



Place-of-Death Disparities by Underlying Cause of Death and Associations With Specialist Palliative Care and Generalist Home Care Among Older Decedents in Taiwan: A Nationwide Population-Based Study

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Abstract

Background: Evidence is limited regarding place-of-death (PoD) differences across underlying cause-of-death categories and the associations of specialist palliative care and generalist home care utilization with PoD among older adults.

Methods: This population-based cross-sectional study included Taiwanese decedents aged ≥ 65 years from 2014 to 2023 with underlying causes of death eligible for palliative care reimbursement under National Health Insurance (NHI) regulations. Linked death registry and NHI claims identified underlying cause of death, specialist palliative care, and generalist home care utilization in the last year of life. PoD was the outcome, being classified as hospital, home, inpatient palliative care unit, long-term care facility, or other. The explanatory variables were underlying cause of death (cancer vs. non-cancer), specialist palliative care utilization, and generalist home care utilization in the last year of life. Their associations with PoD were examined using multinomial logistic regression, with hospital death as the reference category.

Results: Among 632 920 decedents (mean age, 81.03 years; 43.6% women), hospital (44.1%) and home (40.9%) were the most frequent PoD. From 2014 to 2023, home deaths declined from 46.1% to 38.5%, whereas hospital deaths increased from 42.1% to 44.6%. Decedents with underlying non-cancer causes (vs. cancer causes) had lower odds of home death (vs. hospital death; odds ratio [OR], 0.69; 95% confidence interval [CI], 0.68–0.70). Palliative home care was associated with substantially higher odds of home death (vs. hospital death; OR, 5.44; 95% CI, 5.30–5.58), whereas physician and nurse home visits showed more modest associations (OR, 1.40; 95% CI, 1.36–1.44 and OR, 1.12; 95% CI, 1.08–1.15, respectively).

Conclusion: PoD differences by underlying cause of death persisted, and palliative home care and generalist home care utilization were associated with higher odds of home rather than hospital death. These findings support evaluating needs-based referral and integrated home care models to broaden care options.

Keywords: Place-of-Death, Palliative Care, Home Care Services, Healthcare Disparities, Aging in Place, Taiwan

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Citation: Lo YT, Chuang TJ, Ku LJE, et al. Place-of-death disparities by underlying cause of death and associations with specialist palliative care and generalist home care among older decedents in Taiwan: a nationwide population-based study. *Int J Health Policy Manag*. 2026;15:9727. doi:10.34172/ijhpm.9727

Article History:

Received: 6 January 2026

Accepted: 29 September 2026

ePublished: 25 October 2026

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Background

Place-of-death (PoD) is widely regarded as an indicator of end-of-life care quality and healthcare system responsiveness. Importantly, PoD distribution has broad public health implications beyond patients' preferences; for bereaved caregivers, home death (vs. hospital death) has been associated with lower psychological distress, complicated grief, and depressive symptoms.¹ For healthcare systems, PoD shapes healthcare resource allocation² and reflects palliative care policy effectiveness.³ Still, although about half of patients express a preference to die at home,⁴ hospital remains the most common PoD worldwide.⁵ This gap points to system-level barriers and limited community-based care availability, raising concerns about whether end-of-life services concomitantly address individual preferences and policy goals.

Policy responses to ageing populations increasingly

emphasize aging in place and reduced reliance on hospitals at the end of life,⁶ albeit achieving this vision requires timely and equitable palliative care accessibility. Meanwhile, real-world evidence across multiple countries depicts patients with non-cancer diagnoses (eg, heart failure, dementia, chronic obstructive pulmonary disease, or renal failure) as being significantly less likely to receive palliative care^{7,8} and more likely to die in hospitals (vs. patients with cancer).^{4,5} This is even when the symptom burden is comparable to that of patients with cancer.⁹ These disparities across disease groups highlight the need for more equitable, needs-based access to palliative care.

Importantly, care delivery models represent a relevant PoD determinant,⁵ with related evidence showcasing that home-based palliative care, physician home visits, and other community services increase the likelihood of dying outside

Key Messages

Implications for policy makers

- Place-of-death (PoD) differences by underlying cause of death remained evident even under universal coverage: older decedents with non-cancer underlying causes had lower odds of home or inpatient palliative care unit death than those with cancer causes. This indicates that formal coverage alone may not ensure comparable end-of-life care across disease groups.
- Service modality matters, as associations with PoD diverged across specialist palliative care modalities. Palliative home care was strongly associated with home death (hospital death as the reference category), whereas inpatient palliative care and inpatient shared care showed distinct associations with other PoD categories.
- Generalist home care may have a complementary role. Physician and nurse home visits were associated with higher odds of home death (hospital death as the reference category), although these associations were more modest than those observed for palliative home care.
- Implementation strategies require direct evaluation because needs-based referral approaches, provider training, workforce development, and coordinated specialist-generalist care models were not directly assessed in this study. These strategies should be evaluated before being adopted as policy solutions.
- Policy evaluation should account for patient preferences. Specifically, home death should not be treated as a universally preferred outcome. Future evaluations should incorporate preference-concordant care, caregiver circumstances, and the availability of feasible care options.

Implications for the public

Where people die at the end of life is associated with both their underlying illness and the types of care they receive. This national study from Taiwan found that older adults dying from non-cancer conditions were less likely than those dying from cancer to die at home or in an inpatient palliative care unit. Use of palliative home care and regular physician or nurse home visits was associated with a greater likelihood of home rather than hospital death, although the study could not determine whether these services directly caused the observed differences. The findings suggest that expanding feasible care options outside hospital settings may be important, but do not imply that home death is always preferable. End-of-life care should instead support choices that reflect the needs, preferences, and circumstances of patients and their families.

the hospital.^{10,11} Nevertheless, few population-level studies have examined PoD patterns in relation to both underlying cause of death and the utilization of specialist palliative and generalist home care.

Taiwan provides a distinctive setting to examine these questions. Its single-payer National Health Insurance (NHI) covers inpatient hospice, palliative home care, and shared care (ie, collaboration between specialist palliative care teams and primary care teams in caring for patients admitted to non-palliative care units) for both patients with and without cancer.¹² Since 2016, an integrated home care program in the country has further expanded access to physician home visits for older adults with functional limitations.¹³ This infrastructure is comprehensive; however, whether the utilization of these services is associated with less hospital-centered PoD patterns remains uncertain.

This study used 10 years of national data (2014–2023) to examine the associations of PoD with underlying cause-of-death categories, specialist palliative care utilization, and generalist home care utilization among older decedents with an underlying cause of death eligible for palliative care reimbursement in Taiwan. We also described temporal changes in PoD distributions across underlying cause-of-death categories, specialist palliative care utilization, and generalist home care utilization.

Methods

Design and Data Sources

This cross-sectional study used linked national datasets from Taiwan's Health and Welfare Data Science Center between 2014 and 2023, as follows: NHI claims database, featuring data on demographic characteristics, diagnostic codes (International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM]/ICD-10-CM), clinical

records, procedures, medications, and healthcare expenditures for Taiwan's 23 million residents¹⁴; Multiple Causes of Death database, validated for data quality¹⁵ and containing mandatory death registrations featuring data on date, cause, and PoD for all deaths within 10 days of occurrence; Municipal Important Statistical Indicator Query System, providing regional healthcare resource data. These datasets were linked using encrypted patient identifiers. This study was reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Supplementary file 1, Table S1).

Study Population

The study included all individuals aged ≥ 65 years who died in Taiwan between January 1, 2014, and December 31, 2023, with an underlying cause of death eligible for palliative care reimbursement under NHI regulations. The age of 65 years was selected as the threshold because it corresponds to Taiwan's statutory definition of older persons under the Senior Citizens Welfare Act¹⁶ and the age criterion for eligibility in long-term care programs. Underlying cause of death eligibility was determined using ICD codes corresponding to cancer and non-cancer conditions covered by the national palliative care reimbursement framework (Supplementary file 1, Table S2). This disease-based restriction was applied regardless of whether palliative care was actually received and was intended to ensure that comparisons of palliative care utilization were made across disease groups covered by the same reimbursement framework.

Individuals with missing demographic information were excluded. The cohort was restricted to decedents with at least one inpatient admission or emergency department visit during the last year of life to focus on individuals with an observable acute-care trajectory before death. Among 1 790 267 deaths

recorded in Taiwan between 2014 and 2023, 632 920 older decedents met all study eligibility criteria (Supplementary file 1, Figure S1).

Explanatory Variables

The explanatory variables comprised underlying cause of death and two groups of service-utilization measures, namely specialist palliative care utilization and generalist home care utilization. These two service-utilization groups were not mutually exclusive. Underlying cause of death was obtained from the death registry and classified as cancer or non-cancer, with non-cancer causes being further categorized as dementia, cerebrovascular disease, cardiovascular disease, lung disease, liver disease, kidney disease, or other eligible conditions according to NHI palliative care regulations (Supplementary file 1, Table S2).

Specialist palliative care utilization during the last 12 months of life was identified from NHI claims and included palliative home care, inpatient palliative care, and inpatient shared care. Receipt of any of these three services was used to define overall specialist palliative care utilization and applied in the descriptive analyses of temporal trends. For the multinomial regression analyses, the three specialist palliative care services were entered as separate, non-mutually exclusive indicators.

Generalist home care utilization referred to physician and nurse home visits provided under Taiwan's non-palliative home care program during the last 12 months of life. For the descriptive analyses of temporal trends, receipt of either a physician or nurse home visit was used to define overall generalist home care utilization. Because receipt of physician and nurse home visits was not mutually exclusive, the two visit types were entered as separate indicators in the multinomial logistic regression models. The total numbers of physician and nurse visits were also recorded for analyses restricted to service users.

Outcome Variable

The primary outcome, PoD, was derived from the Multiple Causes of Death database, which records hospital, home, long-term care facility, or other locations without further distinguishing emergency department, intensive care unit, or general ward deaths. Because inpatient palliative care units are located within acute care hospitals in Taiwan, decedents recorded as dying in hospital were further linked to NHI claims to identify and reclassify those whose terminal hospitalization occurred in an inpatient palliative care unit. All remaining hospital deaths were retained as a single category. Accordingly, PoD was classified as hospital, home, inpatient palliative care unit, long-term care facility, or other location.

Covariates

Demographic and illness-related factors included age (65–69, 70–74, 75–79, 80–84, 85–89, ≥90 years), sex, salary-based NHI premium quartiles, occupation, and comorbidity burden (as measured by the Charlson Comorbidity Index based on diagnosis codes recorded in NHI claims during the

year before death).¹⁷ The Charlson Comorbidity Index was independent of the underlying cause of death recorded in the death registry.

Environmental factors included marital status (married, unmarried, widow and divorced, and others), the urbanization level in the city district/township of residence, healthcare input, and year of death. Urbanization level was grouped into three categories based on a classification scheme that stratified all 358 city district/townships into seven levels (1 to 2 as high, 3 to 4 as medium, and 5 to 7 as low).¹⁸ Healthcare input was obtained from the city/county important statistical indicator query system of the National Statistics, Executive Yuan, including data on number of hospital beds, number of intensive care unit beds, number of physicians, and number of allied healthcare workers per 10 000 population (<https://winstacity.dgbas.gov.tw/DgbasWeb/ZWeb/Varval.aspx>). Both urbanization level and healthcare input were considered as ecological variables.

Statistical Analysis

Patient characteristics were summarized using frequencies (%) for categorical variables and means (standard deviation, SD) or medians (interquartile range) for continuous variables. Characteristics were compared across PoD categories using analysis of variance for continuous variables and chi-square tests for categorical variables.

For the descriptive trend analyses, specialist palliative care utilization and generalist home care utilization were each summarized as a single composite binary indicator (any modality and any visit type, respectively) to aid with the visual interpretation of overall trends. Annual PoD distributions were summarized descriptively by underlying cause of death category and service-utilization status and presented as 100% stacked bar charts (PoD categories summed to 100% within each year and subgroup).

Multinomial logistic regression was used to examine associations of PoD with underlying cause of death category, each specialist palliative care modality, and each generalist home care visit type; service indicators were entered as separate variables to capture modality-specific associations. Two versions of the underlying-cause-of-death variable were used across analyses: a binary cancer/non-cancer indicator, used to provide an overall summary contrast, and a fully disaggregated cause-specific classification, used to examine heterogeneity across non-cancer subgroups. The reference category was hospital death because it represented the most common outcome in our cohort and has often been regarded as the default, medicalized PoD. Using hospital death as the reference outcome also provides a policy-relevant contrast with home, inpatient palliative care unit, and long-term care facility deaths, which are often emphasized in end-of-life care reforms. Candidate covariates were selected a priori based on clinical relevance, and a fully adjusted model was applied rather than a data-driven stepwise selection. Multicollinearity was assessed using variance inflation factors, and variables with factors >4 (ie, occupation and number of allied healthcare workers) were excluded from the final models.

In our dataset, death in an inpatient palliative care

unit completely overlapped with inpatient palliative care utilization, precluding the estimation of the association between inpatient palliative care utilization and inpatient palliative care unit death. This led us to fit an additional multinomial logistic regression model after excluding deaths occurring in inpatient palliative care units in order to examine the associations of inpatient palliative care utilization with the remaining PoD categories. Likewise, the numbers of physician and nurse home visits were analyzed in models restricted to the respective service users. All analyses were performed using SAS version 9.4 (SAS Institute), while statistical significance was set at a two-tailed $P < .05$.

Results

Study Population and Overall Place-of-Death Distribution

Among 632 920 older decedents, 278 795 (44.1%) died in hospital, 258 628 (40.9%) at home, 56 366 (8.9%) in inpatient palliative care units, 21 955 (3.5%) in long-term care facilities, and 17 176 (2.7%) in other locations. Overall, home deaths

declined from 46.1% in 2014 to 38.5% in 2023; hospital deaths increased from 42.1% to 44.6%; inpatient palliative care unit deaths increased from 6.5% in 2014 to 9.7% in 2023; and long-term care facility deaths increased from 1.9% to 4.7% (Supplementary file 1, Figure S2).

Place-of-Death by Underlying Cause of Death

PoD distributions differed across underlying causes of death (Table 1). Compared with cancer decedents, those with dementia had higher proportions of home death (42.8% vs. 39.4%) and long-term care facility death (9.5% vs. 2.1%). Long-term care facility deaths were more common among decedents with cerebrovascular disease (5.0%) and lung disease (5.8%) than among those with cancer. Hospital death predominated among decedents with liver disease (58.0%) and kidney disease (55.0%). Inpatient palliative care unit death was substantially more common among cancer decedents (14.5%) than among most non-cancer groups (Supplementary file 1, Figure S3).

Table 1. Distribution of Place-of-Death by Underlying Cause of Death, Service Utilization, and Patient Characteristics Among Older Decedents in Taiwan, 2014–2023

Variables	Hospital (n = 278 795)	Home (n = 258 628)	Inpatient Palliative Care Units (n = 56 366)	Long-term Care Facilities (n = 21 955)	Other Locations (n = 17 176)
Underlying cause of death					
Cancer	132 268 (42.50)	122 736 (39.44)	45 047 (14.47)	6440 (2.07)	4737 (1.52)
Dementia	8743 (36.01)	10 387 (42.78)	1979 (8.15)	2315 (9.53)	857 (3.53)
Cerebrovascular diseases	23 249 (46.00)	20 700 (40.96)	1469 (2.91)	2523 (4.99)	2598 (5.14)
Cardiovascular diseases	51 730 (48.97)	41 533 (39.32)	2993 (2.83)	5208 (4.93)	4168 (3.95)
Lung diseases	27 150 (45.82)	25 171 (42.48)	1217 (2.05)	3419 (5.77)	2291 (3.87)
Liver diseases	11 930 (57.95)	7071 (34.35)	805 (3.91)	338 (1.64)	442 (2.15)
Kidney diseases	21 253 (55.01)	12 734 (32.96)	2651 (6.86)	916 (2.37)	1083 (2.80)
Other eligible conditions	2472 (10.86)	18 296 (80.35)	205 (0.90)	796 (3.50)	1000 (4.39)
Specialist palliative care utilization during the last year of life					
Palliative home care	8537 (14.21)	32 866 (54.69)	13 531 (22.52)	4466 (7.43)	691 (1.15)
Inpatient palliative care	2721 (3.45)	18 226 (23.09)	56 366 (71.42)	1208 (1.53)	399 (0.51)
Inpatient shared care	85 739 (45.11)	60 120 (31.63)	38 984 (20.51)	3638 (1.91)	1604 (0.84)
Generalist home care utilization during the last year of life					
Nurse home visit	25 551 (38.77)	32 797 (49.76)	3652 (5.54)	2181 (3.31)	1724 (2.62)
Physician home visit	24 588 (36.72)	34 786 (51.94)	3911 (5.84)	2037 (3.04)	1646 (2.46)
Age group, years					
65–69	43 847 (49.93)	28 858 (32.86)	10 427 (11.87)	2060 (2.35)	2617 (2.98)
70–74	42 228 (46.97)	33 014 (36.72)	9679 (10.76)	2467 (2.74)	2525 (2.81)
75–79	45 634 (43.89)	42 631 (41.00)	9671 (9.30)	3130 (3.01)	2915 (2.80)
80–84	52 495 (42.08)	54 224 (43.47)	10 207 (8.18)	4418 (3.54)	3396 (2.72)
85–89	51 179 (42.76)	51 703 (43.20)	8962 (7.49)	4740 (3.96)	3110 (2.60)
≥90	43 412 (40.65)	48 198 (45.14)	7420 (6.95)	5140 (4.81)	2613 (2.45)
Sex					
Male	162 061 (45.39)	142 145 (39.81)	30 828 (8.63)	11 979 (3.36)	10 001 (2.80)
Female	116 734 (42.31)	116 483 (42.22)	25 538 (9.26)	9976 (3.62)	7175 (2.60)
Salary-based NHI premium quartile ^a					
<Q1	72 164 (53.87)	37 760 (28.19)	14 277 (10.66)	4822 (3.60)	4934 (3.68)
Q1–<Q2	56 543 (42.04)	57 235 (42.55)	11 237 (8.35)	5676 (4.22)	3808 (2.83)
Q2–<Q3	80 241 (37.05)	109 666 (50.63)	16 131 (7.45)	6210 (2.87)	4356 (2.01)
≥Q3	69 847 (47.24)	53 967 (36.50)	14 721 (9.96)	5247 (3.55)	4078 (2.76)

Table 1. Continued

Variables	Hospital (n = 278 795)	Home (n = 258 628)	Inpatient Palliative Care Units (n = 56 366)	Long-term Care Facilities (n = 21 955)	Other Locations (n = 17 176)
Occupation					
Blue collar	92 954 (35.37)	139 329 (53.01)	18 069 (6.87)	6958 (2.65)	5521 (2.10)
White collar	78 505 (47.44)	60 103 (36.32)	16 662 (10.07)	5615 (3.39)	4605 (2.78)
Other	107 336 (52.46)	59 196 (28.93)	21 635 (10.57)	9382 (4.59)	7050 (3.45)
Comorbidity burden					
Charlson Comorbidity Index, mean (SD)	5.66 (3.52)	5.09 (3.68)	7.73 (3.35)	4.34 (3.07)	3.70 (3.21)
Marital status					
Married	139 141 (43.79)	133 765 (42.10)	28 784 (9.06)	7641 (2.40)	8407 (2.65)
Unmarried	12 411 (58.14)	4384 (20.54)	2326 (10.90)	1495 (7.00)	731 (3.42)
Widowed	107 556 (41.65)	112 390 (43.52)	20 889 (8.09)	10 700 (4.14)	6718 (2.60)
Divorced or other	19 687 (55.33)	8089 (22.73)	4367 (12.27)	2119 (5.96)	1320 (3.71)
Urbanization level of one's residence					
High	103 158 (51.33)	62 348 (31.02)	21 694 (10.79)	7508 (3.74)	6256 (3.11)
Medium	88 123 (45.73)	73 446 (38.11)	17 603 (9.13)	7624 (3.96)	5922 (3.07)
Low	87 514 (36.58)	122 834 (51.34)	17 069 (7.13)	6823 (2.85)	4998 (2.09)
Healthcare resources per 10 000 population, mean (SD)					
Hospital beds	42.98 (13.51)	43.46 (13.47)	44.40 (16.04)	44.10 (16.98)	43.09 (14.41)
Intensive care unit beds	3.14 (1.08)	3.06 (0.97)	3.20 (1.14)	3.16 (1.23)	3.16 (1.22)
Physicians	21.43 (8.87)	19.46 (7.58)	21.78 (9.01)	21.84 (9.82)	21.01 (9.12)
Allied healthcare workers	114.44 (38.44)	107.07 (34.04)	116.74 (39.26)	116.04 (42.77)	111.95 (40.70)

Abbreviations: NHI, National Health Insurance; SD, standard deviation.

Notes. Unless otherwise indicated, values are presented as n (row %). Percentages across place-of-death categories sum to 100% within each row; minor discrepancies may occur because of rounding.

^a The salary-based NHI premium was used as a proxy for socioeconomic status, with the quartile cut points being Q1 = NTD 1377, Q2 = NTD 22 800, and Q3 = NTD 26 400. Categories were defined as <Q1, Q1–<Q2, Q2–<Q3, and ≥Q3. NTD indicates New Taiwan dollar.

Temporal patterns also varied with underlying cause of death (Figure 1). From 2014 to 2023, the proportion of hospital deaths increased and that of home deaths declined among cancer decedents. Home death proportions also declined among decedents with dementia and lung disease, although home remained one of the more frequent places of death in these groups. Hospital death proportions were comparatively high among decedents with cardiovascular, liver, and kidney diseases, while those with liver disease showed the highest hospital death proportion (63.7%) in 2023.

Place-of-Death and Specialist Palliative Care Utilization

PoD distributions differed across specialist palliative care service types (Table 1). Among palliative home care users, 54.7% died at home, whereas 71.4% of inpatient palliative care users died in inpatient palliative care units. Inpatient shared care users most often died in hospital (45.1%) or at home (31.6%). When specialist palliative care utilization was defined as receipt of any specialist palliative service, hospital deaths increased and home deaths declined over time among users, while inpatient palliative care unit deaths remained relatively stable (Figure 2A).

Place-of-Death and Generalist Home Care Utilization

Home death accounted for approximately half of deaths among users of nurse home visits (49.8%) and physician home

visits (51.9%; Table 1). Among decedents who received any generalist home care, the home death proportion increased from 39.8% in 2014 to 56.1% in 2023, while the hospital death proportion declined from 47.1% to 32.5% (Figure 2B). Non-users showed contrasting results: hospital deaths increased and home deaths declined over the study period.

Associations Between Underlying Cause of Death and Place-of-Death

Using hospital death as the reference outcome, PoD patterns differed substantially between cancer and non-cancer decedents (Table 2). Compared with cancer decedents, non-cancer decedents had lower adjusted odds of home death (odds ratio [OR], 0.69; 95% confidence interval [CI], 0.68–0.70) and inpatient palliative care unit death (OR, 0.45; 95% CI, 0.43–0.46), and higher adjusted odds of long-term care facility death (OR, 1.81; 95% CI, 1.74–1.89). Disease-specific analyses, however, showed substantial heterogeneity within the non-cancer group (Figure 3; Supplementary file 1, Table S3). Associations with long-term care facility death also varied markedly across underlying causes; for example, dementia was associated with substantially higher odds of long-term care facility versus hospital death (OR, 3.96; 95% CI, 3.72–4.21), whereas liver and kidney diseases showed odds below or close to those for cancer.

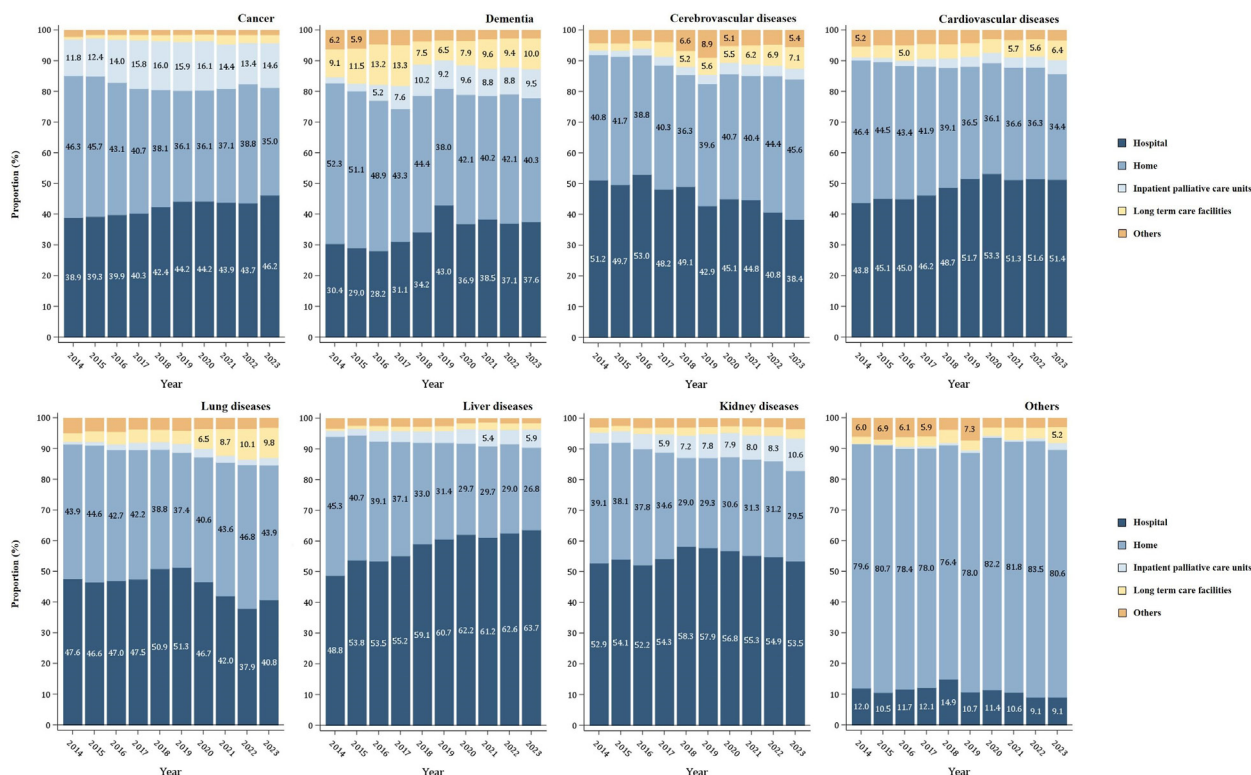


Figure 1. Trends in Place-of-Death Among Older Adults by Underlying Cause of Death, 2014–2023. For visual clarity, percentage labels are shown only for categories accounting for 5% or more of deaths in a given year.

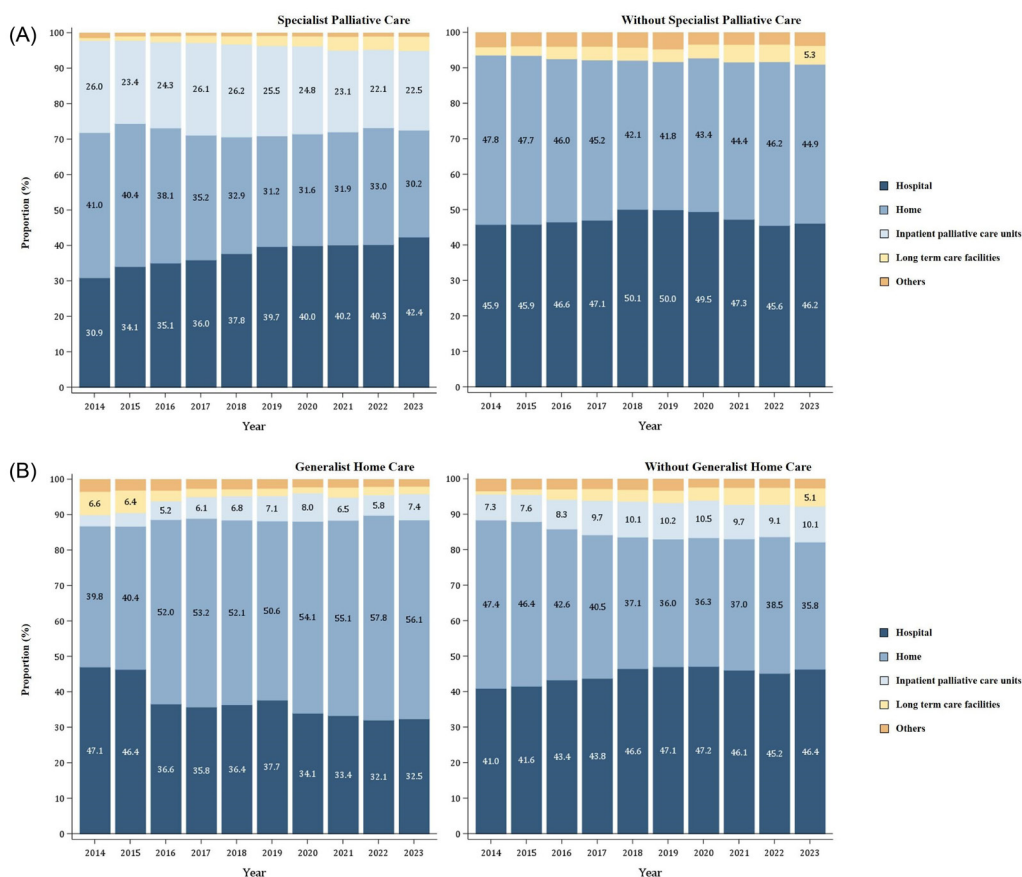


Figure 2. Trends in Place-of-Death by Specialist Palliative Care and Generalist Home Care Utilization, 2014–2023. (A) Specialist palliative care utilization was defined as receipt of any palliative home care, inpatient palliative care, or inpatient shared care during the last year of life. (B) Generalist home care utilization was defined as receipt of any physician or nurse home visit under the non-palliative home care program during the last year of life. For visual clarity, percentage labels are shown only for categories accounting for 5% or more of deaths in a given year.

Table 2. Adjusted Odds Ratio for PoD in Association With Cancer Versus Non-cancer Diagnoses, Palliative Care Utilization, and Home Care Utilization in Taiwan, 2014–2023

Variables	PoD (Reference Category: Hospital Death)			
	Home (95% CI)	Inpatient Palliative Care Units (95% CI)	Long-term Care Facilities (95% CI)	Others (95% CI)
Primary cause of death				
Cancer	1.00	1.00	1.00	1.00
Non-cancer	0.69 (0.68–0.70)	0.45 (0.43–0.46)	1.81 (1.74–1.89)	1.21 (1.16–1.26)
Palliative care utilization (reference to non-user)				
Palliative home care	5.41 (5.27–5.55)	5.85 (5.68–6.03)	13.67 (13.09–14.27)	2.55 (2.35–2.76)
Inpatient palliative care ^a	6.97 (6.67–7.28)	–	5.74 (5.32–6.20)	5.89 (5.26–6.59)
Inpatient shared care	0.66 (0.65–0.67)	3.15 (3.09–3.22)	0.48 (0.46–0.50)	0.33 (0.31–0.35)
Home care services				
Any nurse visit (vs. none)	1.07 (1.04–1.11)	1.01 (0.96–1.07)	1.33 (1.24–1.43)	1.00 (0.92–1.09)
Total nurse visits (continuous, among users) ^b	1.00 (1.00–1.01)	1.02 (1.01–1.03)	1.01 (0.99–1.02)	1.00 (0.98–1.02)
Any physician visit (vs. none)	1.43 (1.39–1.48)	1.01 (0.95–1.07)	0.63 (0.59–0.68)	0.94 (0.86–1.03)
Total physician visits (continuous, among users) ^b	1.02 (1.01–1.03)	0.99 (0.98–1.01)	0.98 (0.96–0.99)	1.00 (0.98–1.01)

Abbreviations: CI, confidence interval; PoD, place-of-death.

^a To estimate the effect of inpatient palliative care utilization on other places of death, we conducted an additional multinomial logistic regression model without deaths occurring in inpatient palliative care units.

^b To examine dose–response associations, we conducted additional multinomial logistic regression models for patients who received home care services (N = 54 327) in which the number of physician and nurse home visits were modelled as continuous variables (number of visits).

Associations of Specialist Palliative Care and Generalist Home Care Utilization with Place-of-Death

Specialist palliative care utilization was strongly associated with PoD (Figure 3), although the pattern varied by service modality. Palliative home care showed the strongest association with home versus hospital death (OR, 5.44; 95% CI, 5.30–5.58), whereas inpatient-based palliative services were strongly associated with death in an inpatient palliative care unit (Figure 3; Supplementary file 1, Table S3).

Generalist home care utilization was also associated with PoD, but the associations with home death were more modest than those observed for specialist palliative home care (Figure 3). Physician and nurse home visits were associated with higher odds of home death, with adjusted ORs of 1.40 (95% CI, 1.36–1.44) and 1.12 (95% CI, 1.08–1.15), respectively. Complete estimates, including those for other covariates, are presented in Table S3.

Discussion

This national study identified persistent differences in PoD despite universal health coverage in Taiwan. Older decedents with non-cancer underlying causes were less likely than those with cancer to die at home or in inpatient palliative care units, indicating persistent disparities across underlying cause-of-death categories. Specialist palliative home care and generalist home care utilization were also associated with PoD, particularly with higher odds of home rather than hospital death. Given the observational, cross-sectional design, these associations should not be interpreted as causal effects. Nevertheless, the findings highlight three policy-relevant domains that warrant attention: referral practices across underlying cause-of-death categories, specialist palliative care accessibility and workforce capacity, and generalist home care delivery. Together, these patterns suggest that formal coverage alone may be insufficient to eliminate differences in

end-of-life care across disease groups, although the specific mechanisms underlying these differences require further investigation.

Three aspects of these findings merit further interpretation. First, the observed differences in PoD across underlying causes of death raise questions about whether palliative care needs are recognized and acted upon similarly across disease groups. Compared with cancer decedents, those with non-cancer conditions had lower adjusted odds of home or inpatient palliative care unit death and higher adjusted odds of long-term care facility death, relative to hospital death. However, the cancer versus non-cancer comparison is best interpreted as an overall summary contrast rather than as the sole analytical classification or as evidence of a uniform non-cancer pattern. In the disease-specific analyses, adjusted associations with PoD varied substantially across non-cancer underlying causes, indicating considerable heterogeneity within the non-cancer group. The pooled contrast therefore provides a broad policy-relevant summary, whereas the cause-specific estimates offer a more granular interpretation of these differences. These patterns should not be interpreted as evidence that underlying cause of death itself determines PoD. Rather, prior studies suggest that prognostic uncertainty, delayed recognition of palliative care needs, and differences in referral practices may contribute to lower and later palliative care use among people with non-cancer illnesses.¹⁹ Although symptom burden may be comparable across cancer and non-cancer populations,⁹ the present study did not directly assess clinical need, referral timing, or the reasons for non-referral. Needs-based referral approaches, including electronic health record triggers and disease-specific pathways, have been proposed in other settings to support earlier identification of patients who may benefit from palliative care.^{20,21} Whether such approaches would be effective and feasible in Taiwan remains an open question for future research.

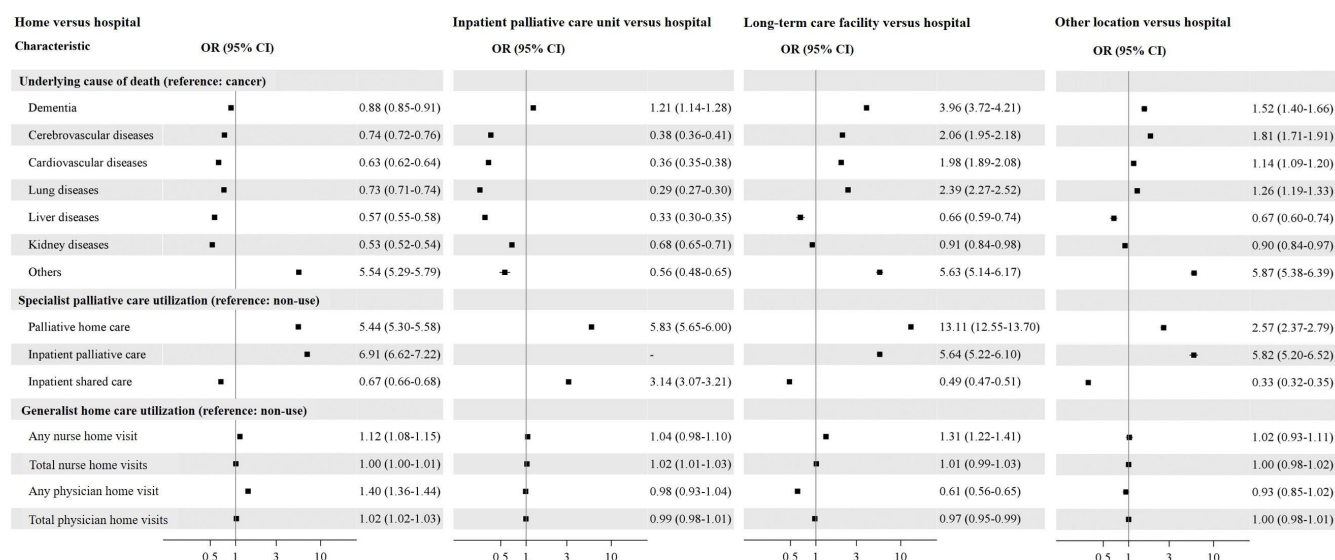


Figure 3. Adjusted Associations of Underlying Cause of Death, Specialist Palliative Care Utilization, and Generalist Home Care Utilization With Place-of-Death. The association between inpatient palliative care utilization and inpatient palliative care unit death could not be estimated because all decedents classified as dying in an inpatient palliative care unit had received inpatient palliative care. This led us to fit an additional multinomial logistic regression model (after excluding inpatient palliative care unit deaths) to estimate associations with the remaining place-of-death categories. Abbreviations: CI, confidence interval; OR, odds ratio.

Second, the descriptive temporal trend among recipients of any specialist palliative care should be interpreted cautiously. This composite group included palliative home care, inpatient palliative care, and inpatient shared care, which represent distinct care settings and, as shown in Figure 3, had markedly different associations with PoD. The observed increase in hospital deaths and decline in home deaths among users may therefore reflect changes over time in the mix of palliative care modalities, patient case mix, or timing of referral rather than an adverse effect of palliative care itself. A recent nationwide study of palliative care recipients in Taiwan similarly found that inpatient shared care was the predominant modality and that modality-specific hospital-death likelihoods rose steadily over a comparable period.²² Because the temporal trend in the present study was descriptive and unadjusted, the modality-specific regression findings provide a more informative basis for interpreting associations between specialist palliative care and PoD.

Palliative home care utilization showed the strongest association with home death, underscoring the potential importance of specialist palliative care access outside hospital settings. Prior evidence suggests that this pattern may relate to symptom management, caregiver support, and continuity of care, although these mechanisms could not be directly examined using the available claims data.^{10,23} Uptake of specialist palliative care has also remained lower and later among non-cancer populations than among cancer populations in Taiwan, a gap that prior literature has attributed to prognostic uncertainty, referral practices, and workforce constraints.^{8,24} Potential contributing factors, including prognostic uncertainty, referral practices, workforce capacity, and provider training, were not directly examined in this study.^{18,25} Telehealth-supported consultation has also been proposed as a means of extending specialist palliative care expertise into home settings, but its contribution to

home death could not be evaluated in the present analysis.²⁶ These factors and approaches should therefore be considered priorities for future implementation and policy research rather than explanations established by our findings.

Third, physician and nurse home visits were associated with higher odds of home rather than hospital death, highlighting the potential relevance of generalist home care within end-of-life care systems. In Taiwan, NHI has supported home nursing and other home-based services since the 1990s. In 2016, the NHI Administration introduced an integrated home care program that expanded physician home visits and multidisciplinary care coordination.¹³ Prior studies from Taiwan,²⁷ Canada,²⁸ and Japan²⁹ have similarly reported associations between continuity or use of community-based care and lower hospital use or a greater likelihood of home death. However, the present study did not directly assess continuity of care, the mechanisms underlying these associations, or coordination between generalist and specialist services. Accordingly, the findings support further evaluation of coordinated models linking generalist home care with specialist palliative care expertise as a potential approach to broadening end-of-life care options.

These findings should also be interpreted in light of the heterogeneity of end-of-life preferences. Although individual preferences were not measured in the present study, prior research indicates that some patients value home death for comfort and familiarity, whereas others may prefer hospital care when home support is perceived as inadequate or caregiver burden is substantial.⁵ People who are widowed or live alone may also be less likely to prefer or achieve home death.³⁰ Given this heterogeneity, the observed associations with home rather than hospital death should not be interpreted as evidence that home death is universally preferable or that a higher proportion of home deaths necessarily indicates better care. The policy relevance of community-based and palliative

services lies instead in their potential to broaden feasible end-of-life care options. Future evaluations should incorporate preference-concordant care and caregiver circumstances rather than rely on PoD alone as a quality indicator.³¹

Taken together, our findings define a focused agenda for further investigation rather than establish specific implementation prescriptions. First, the mechanisms underlying differences in PoD across underlying cause-of-death categories, including possible differences in prognostic recognition, referral timing, and service access, require direct investigation. Second, the modality-specific associations observed across specialist palliative care and generalist home care indicate that these services should not be treated as interchangeable. Third, coordinated models linking generalist home care with specialist palliative care should be evaluated to determine whether they broaden preference-concordant end-of-life care options and address disease-related disparities. For universal coverage systems, particularly in East Asian settings where hospital death remains common,^{29,32} Taiwan provides a relevant case for comparative policy evaluation, although the effectiveness and transferability of specific care models require direct study.

Limitations and Strengths

Several limitations should be acknowledged. First, despite extensive covariate adjustment, the influence of unmeasured confounders not captured in claims data, such as patient and family preferences, functional status, and caregiver availability, cannot be excluded. Second, although the requirement for at least one inpatient admission or emergency department visit during the last year of life excluded only approximately 1.3% of otherwise eligible decedents, it may have preferentially excluded individuals whose end-of-life care occurred primarily in outpatient, home, or long-term care settings and may therefore have underrepresented care trajectories without acute-care utilization. Third, deaths occurring in inpatient palliative care units were identified and analyzed as a separate PoD category. However, all remaining deaths recorded as occurring in hospital were retained within a single hospital category. Because emergency department, intensive care unit, general ward, and other non-palliative hospital locations were not separately identified, potentially distinct hospital-based end-of-life trajectories could not be examined. In addition, although long-term care facilities were treated as a separate PoD category, they may represent the usual place of residence for some older adults. The available data did not allow us to distinguish deaths occurring in a person's usual long-term residential setting from those occurring in a facility used only temporarily. Fourth, our operationalization of home care was limited to NHI-reimbursed services, potentially underestimating the roles of privately funded or informal care. Finally, because the cohort was restricted to older decedents whose underlying causes of death fell within disease categories eligible for palliative care reimbursement, the findings should not be generalized to all older decedents in Taiwan, particularly those with causes of death outside this reimbursement framework. Generalizability may also be limited for older decedents without acute-care utilization and

for countries with healthcare financing systems and cultural contexts that differ from those of Taiwan.

The notable strengths of this study include the use of nationwide linked data from insurance claims and the mortality registry, providing a broad population-level perspective on older decedents within the defined eligibility framework. In addition, service utilization was ascertained from medical claims rather than self-reports, reducing potential exposure misclassification and strengthening internal validity.

Conclusion

Even within a universal coverage system, PoD patterns differed by underlying cause of death, with non-cancer decedents showing lower odds of home or inpatient palliative care unit death than cancer decedents. Associations between specialist palliative care and PoD varied by service modality, while palliative home care and generalist home care utilization were associated with higher odds of home rather than hospital death. These findings highlight disparities across underlying cause-of-death categories and support further investigation of how referral practices and coordinated home-based care models may broaden end-of-life care options.

Acknowledgements

We thank Mei-Hua Chen for her assistance with ethical approval, and Teng-Lung Kuo for his assistance with data application to the Health and Welfare Data Science Center.

Disclosure of artificial intelligence (AI) use

Section(s) of manuscript affected: All sections.

Type of AI tool(s) used: ChatGPT (GPT-5, OpenAI, San Francisco, CA; version updated October 2025).

Purpose of use: Language editing, refinement of section structure, and generation of alternative title options.

Ethical issues

This study was approved by the Human Research Ethics Committee of National Cheng Kung University (HREC-114-0345). Informed consent was waived because all data were de-identified. All procedures complied with the Declaration of Helsinki and its later amendments.

Conflicts of interest

Authors declare that they have no conflicts of interest.

Authors' contributions

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Funding statement

This study was supported by grants from the National Science and Technology Council, Taiwan [NSTC 114-2321-B-006-013]; National Cheng Kung University Hospital, Taiwan [NCKUH-V101-10]. The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; or decision to submit the manuscript for publication.

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Supplementary files

Supplementary file 1 contains Tables S1-S3 and Figures S1-S3.

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