46.8	22791.9	2418.9	8247.3	5001.0	59337.2
Death								
No	42.8	25.7	40.3	12031.3	1607.1	6180.9	3766.4	54020.8
Yes	124.9	40.8	53.4	32308.4	2684.7	8988.1	5831.8	81395.7

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The table shows the results (marginal means) of generalized linear models assuming a negative binomial distribution for care days and a gamma distribution for care expenditure.

Analyzed, dependent variables include: inpatient care days, outpatient care days, home care days, inpatient care expenditures, outpatient care expenditures, home care expenditures, prescription expenditures, and long-term care expenditures. The exposure of interest was the homecare facility type. The models adjusted for the following covariates: sex, age, care needs level, Charlson comorbidity index, death, and the number of years the participants lived during the study period. The marginal means of the dependent variables were calculated by substituting the means of the estimates into the generalized linear regression models. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of

enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

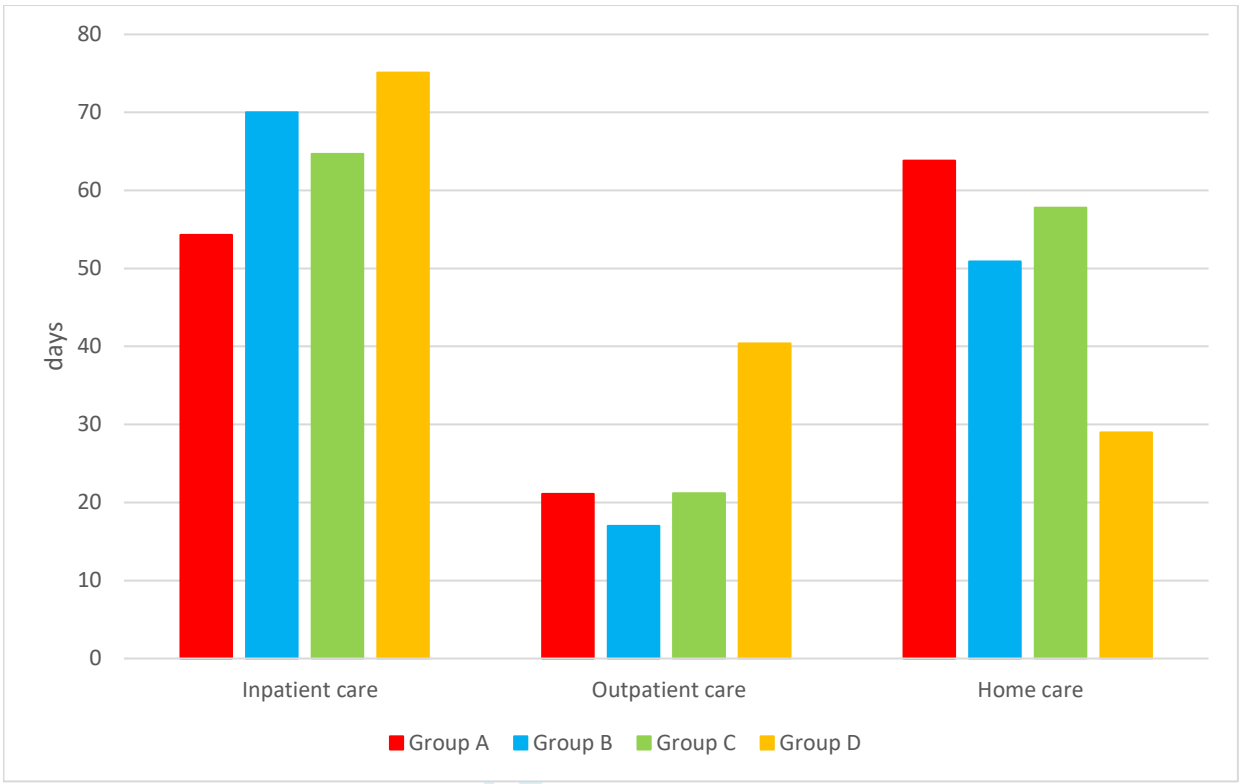
Figure legends

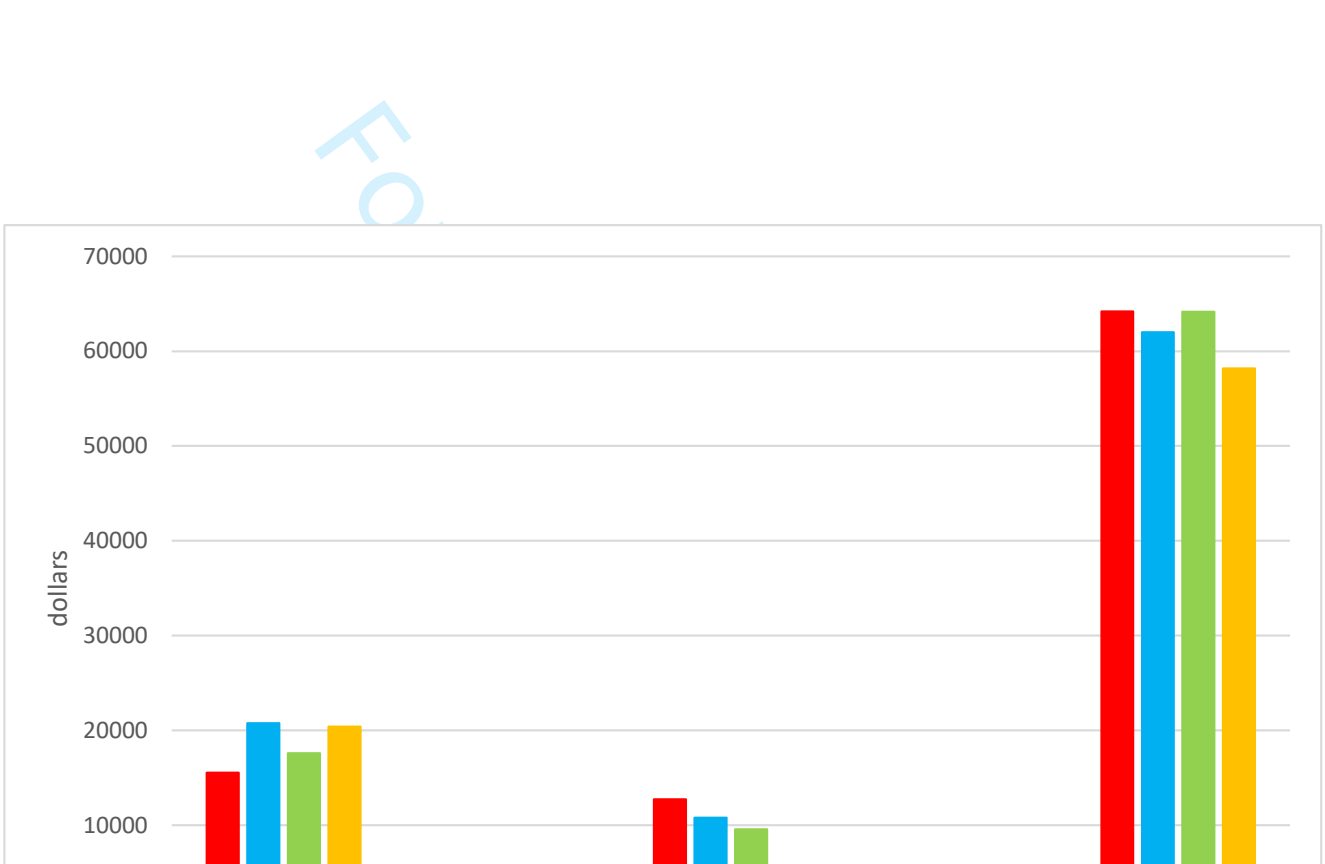
Image1: Figure1

The title is “Comparison of medical utilization using marginal means by home care facility type”. This shows the care days by home care facility, which is the result of Table 4.

Image2: Figure2

The title is “Comparison of medical and long-term care expenditures using marginal means by home care facility type”. This shows the care expenditures by home care facility, which is the result of Table 4.

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Inpatient care
Outpatient care
Home care
Prescription
Long-term care
Group A
Group B
Group C
Group D

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4, 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6, 7 (Database, Study Design)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6, 7 (Database, Study Design)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6, 7 (Database, Study Design)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8, 9 (Statistical Analysis)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8, 9 (Statistical Analysis)
Bias	9	Describe any efforts to address potential sources of bias	8, 9 (Statistical Analysis)
Study size	10	Explain how the study size was arrived at	6-7 (Study Design)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8, 9 (Statistical Analysis)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8, 9 (Statistical Analysis)
		(*b*) Describe any methods used to examine subgroups and interactions	8, 9 (Statistical Analysis)

		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-10 (Results)
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7 (Database, Study Design) Table 1
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	9
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2, Table 3, and Table 4
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12, 13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12, 13, 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2020-041964.R3
Article Type:	Original research
Date Submitted by the Author:	30-Mar-2021
Complete List of Authors:	Kim, Sung-A; Kyushu University, Graduate School of Medical Sciences, Department of Health Care Administration and Management Babazono, Akira; Kyushu University, Graduate School of Medical Sciences, Department of Health Care Administration and Management Jamal, Aziz; Kyushu University, Graduate School of Medical Sciences, Department of Health Care Administration and Management; Universiti Teknologi MARA, International Business & Management Li, Yunfei; Kyushu University, Graduate School of Medical Sciences, Department of Health Care Administration and Management Liu, Ning; University of Occupational and Environmental Health Japan, Preventive Medicine and Community Health
Primary Subject Heading:	Health policy
Secondary Subject Heading:	Health economics, Health services research
Keywords:	HEALTH SERVICES ADMINISTRATION & MANAGEMENT, HEALTH ECONOMICS, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Title:

Comparison of Care Utilization and Medical Institutional Death among Older Adults by Home Care Facility Type: A Retrospective Cohort Study in Fukuoka, Japan

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Words counts: Main text 4,485 words, 4 exhibits and 2 figures; Abstract 294 words

Abstract

Objectives: We compared the care services use and medical institutional deaths among older adults across four home care facility types.

Design: This was a retrospective cohort study.

Setting: We used administrative claims data from April 2014 to March 2017.

Participants: We included 18,347 residents of Fukuoka Prefecture, Japan, who received home care during the period, and aged ≥75 years with certified care needs of at least level 3. Participants were categorized based on home care facility use (i.e., general clinics, Home Care Support Clinics/Hospitals (HCSCs), enhanced HCSCs with beds, and enhanced HCSCs without beds).

Primary and secondary outcome measures: We used generalized linear models to estimate care utilization and the incidence of medical institutional death, as well as the potential influence of sex, age, care needs level, and Charlson comorbidity index as risk factors.

Results: The results of generalized linear models showed the inpatient days were 54.3, 69.9, 64.7, and 75.0 for users of enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics, respectively. Correspondingly, the numbers of home care days were 63.8, 51.0, 57.8, and 29.0. Our multivariable logistic regression model estimated medical institutional death rate among participants who died during the study period (n = 9919) was 2.32 times higher (P<0.001) for general clinic users than enhanced HCSCs with beds users (relative risks=1.69, P<0.001).

Conclusions: Participants who used enhanced HCSCs with beds had a relatively low inpatient utilization, medical institutional deaths, and a high utilization of home care and home-based end-of-life care. Findings suggest enhanced HCSCs with beds could reduce hospitalization days and medical institutional deaths. Our study warrants further investigations of home care as part of community-based integrated care.

Trial registration: This study was approved by the Kyushu University Institutional Review Board for Clinical Research (Approval No. 20209).

Keyword:

Home care, integrated care, health care cost, long-term care, aging in place

Strengths and limitations of this study

1. This was a retrospective cohort study including data on 18,347 individuals.
2. This study was designed to suggest the kind of healthcare system that will be needed in the future in aging societies by examining the associations of the type of home care provision system with end-of-life care and place of death for older adults.
3. We calculated the number of years that participants lived during the study period and estimated the annual utilization rates per person-year of observation.
4. This study was conducted using data only on residents of Fukuoka Prefecture in Japan, which limits the generalizability of our findings
5. There were no clinical data for individual participants because this study focused on the types of healthcare facilities that provide home care.

INTRODUCTION

In 2012, approximately 800 million adults—11% of the global population—were aged 65 years or older.[1] This age group is projected to reach 1.4 billion people by 2030 and to exceed 2 billion around 2050.[2] Japan is presently the world's most aged society, with adults aged 65 years and older accounting for 22.6% of the country's population in 2010, and this percentage is expected to surpass 30% in 2025.[3] Notably, the post-World War II baby-boom generation in Japan will reach the age of 75 years in 2025, imposing a heavy financial burden on the nation's social security system.[4, 5]

The present of care for the older adults in Japan

Japan's health insurance system categorizes older adults aged 65–74 years as "early-stage elderly" and those aged 75 years and older as "latter-stage elderly," and these age groups' out-of-pocket copayment rates are set at 20% and 10%, respectively.[6] The average annual medical expenditure in 2018 was 553,000 Japanese yen (US$5,247) for early-stage elderly patients and 910,000 Japanese yen (US$8,634 and this is 1.6 times higher) for latter-stage elderly patients.[7] In contrast, the average annual long-term care (LTC) expenditure was 50,000 Japanese yen (US$474) for early-stage elderly patients and 480,000 yen (US$4,554 and this is over 10 times higher) for latter-stage elderly patients.[7] Latter-stage elderly patients tend to be relatively frail and to have multiple chronic conditions that require the use of both medical and LTC services.[8, 9] To efficiently provide integrated care for these individuals, Japan has implemented the Community-based Integrated Care System (CICS), with the aim of moving away from the conventional hospital-centered healthcare delivery system toward a system that is focused on patients' residences and local facilities.[10] The CICS comprehensively provides medical care that provided at medical facilities, home care that provided at patient's own house or nursing home by medical professional and LTC services such as day care at LTC facilities or home visiting by care workers in addition to preventive care and daily living support. These services enable older adults to age in place until the end of life, even when they become increasingly care-dependent.[11] It is necessary to ensure the

availability of 24-hour, 365-day care services to monitor and manage any sudden changes in these older adults' health status.

Why is home-based end-of-life care necessary?

The percentage of deaths occurring at home in Japan exceeded 80% in 1951, with only 9% of deaths occurring at medical institutions such as hospitals.[12] This trend began to reverse in 1976, and 75.8% of deaths occurred in medical institutions in 2016,[12] despite approximately 70% of people reporting that they would prefer to spend the end of their lives at home rather than in a medical institution.[13] If the current trends continue, almost half a million people in Japan will be unable to receive end-of-life care at a medical institution in 2030, even if the number of home deaths increases by a factor of 1.5.[14] To resolve this issue, in 2006, Japan introduced Home Care-Support Clinics/Hospitals (HCSCs), which provide 24-hour home care and home-visit nursing care.[15] Furthermore, in 2012, Japan established "enhanced HCSCs," which fulfill more stringent criteria such as having three or more full-time doctors on staff and having handled at least five cases of emergency home care treatment and at least two cases of end-of-life care within the past year.[15] HCSCs that qualify for this "enhanced" designation receive higher reimbursements compared with conventional HCSCs.[15] At present, general clinics, HCSCs, and enhanced HCSCs are authorized to provide insurance-covered home care. Enhanced HCSCs are further categorized into those with beds and those without beds,[16] yielding a current total of four types of home care facilities available in Japan.

What affects the end-of-life care of older adults?

The percentage of adults aged 75 years and older in Japan is expected to reach 18.1% in 2025,[3] and optimizing community-based care systems may help to provide solutions for problems faced by aging populations in Japan and throughout the world. To improve the circumstances allowing older adults to continue living at home, it is necessary to first ascertain how different types of facilities in the current home care delivery system influence the use of medical and LTC services. Previous studies have shown that strengthening home care services has contributed to reducing

patient hospitalization.[17-24] However, it remains unclear whether specific measures to strengthen the home care delivery system, such as the introduction of HCSCs and enhanced HCSCs, have affected where older adults receive end-of-life care or their utilization of various care services.

This study examined the influence of the home care delivery system on end-of-life care in adults aged 75 years and older. We comparatively examined home-based end-of-life care utilization, deaths in medical institutions, and the use of medical and LTC services among older adults who received home care services from four different types of facilities (enhanced HCSCs with beds, enhanced HCSCs without beds, HCSCs, and general clinics).

METHODS

Database

The study was conducted using data from a medical claims database and an LTC insurance claims database provided by the Fukuoka Prefecture Association of Latter-stage Elderly Healthcare. Medical claims included information on patient characteristics, medical treatments, disease diagnoses, and medical expenditures for all individuals who received insurance-covered care.[25] LTC insurance refers to the public insurance for older adults aged ≥65 years and adults aged ≥40 years with specific diseases. These claims include information on LTC service utilization and the corresponding expenditures for all individuals with certified care needs. Under the LTC insurance system, care needs are categorized into seven levels (support needs levels 1–2 and care needs levels 1–5), with increasing levels signifying higher degrees of dependence.[25]

The administrative claims data were de-identified by constructing specific databases using a work station with no connection to any networks.

Study Design

This retrospective cohort study used data from April 2014 to March 2017. As of April 2014, the Fukuoka Prefecture Latter-stage Elderly Healthcare Association has 574,202 beneficiaries aged 75

and over.[26] The study participants were Fukuoka Prefecture residents aged 75 years and older with certified care needs of level 3 or higher in April 2014 who received home care services between April and June 2014. Residents who migrated to other Prefectures between April 2014 and March 2017 were excluded. Figure 1 shows the flow diagram to select participants. The participants were divided into four groups according to the facility type providing them with home care services: Group A (enhanced HCSCs with beds), Group B (enhanced HCSCs without beds), Group C (HCSCs), and Group D (general clinics). In this study, general clinics refer to facilities other than HCSCs that provide home medical care services. Unlike HCSCs, these facilities are not eligible for insurance claims reimbursement due to establishment status.

We conducted pooled cross-sectional study for participants who died during the 3-year study period to compare their home-based end-of-life care utilization and place of death across the four groups. The use of home-based end-of-life care was identified using claims records of additional fees specifically for these services. Place of death was categorized as medical institution for participants who were recorded as dying at a hospital or a clinic in the claims data. The medical institutional death rate was calculated as the percentage of all participants who died during the study period whose death occurred in a medical institution.

We also examined the number of days that participants received inpatient care, outpatient care, and home care across the four groups. Expenditures for inpatient care, outpatient care, home care, drug prescription and LTC services were also calculated for each group. Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = JP¥105.4).

Information was obtained on participant sex, age, care needs level, and Charlson comorbidity index (CCI) score as of April 2014.[27] Age was divided into four categories (75–79, 80–84, 85–89, and ≥90 years). The care needs levels included in our analysis were levels 3, 4, and 5 (with level 5 representing the highest level of dependence). CCI scores, which indicate the weighted number of concomitant diseases in an individual, were divided into three categories (0–2, 3–4, and ≥5).

Patient and Public Involvement

We used administrative claims data and did not involve patients in this study.

Statistical Analysis

The distributions of sex, age, care needs level, CCI, and death were examined across the four facility type groups. Additionally, inter-group differences in home-based end-of-life care utilization and institutional death among those who died during the study period were examined. One-way analysis of variance was used to compare these differences.

We constructed multivariable logistic regression models to evaluate the influence of home care facility type on home-based end-of-life care utilization and medical institutional death. In these models, the dependent variables were the use of home-based end-of-life care and death at a medical institution. The exposure of interest was the home care facility type, with Group A (enhanced HCSCs with beds) as the reference category. The covariates were sex, age, care needs level, and CCI. Odds ratios (ORs) and 95% confidence intervals were estimated.

Next, we calculated the mean annual days of inpatient care, outpatient care, and home care, as well as the mean annual expenditures for inpatient care, outpatient care, home care, drug prescription and LTC services for each facility type group. The inter-group differences were compared using analysis of variance. Each participant's service utilization was calculated over the number of years he/she lived during the study period, and annual utilization rates per person-year of observation were estimated. This method allowed the inclusion of data from participants who died during the study period, which was useful because the study population comprised individuals with an elevated mortality risk because of advanced age and high care needs.

To evaluate the influence of home care facility type on the use of medical and LTC services, we constructed generalized linear models (GMLs). Here, the dependent variables were the numbers of days of inpatient care, outpatient care, and home care, as well as the expenditures for inpatient care,

outpatient care, home care, drug prescription and LTC services. The exposure of interest was the home care facility type. The covariates were sex, age, care needs level, CCI, death, and the number of years the participant lived.

The dependent variables data were highly skewed and over-dispersed. Thus, analyzing these data using a conventional regression method might violate the data normality assumption. Furthermore, the data containing the number of days is commonly regarded as a 'count' variable, and the use of statistical techniques based on normal distribution might not be appropriate [28,29]. Many researchers have suggested the use of the generalized linear model (GLM) by assuming such data has a negative binomial or a Poisson distribution [30,31,32]. In contrast, the use of GLM with a gamma distribution is recommended when analyzing data involving health care costs [33,34]. In our preliminary analyses, dependent variables containing the number of days were fitted in two separate models: GLM with a negative binomial distribution, and GLM with a Poisson distribution. Diagnostic statistics, however, identified GLM with a negative binomial distribution provides better estimates than the model with an assumed Poisson distribution. The results of the analysis presented in this study are therefore, based on the estimates of GLM with a negative binomial distribution with log-link function and robust standard errors, for the analyses involving the number of days. On the other hand, for the results of analyses involving care expenditure, the estimates of GLM with a gamma distribution with log-link and robust standard errors are presented.

The marginal means of the dependent variables were calculated to indicate the estimated values of numbers of care days and expenditures for the examined care services. These were calculated by substituting the mean of the estimates into GLMs with a negative binomial distribution for care days and a gamma distribution for care expenditure.

SQL Server 2014 was used to extract the data, and Stata, 14.2 was used for all analyses.

RESULTS

The participants' characteristics are summarized in table 1. The included participants were 18,347

Fukuoka Prefecture residents who used home care at any of the four facilities categorized in this study, between April and June 2014, as well as 75 years and over and have a care of needs level of 3 or higher as of April 2014. The follow-up on the utilizations of medical and long-term care services by the participants was carried out from April 2014 to March 2017. The participants were comprising Group A with 2,509, Group B with 825, Group C with 6,218 and Group D with 8,795 participants who had both medical claims data and an LTC insurance claims data. We observed significant inter-group differences in sex (P=0.002), age (P<0.001), and CCI (P<0.008). However, there were no significant differences in care needs level (P=0.816) or death (P<0.669). Groups A and B tended to have higher CCI scores and older ages than did Groups C and D. During the 3-year study period, 54% of the participants died; Group A had the highest percentage of deaths (59.9%). Among the participants who died, there were significant inter-group differences in home-based end-of-life care utilization and in medical institutional death. Group A had the highest home-based end-of-life care utilization rate (57.4%) and the lowest rate of medical institutional death (25.6%). The home-based end-of-life care utilization rate in Group A, was followed (in order) by Groups B, C, and D, but this order was reversed for the rate of medical institutional death.

Table 2 shows the multivariate logistic regression analysis results for the associations of home care facility type with home-based end-of-life care utilization and medical institutional death among the participants who died during the study period. Relative to Group A, Group D had the lowest odds of using home-based end-of-life care (OR=0.13; P<0.001) and the highest odds of institutional death (OR=2.32; P<0.001).

The distribution of medical and LTC service utilization per person-year across the groups is shown in table 3. The mean total number of care days used by the participants was similar across the four groups. However, there were significant inter-group differences when the number of days was categorized into inpatient care, outpatient care, and home care. The mean annual number of inpatient care days was highest in Group D (34.0 days), followed by Group B (33.0 days), Group C (29.6 days), and Group A (26.6 days). The mean annual number of outpatient care days was also

highest in Group D (18.5 days), followed by Group A (10.1 days), Group C (9.8 days), and Group B (8.5 days). The mean annual number of home care days was highest in Group A (31.1 days), followed by Group C (27.2 days), Group B (24.9 days), and Group D (13.3 days). The mean annual inpatient care expenditure was highest in Group B (US$9,822.8) and lowest in Group A (US$7,661.7). The mean annual outpatient care expenditure was highest in Group D (US$1,109.3) and lowest in Group C (US$675.2). The mean annual home care expenditure was highest in Group A (US$6,122.2) and lowest in Group D (US$1,627.7). The mean annual prescription expenditure was highest in Group A (US$2,393.7) and lowest in Group D (US$1,722.2). The mean annual LTC expenditure was highest in Group A (US$30,252.7) and lowest in Group D (US$26,688.6).

Table 4 shows the marginal means estimated from the GLMs evaluating the associations of home care facility type with medical and LTC service utilization. The number of inpatient care days was highest in Group D (75.0 days), followed by Group B (69.9 days), Group C (64.7 days), and Group A (54.3 days). The number of outpatient care days was also highest in Group D (40.2 days), followed by Group C (21.2 days), Group A (21.1 days), and Group B (17.1 days). In contrast, the number of home care days was highest in Group A (63.8 days), followed by Group C (57.8 days), Group B (51.0 days), and Group D (29.0 days). Inpatient care expenditure was highest in Group B (US$20,767.7), followed by Group D (US$20,413.7), Group C (US$17,606.3), and Group A (US$15,523.3). Outpatient care expenditure was highest in Group D (US$2,332.9), followed by Group A (US$1,522.8), Group C (US$1,500.6), and Group B (US$1,455.8). Home care expenditure was highest in Group A (US$12,747.4), followed by Group B (US$10,790.1), Group C (US$9,551.4), and Group D (US$3,440.9). Prescription expenditure was highest in Group A (US$5,183.1), followed by Group C (US$4,766.9), Group B (US$4,753.0), and Group D (US$3,715.1). LTC expenditure was highest in Group A (US$64,192.7), followed by Group C (US$64,147.1), Group B (US$62,003.3), and Group D (US$58,186.0). The results of the marginal means are also presented visually in figures 1 and 2.

DISCUSSION

In this retrospective study of older adult home care service users with high care needs levels residing in Fukuoka Prefecture, we compared the utilization of medical and LTC services among patients treated by four types of home care facilities. Participants who used enhanced HCSCs with beds had the highest number of home care days and the lowest number of inpatient care days per person-year. In contrast, participants who used general clinics had the lowest number of home care days and the highest number of inpatient and outpatient care days per person-year. These results corroborate previous findings showering that the integration of home care into community care by specialized clinics is effective in reducing hospitalization duration among older adults [20, 35].

A novel finding of the present study is that participants who used home care services from enhanced HCSCs with beds were the most likely to receive end-of-life care at home and the least likely to die in a medical institution. Specifically, the odds of institutional death were 2.32 times higher for participants who used general clinics than for those who used enhanced HCSCs with beds, indicating that treatment by the latter type of facility is associated with a reduction in medical institutional deaths. The Ministry of Health, Labour and Welfare of Japan reported that the national medical institutional death rate in 2016 was 75.8%,[36] which was substantially higher than the corresponding rate observed among the patients in our study (36.6%) and even among the general clinic user group alone (44.3%). This suggests that older adults who use home care services are more likely to die outside of medical institutions, in places such as their homes or an LTC facility. Promoting the use of home care could, therefore, help to reduce the medical institutional death rate, as has also been demonstrated in a previous study [37]. Similarly, Sadamura and Babazono examined the correlation between LTC resources and place of death, finding that collaborations among clinics to provide home-based medical and LTC services reduced medical institutional deaths [38]. This form of integrated care may be effective in providing home-based end-of-life care for older adults.

It is noteworthy that participants who used enhanced HCSCs with beds had a substantially lower

number of inpatient care days and expenditures but a higher number of home care days and expenditures, compared with participants who used enhanced HCSCs without beds. This suggests that in enhanced HCSCs, the availability of bed resources that can be hospitalized at any time may reduce inpatient care by focusing more on home care. However, there can be fundamental differences in facility size, volume of other resources, and payment systems between facilities with and without beds. Therefore, enhanced HCSCs with beds are likely to include facilities with relatively abundant resources, and differences in volume of resources including beds may affect the inpatient utilizations. Another notable result is that conventional HCSCs appeared to be more effective in providing home care, compared with enhanced HCSCs without beds in terms of the metrics of inpatient care, home care days, and home care expenditures. These findings indicate a need to review the current insurance system, which reimburses enhanced HCSCs without beds at a higher rate for the same services, compared with conventional HCSCs.[15] In our study population, the users of enhanced HCSCs with beds had a higher utilization of home-based end-of-life care and a lower utilization of inpatient care, despite having relatively high care needs levels. Among the home care facility types, those that are well equipped to manage sudden changes in their patients' conditions may be able to provide high-quality home-based daily living support and reduce the length of hospitalization. A point of concern is that there was no significant difference in the number of inpatient care days between general clinics and enhanced HCSCs without beds. The prerequisites for receiving enhanced HCSC status may be met by a home care facility through collaboration with other clinics.[15] Therefore, it is possible that some of the enhanced HCSCs without beds were not individual facilities but instead comprised two or more clinics collaborating to satisfy the relevant criteria. Consequently, decisions on treatment strategies (such as hospitalization) at these facilities may involve doctors working at several facilities rather than only one facility. And these facilities also may be employing part-time doctor for on call duty. Bynum et al. examined the effects of different types of primary care on hospitalizations in a continuing care retirement community, finding that individuals with 24-hour primary care availability from physicians providing care only at that site had

significantly fewer hospitalizations and emergency department visits than did those who were served by external non-site-specific doctors [35]. This suggests that the decentralization of healthcare provision may be reduced when one facility is in charge of providing primary care for older adults living in a community, which can improve the quality of care and reduce the number of hospitalizations and overall healthcare utilization rates. On the basis of our findings and those from previous studies, we propose that the home care delivery system in Japan to encourage the development of "enhanced" status to clinics with beds. Under Japan's current medical fee schedule, there are no differences in home care fees between enhanced facilities operating independently and those working in collaboration with other facilities. To expand the role of enhanced HCSCs, when examining the differences among HCSCs, it is necessary to consider whether the facility works in collaboration with other clinics in addition to considering whether the facility has beds.

This study has several limitations. First, the study was conducted using data only on Fukuoka Prefecture residents, which limits the generalizability of our findings [39]. This prefecture has a relatively high number of hospital beds and relatively high medical expenditures per person, and this study's results therefore may be overestimated. Second, our data did not include detailed information about living conditions reflecting the participants' family structure or characteristics of living, which may influence the choice of a home care facility. Third, although the statistical analyses incorporated characteristics such as sex, age, care needs level, and CCI, the specific diseases of each participant were not taken into consideration. Fourth, no clinical data (e.g., disease progression or laboratory test results) for individual participants were included because this study focused on the types of healthcare facilities providing home care. Moreover, the issue related to the possibility of participants who moved from home to a long-term care facility such as a nursing home during the follow-up period was not addressed. Finally, we used care needs level as a covariate, but we were unable to account for any changes in this level over the study period. Nevertheless, considering the care needs level and CCI at the start of the study provided insight into the participants' baseline disease severity.

In this study, we showed the difference of home care system in Japan's CICS on the use of

medical and LTC services, the use of home-based end-of-life care, and the place of death among older community-dwelling adults. We also confirmed the important role of enhanced HCSCs with beds in providing home care services. Currently, there are 7,629 clinics with beds in Japan, and approximately 100,000 beds are available. Of these beds, 46% are used for emergency care and 37% provide transitional care for hospital-discharged patients before they are transferred to home or to an LTC facility [40]. Approximately 60% of the patients occupying the available beds are aged 75 years and older [40]. To optimize the provision of home care through a community-based care system, it is necessary to consider functional changes in clinics with beds. The promotion of integrated community care is regarded as a viable solution for aging societies in many countries. To support the increasing need for community care, the World Health Organization published *Integrated Care for Older People: Guidelines on Community-level Interventions to Manage Declines in Intrinsic Capacity* in 2017 [41]. These guidelines, which emphasize the need for comprehensive community-based strategies and primary care-level interventions to prevent diminishing capacity, are consistent with our study's conclusion that HCSCs with beds play an integral role in Japan, as the main healthcare facilities providing home care. As part of its national policy, Japan is considering a further expansion of the CICS. This expansion would involve the construction of a large system by coordinating the resources of acute care hospitals, rehabilitation hospitals, LTC facilities, clinics with beds, primary healthcare clinics, and comprehensive support centers within each region of the country. Consequently, there would be a need to clarify each facility's role in this expanded system. Our study provides useful information for further investigations of home care for older adults as part of community-based integrated care.

Acknowledgements The authors thank the Fukuoka Prefecture Association of Latter-Stage Elderly Healthcare for provision of the healthcare claims database. We also thank Jennifer Barrett, PhD, from Edanz Group (https://en-author-services.edanzgroup.com/ac) for editing a draft of this manuscript.

Contributors SK lead the study design, conducted the literature search, extracted and analyzed the data, and wrote the manuscript. AB contributed to the study design, analysis and manuscript revision. AJ, YL and LN contributed to the study design and analysis.

Funding This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study was approved by the Institutional Review Board of Kyushu University (Clinical Bioethics Committee of the Graduate School of Healthcare Sciences, Kyushu University). (Approval No. 20209).

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement No additional data are available.

Open access

REFERENCES

1. Hope P, Bamford SM, Beales S, et al. Creating sustainable health and care system in ageing societies. Report of the Ageing Societies Working Group 2012. The Global Health Policy Summit; 2012.
2. United Nations. World population ageing 2015. New Work: United Nations, Department of Economic and Social Affairs Population Division. 2015;ST/ESA/SER.A/390.
3. Cabinet Office. Heisei29nenban Koureishakai Hakusho. Koreikano jyoukyo (Annual Report on the Aging Society in 2017. The aging situation). https://www8.cao.go.jp/kourei/whitepaper/w-2017/zenbun/pdf/1s1s_01.pdf (Accessed May 20, 2020).
4. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age and Ageing. 2006;35 Suppl 2:ii37-ii41.
5. National Institute of Population and Social Security Research. Nihonno Shouraisuikei jinkou -Heisei29nen Suikei (The future population estimates in 2017). http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_gaiyou.pdf (Accessed May 20, 2020).
6. Ministry of Health, Labour and Welfare. Wagakunino Kokuminminahoken Seido (The overview of Medical insurance system for elderly). 2006. https://www.mhlw.go.jp/content/12400000/000377686.pdf (Accessed May 20, 2020).
7. Ministry of Finance. Shakaihoshouni tsuite (About Social Security). 2018. https://www.mof.go.jp/about_mof/councils/fiscal_system_council/sub-of_fiscal_system/proceedings/material/zaiseia301009/01.pdf (Accessed May 20, 2020).
8. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: a systematic review of the literature. Ageing Res Rev. 2011;10(4):430-9.
9. World Health Organization. Global status report on noncommunicable diseases 2014. World Health Organization Geneva. 2014.
10. Ministry of Health, Labour and Welfare. 2015nenno Koureisha Kaigo -Koureishano Sonchouwo

Sasaeru Keano Kakuritsuni Mukete (Elderly Care in 2015 -Toward the Establishment of Care to Support the Dignity of Elderly Persons-). 2003. https://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/3.html (Accessed May 20, 2020).

11. Ministry of Health, Labour and Welfare. Chiikihoukatsukea Kenkyukai Houkokusho (The study report of community-based integrated care systems).2019. https://www.mhlw.go.jp/houdou/2009/05/dl/ h0522-1.pdf (Accessed May 20, 2020).
12. Ministry of Health, Labour and Welfare. Jaitakuiryouno Genjyou (Consciousness survey of end-of-life care). 2016. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000129546.pdf. (Accessed May 20, 2020).
13. Ministry of Health, Labour and Welfare. Jinseino Saishudankaino Iryouniokeru Kouseiroudoshono Torikumi (Ministry of Health, Labor and Welfare's efforts in medical care at the end-of life). 2017. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000200749.pdf. (Accessed May 20, 2020).
14. Miura H. Homecare for the Elderly. The Japan Geriatrics Society. 2013;50:164-7.
15. Ohta H. Current conditions and issues for home care support clinics. Japan Medical Association Journal. 2015;58:6-9.
16. Ministry of Health, Labour and Welfare. Zaitakuiryono Kouchikunitsuite (The construction of home medical care system).2018. https://www.mhlw.go.jp/file/05-Shingikai-10801000-Iseikyoku-Soumuka/0000170234.pdf (Accessed May 20, 2020).
17. Johri M, Beland F, Bergman H. International experiments in integrated care for the elderly: a synthesis of the evidence. Int J Geriatric Psychiatry. 2003;18(3):222-35.
18. Eklund K, Wilhelmson K. Outcomes of coordinated and integrated interventions targeting frail elderly people: a systematic review of randomised controlled trials. Health Soc Care Community.

2009;17(5):447-58.

19. Stewart MJ, Georgiou A, Westbrook JI. Successful integrating aged care services: a review of the evidence and tools emerging from a long-term care program. International journal of integrated care. 2013;13(1).
20. Rosenberg T. Acute hospital use, nursing home placement, and mortality in a frail community-dwelling cohort managed with Primary Integrated Interdisciplinary Elder Care at Home. J Am Geriatr Soc. 2012;60(7):1340-6.
21. Damery S, Flanagan S, Combes G. Does integrated care reduce hospital activity for patients with chronic diseases? An umbrella review of systematic reviews. BMJ Open. 2016;6(11):e011952.
22. Di Pollina L, Guessous I, Petoud V, et al. Integrated care at home reduces unnecessary hospitalizations of community-dwelling frail older adults: a prospective controlled trial. BMC Geriatr. 2017;17(1):53.
23. Ellis G, Whitehead MA, Robinson D, et al. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. BMJ. 2011;343:d6553.
24. Baxter S, Johnson M, Chambers D, et al. The effects of integrated care: a systematic review of UK and international evidence. BMC Health Serv Res. 2018;18(1):350.
25. Olivares-Tirado P, Tamiya N. Trends and Factors in Japan's Long-Term Care Insurance System: Japan's 10-year Experience. Springer. 2014.
26. Fukuoka Prefecture Latter-stage Elderly Healthcare Association. Hihokensyasuu2014 (Number of beneficiaries). 2014. http://www.fukuoka-kouki.jp/documents/hihokensyasuu2014.pdf. (Accessed May 27, 2021).
27. D'Hoore W, Sicotte C, Tilquin C. Risk Adjustment in Outcome Assessment: the Charlson Comorbidity Index. Methods Inf Med. 1993;32(05):382-387.
28. Agresti, A. (2001) Categorical Data Analysis (2nd ed). New York: Wiley.
29. Long, S. J. & Freese, J. (2001) Regression Models for Categorical Dependent Variables using

Stata. College Station, TX: Stata Press.

30. Austin PC, Rothwell DM, Tu JV. A comparison of statistical modeling strategies for analyzing length of stay after CABG surgery. Health Services & Outcomes Research Methodology. 2002, 3: 107-133.
31. Carter EM, Potts HW. Predicting length of stay from an electronic patient record system: a primary total knee replacement example. BMC Med Inform Decis Mak. 2014;14:26. Published 2014 Apr 4. doi:10.1186/1472-6947-14-26.
32. Marazzi A, Paccaud F, Ruffieux C, et al. Fitting the distributions of length of stay by parametric models. Medical care. 1998;36(6):915–27.
33. Mihaylova B, Briggs A, O'Hagan A, et al. Review of statistical methods for analysing healthcare resources and costs. Health Econ. 2011;20:897–916.
34. Dodd S, Bassi A, Bodger K, et al. A comparison of multivariable regression models to analyse cost data. J Eval Clin Pract. 2006;12:76–86.
35. Bynum J, Andrews A, Sharp S, et al. Fewer hospitalizations result when primary care is highly integrated into a continuing care retirement community. Health Affairs. 2011;30(5):975-84.
36. Ministry of Health, Labour and Welfare. Heisei28nen Jinkoudoutaitoukeino Gaikyou (Vital Statistics of Japan in 2016). https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/kakutei16/index.html (Accessed May 20, 2020).
37. Kishida K, Tanigaki S. Jaitakushienshinryoujyoniyoru Mitorikazuni Eikyousuru Chiikitokusei (Regional characteristics that affect the number of end-of-life care provided by home care support clinics). Journal of health and welfare statistics. 2011;58:27-30.
38. Sadamura M, Babazono A. Kaigohokenseidouniyoru Kaigoshigenno Shihyouto siboubashotono Kanren (Relationship between long-term Care resource indicators by long-term Care insurance system and place of death. Journal of health and welfare statistics). 2005;52:8-14.
39. Ministry of Health, Labour and Welfare. Iryouhino Chiikisa Bunseki (Regional difference analysis of medical expenses). 2017. https://www.mhlw.go.jp/content/iryohi_h29.pdf (Accessed May 20,

2020).

40. Ministry of Health, Labour and Welfare. Dai55kai Shakaihoshousingikai Iryoubukai: Yushoushinryoujyono Genjyouto Kadai (55th Social Security Council Medical Section: Current status and issues of clinics with beds). 2017. https://www.mhlw.go.jp/file/05-Shingikai-12601000-Seisakutoukatsukan-Sanjikanshitsu_Shakaihoshoutantou/0000184304.pdf (Accessed May 20, 2020).
41. World Health Organization. Integrated care for older people guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization Geneva; 2017.

Table 1. Participant characteristics by home care facility type

	Total	Group A	Group B	Group C	Group D	*P* value
Number of participants	18,347	2,509 (13.7)	825 (4.5)	6,218 (33.9)	8,795 (47.9)	
Sex						
Men (%)	4,709 (25.7)	645 (25.7)	204 (24.7)	1,473 (23.7)	2,387 (27.1)	0.002
Women (%)	13,638 (74.3)	1,864 (74.3)	621 (75.3)	4,745 (76.3)	6,408 (72.9)	
Age						
Mean [SD]	87.5 [6.2]	87.8 [6.1]	88.1 [6.1]	87.7 [6.1]	87.1 [6.3]	
75–79 (%)	2,051 (11.2)	226 (9.0)	70 (8.5)	605 (9.7)	1,150 (13.1)	
80–84 (%)	4,035 (22.0)	542 (21.6)	167 (20.2)	1,388 (22.3)	1,938 (22.0)	<0.001
85–89 (%)	5,394 (29.4)	746 (29.7)	258 (31.3)	1,876 (30.2)	2,514 (28.6)	
≥90 (%)	6,867 (37.4)	955 (39.7)	330 (40.0)	2,349 (37.8)	3,193 (36.3)	
Care needs levels						
Level 3 (%)	5,081 (27.7)	582 (23.2)	227 (27.5)	1,739 (28.0)	2,533 (28.8)	
Level 4 (%)	6,804 (37.1)	882 (35.2)	281 (34.1)	2,341 (37.6)	3,300 (37.5)	0.816
Level 5 (%)	6,462 (35.2)	1,045 (41.6)	317 (38.4)	2,138 (34.4)	2,962 (33.7)	
Charlson comorbidity index						
0–2 (%)	4,115 (22.4)	507 (20.2)	144 (17.4)	1,331 (21.4)	2,133 (24.2)	
3–4 (%)	6,629 (36.1)	873 (34.8)	295 (35.8)	2,385 (38.4)	3,076 (35.0)	0.008
≥5 (%)	7,603 (41.5)	1,129 (45.0)	386 (46.8)	2,502 (40.2)	3,586 (40.8)	
Death						
Yes (%)	9,919 (54.1)	1,502 (59.9)	471 (57.1)	3,271 (52.6)	4,675 (53.2)	0.699
No (%)	8,428 (45.9)	1,007 (40.1)	354 (42.9)	2,947 (47.4)	4,120 (46.8)	
Number of deaths	9,919	1,502 (15.1)	471 (4.8)	3,271 (33.0)	4,675 (47.1)	
Home-based end-of-life care						
Yes (%)	3,103 (31.3)	862 (57.4)	220 (46.7)	1,285 (39.3)	736 (15.7)	<0.001
No (%)	6,816 (68.7)	640 (42.6)	251 (53.3)	1,986 (60.7)	3,939 (84.3)	
Medical Institutional death						
Yes (%)	3.633 (36.6)	384 (25.6)	137 (29.1)	1,039 (31.8)	2,073 (44.3)	<0.001
No (%)	6,286 (63.4)	1,118 (74.4)	334 (70.9)	2,232 (68.2)	2,602 (55.7)	

NOTES: Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics. "Number of deaths" refers to participants who died during the study period.

Table 2. Associations of home care facility type with home-based end-of-life care utilization and medical institutional death

	Home-based end-of-life care		Medical Institutional death	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Home care facility type				
Group A	Reference			
Group B	0.66 (0.53–0.82)	<0.001	1.17 (0.93–1.47)	0.19
Group C	0.47 (0.41–0.54)	<0.001	1.35 (1.18–1.56)	<0.001
Group D	0.13 (0.11–0.15)	<0.001	2.32 (2.03–2.65)	<0.001
Sex				
Men	Reference			
Women	1.36 (1.22–1.51)	<0.001	0.75 (0.68–0.82)	<0.001
Age				
75–79 (%)	Reference			
80–84 (%)	1.11 (0.89–1.38)	0.34	1.05 (0.88–1.25)	0.58
85–89 (%)	1.34 (1.09–1.65)	<0.001	0.95 (0.81–1.13)	0.58
≥90 (%)	1.96 (1.61–2.39)	<0.001	0.74 (0.63–0.87)	<0.001
Care needs levels				
Level 3 (%)	Reference			
Level 4 (%)	1.31 (1.15-1.49)	<0.001	0.88 (0.79–0.98)	0.02
Level 5 (%)	1.94 (1.71–2.20)	<0.001	0.71 (0.63–0.79)	<0.001
Charlson comorbidity index				
0–2 (%)	Reference			
3–4 (%)	0.74 (0.65–0.84)	<0.001	1.25 (1.10–1.41)	<0.001
≥5 (%)	0.57 (0.50–0.64)	<0.001	1.51 (1.35–1.70)	<0.001

NOTES: This table shows the results of multivariate logistic regression analyses that adjusted for the following covariates: sex, age, care needs level, and Charlson comorbidity index. The dependent variables were home-based end-of-life care utilization and medical institutional death. The exposure of interest was the home care facility type, with Group A as the reference category. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 3. Medical and long-term care utilization and expenditure per person-year by home care facility type

	Group A	Group B	Group C	Group D	*P* value
Person-year	4955.1	1703.5	13667.8	18564.3	
Mean [SD]	2.0 [1.1]	2.1 [1.1]	2.2 [1.0]	2.1 [1.0]	
Rate per person-year					
Care days					
Inpatient care	26.6	33.0	29.6	34.0	<0.001
Outpatient care	10.1	8.5	9.8	18.5	<0.001
Home care	31.1	24.9	27.2	13.3	<0.001
Care expenditure					
Inpatient care	7661.7	9822.8	8024.9	9382.9	<0.001
Outpatient care	709.0	696.2	675.2	1109.3	<0.001
Home care	6122.2	5172.5	4365.2	1627.7	<0.001
Prescription	2393.7	2157.0	2151.9	1722.2	<0.001
Long-term care	30252.7	29153.8	29457.1	26688.6	<0.001

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The values were calculated over the number of years each participant lived during the study period and are reported here as the annual rates per person-year of observation. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Table 4. Comparison of medical and long-term care utilization and expenditure by home care facility type

	Care days			Care expenditure				
	Inpatient	Outpatient	Home care	Inpatient	Outpatient	Home care	Prescription	Long-term care
Home care facility type								
Group A	54.3	21.1	63.8	15523.3	1522.8	12747.4	5183.1	64192.7
Group B	69.9	17.1	51.0	20767.7	1455.8	10790.1	4753.0	62003.3
Group C	64.7	21.2	57.8	17606.3	1500.6	9551.4	4766.9	64147.1
Group D	75.0	40.2	29.0	20413.7	2332.9	3440.9	3715.1	58186.0
Sex								
Men	77.6	30.8	44.6	21639.5	2143.2	7867.3	4542.4	57792.6
Women	64.9	29.9	44.7	17681.4	1811.9	6885.3	4238.6	62216.6
Age								
75–79	86.4	34.1	42.0	24272.6	2800.2	8101.9	5316.7	56446.0
80–84	76.2	32.2	43.3	21405.5	2271.6	7308.3	4789.7	60468.6
85–89	67.3	30.3	45.7	18527.4	1838.7	6957.2	4292.0	62223.8
≥90	58.3	26.9	45.6	15569.4	1326.0	6805.5	3598.5	62691.4
Care needs levels								
Level 3	64.2	30.7	41.0	18907.6	2161.7	6706.5	4518.9	53625.4
Level 4	68.7	31.5	43.4	18701.5	2023.9	6622.3	4238.5	60912.2
Level 5	71.6	28.0	49.2	18829.2	1516.9	8029.8	4202.8	68709.6
Charlson comorbidity index								
0–2	49.2	28.5	41.3	12987.0	1351.7	5854.5	3405.7	62673.7
3–4	65.0	29.6	44.4	17513.9	1648.3	6610.3	4109.3	62362.6
≥5	81.0	31.5	46.8	22791.9	2418.9	8247.3	5001.0	59337.2
Death								
No	42.8	25.7	40.3	12031.3	1607.1	6180.9	3766.4	54020.8
Yes	124.9	40.8	53.4	32308.4	2684.7	8988.1	5831.8	81395.7

NOTES: Expenditures were converted from Japanese yen to US dollars using the 2017 purchasing power parity rate (US$1 = 105.4). The table shows the results (marginal means) of generalized linear models assuming a negative binomial distribution for care days and a gamma distribution for care expenditure.

Analyzed, dependent variables include: inpatient care days, outpatient care days, home care days, inpatient care expenditures, outpatient care expenditures, home care expenditures, prescription expenditures, and long-term care expenditures. The exposure of interest was the homecare facility type. The models adjusted for the following covariates: sex, age, care needs level, Charlson comorbidity index, death, and the number of years the participants lived during the study period. The marginal means of the dependent variables were calculated by substituting the means of the estimates into the generalized linear regression models. Group A comprised users of enhanced Home Care Support Clinics/Hospitals (HCSCs) with beds, Group B comprised users of

enhanced HCSCs without beds, Group C comprised users of HCSCs, and Group D comprised users of general clinics.

Figure legends

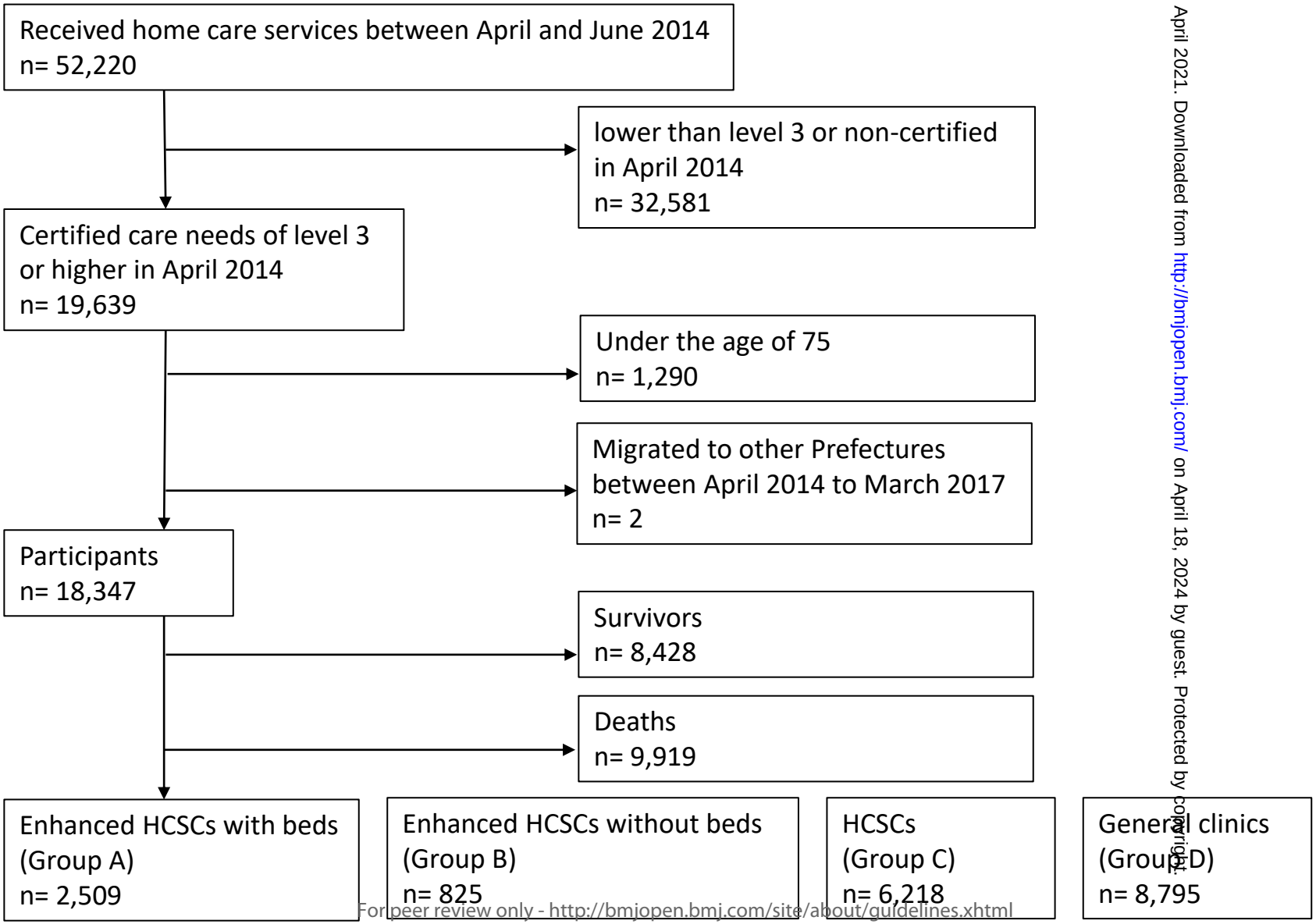
Image1: Figure1

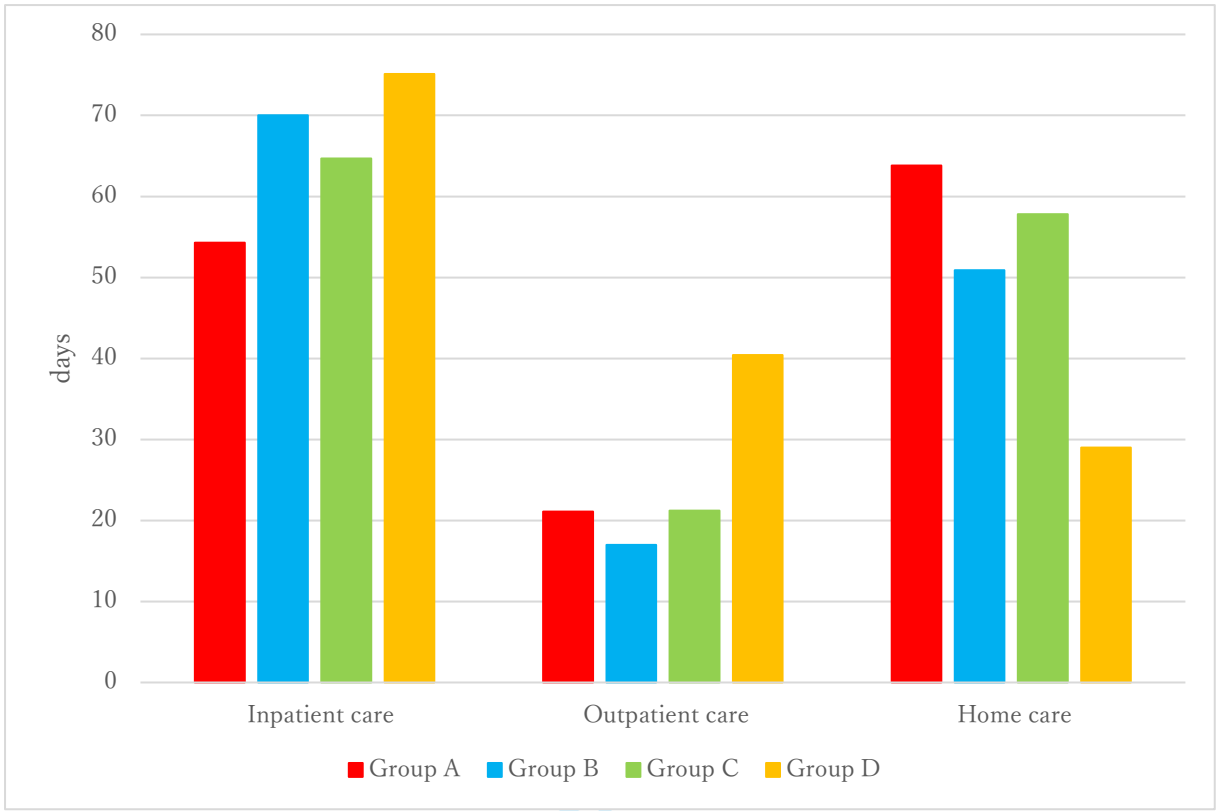
The title is “Flow diagram of inclusion/exclusion criteria”. This shows the number of participants at the baseline and the end of the study.

Image2: Figure2

The title is “Comparison of medical and long-term care utilization using marginal means by home care facility type”. This shows the care utilization by home care facility, which is the result of Table 4.

Figure 1. Flow diagram of inclusion/exclusion criteria.

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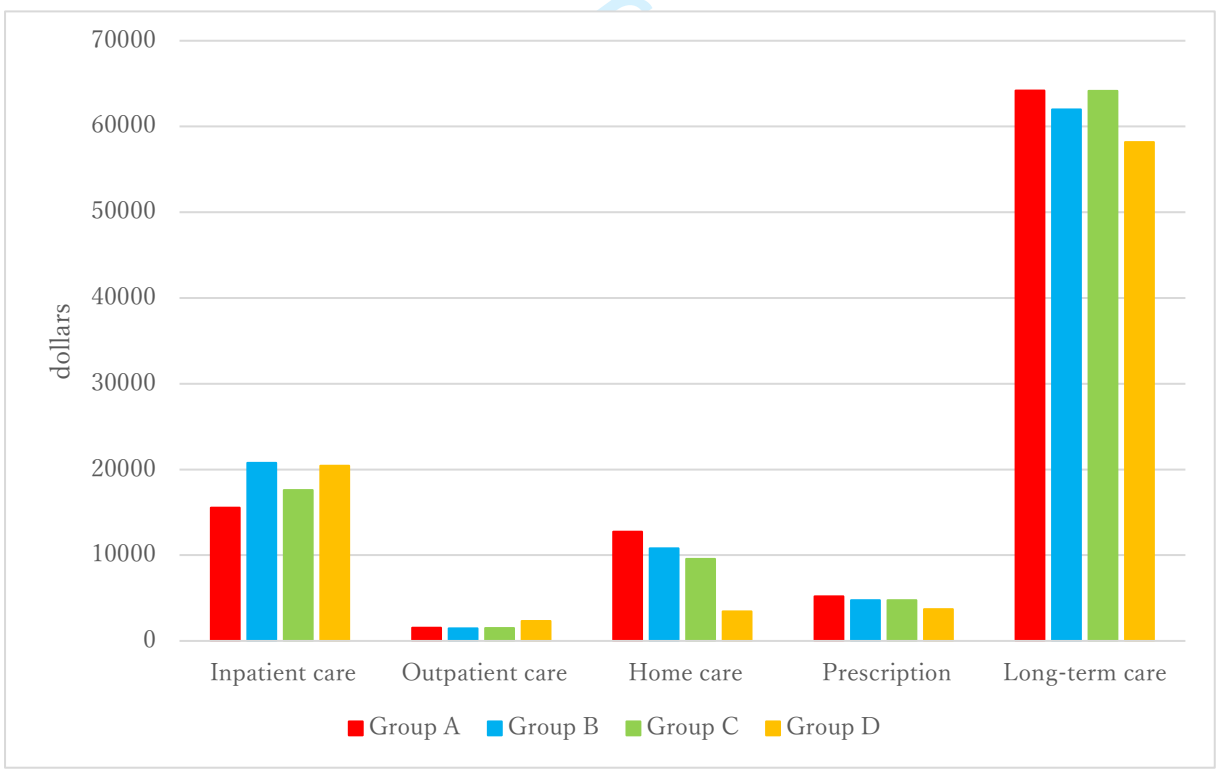
Group C
Group D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Group B
Group C
Group D

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cohort studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1, 2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4, 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6, 7 (Database, Study Design)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6, 7 (Database, Study Design)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	6, 7 (Database, Study Design) , Figure1
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8, 9 (Statistical Analysis)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8, 9 (Statistical Analysis)
Bias	9	Describe any efforts to address potential sources of bias	8, 9 (Statistical Analysis)
Study size	10	Explain how the study size was arrived at	6-7 (Study Design)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8, 9 (Statistical Analysis)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8, 9 (Statistical Analysis)
		(*b*) Describe any methods used to examine subgroups and interactions	8, 9 (Statistical Analysis)

		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, explain how loss to follow-up was addressed	
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9-10 (Results)
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6,7 (Database, Study Design) Table 1
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) Summarise follow-up time (eg, average and total amount)	9
Outcome data	15*	Report numbers of outcome events or summary measures over time	Table 1
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Table 2, Table 3, and Table 4
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12, 13
Limitations			
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12, 13, 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.