*Original Article*

PALLIATIVE MEDICINE

*Palliative Medicine*
26(1) 80–88

DOI: 10.1177/0269216311406989
pmj.sagepub.com

SAGE

# Impact of age on end-of-life care for adult Taiwanese cancer decedents, 2001–2006

**Siew Tzuh Tang** *Chang Gung University, School of Nursing, R.O.C*
**Tsang-Wu Liu** *National Institute of Cancer Research, National Health Research Institutes, R.O.C*
**Yea-Ing Lotus Shyu** *Chang Gung University, School of Nursing, R.O.C*
**Ean-Wen Huang** *Department of Information Management, National Taipei College of Nursing, R.O.C*
**Shin Lan Koong** *Bureau of Health Promotion, Department of Health, R.O.C*
**Shu Chun Hsiao** *Bureau of Health Promotion, Department of Health, R.O.C*

## Abstract

**Background**: With increasing patient age in Western countries, evidence indicates a pervasive pattern of decreasing healthcare expenditures and less aggressive medical care, including end-of-life (EOL) care. However, the impact of age on EOL care for Asian cancer patients has not been investigated.

**Purpose**: To explore how healthcare use at EOL varies by age among adult Taiwanese cancer patients.

**Methods**: Retrospective cohort study using administrative data among 203,743 Taiwanese cancer decedents, 2001–2006. Age was categorized as 18–64, 65–74, 75–84, and ≥85 years.

**Results**: Elderly (≥65 years) Taiwanese cancer patients were significantly less likely than those 18–64 years to receive aggressive treatment in their last month of life, including chemotherapy, >1 emergency room visits, >1 hospital admissions, >14 days of hospitalization, hospital death, intensive care unit admission, cardiopulmonary resuscitation, intubation, and mechanical ventilation. However, they were significantly more likely to receive hospice care in their last year of life.

**Conclusion**: Elderly Taiwanese cancer patients at EOL received less chemotherapy, less aggressive management of health crises associated with the dying process, and fewer life-extending treatments, but they were more likely to receive hospice care in their last year and to achieve the culturally highly valued goal of dying at home.

## Keywords

Age factors, cancer, elderly, end-of-life care, health services accessibility, palliative care

## Introduction

Cancer is a major public health problem affecting disproportionately more elderly than younger individuals.[1] In the USA and Taiwan, 57%[2] and 47.1%[3] of new cancer cases, and 75.5%[4] and 59.8%[3] of cancer deaths occur among those ≥65 years, respectively. Elderly patients therefore bear the brunt of cancer burden, challenging both healthcare professionals and healthcare institutions.

Patient age has been shown to influence healthcare delivery. A pervasive pattern of decreasing healthcare expenditures and aggressive medical care with age has been demonstrated in almost all areas of cancer care, for example, screening,[5] investigation,[6] and treatment,[7,8] and is now evidenced for end-of-life (EOL) care in the USA,[9,10] Canada,11 western Australia,[12] and the Netherlands.[13] The considerable decrease in EOL care for elderly cancer patients in Western countries persists for aggressive[14] and palliative care services.[15,16]

Age represents the synergistic outcome of biological and developmental life-course phenomena within a

**Corresponding author:**
Professor Siew Tzuh Tang, Chang Gung University, School of Nursing, 259 Wen-Hwa 1st Road, Kwei-Shan, Tao-Yuan, Taiwan, 333, R.O.C
Email: sttang@mail.cgu.edu.tw

cultural context.[17–19] Older populations in developed and highly industrialized Western countries are generally perceived in a more negative, stereotypical light than in Asian cultures, which value elders for their life history and wisdom and grant them an important societal role.[6,18,19] This different value on the social role of the elderly may influence preferred and actual medical care,[20] despite elderly cancer patients having similar symptoms, problems, and needs as their younger counterparts.[21] Therefore, Asian countries might take a different approach to providing EOL care to older than to younger cancer patients based on older patients' social role, even where every citizen is entitled to equal healthcare access, as in Taiwan's National Health Insurance (NHI) system. However, the possibility of need- and/or culture-based inequity in EOL care cannot be verified as the impact of age on EOL care for cancer patients has not been investigated in Asian countries. Therefore, as a first step in improving understanding of EOL care equity in Taiwan, this study explored how healthcare use at EOL varies by age among a cohort of adult Taiwanese cancer patients who died between 2001 and 2006.

## Methods

### Study design and sample

A retrospective cohort design was used by linking individual patient-level data with encrypted personal identification numbers from computerized data of the National Register of Deaths Database (NRDD), the Cancer Registration System (CRS) database, and NHI claims data. These databases were monitored for completeness and accuracy by Taiwan's Department of Health. Taiwan's NHI has the unique characteristics ofuniversal insurance coverage, comprehensive services provided, and a single-payer system with the government as sole insurer. Patients have free access to any healthcare system and provider they choose. Healthcare systems are reimbursed for services provided, and co-payment is waived for patients with recognized major diseases, including malignancy. At the end of 2006, the NHI covered 99.0% of Taiwan's population.[22] The CRS database included 97.34% of incident cancer cases, with 86.80% completeness and 83.51%–90.06% accuracy.[23] The NRDD identified 210,976 cancer deaths (including all ages and disease groups of cancer patients) from 2001 to 2006. Among these cancer decedents, 6126 were excluded because they did not submit any NHI claims for inpatient or outpatient care in the last month of life, leaving a study sample of 204,850 patients who had received medical care in the last month of life. Another 1107 patients <18 years old were excluded, for a final sample of 203,743 adult Taiwanese cancer decedents.

The majority of cancer decedents were male (64.3%), married (69.3%), and with multiple comorbidities (53.2%). The top five cancer sites were lung (20.0%), liver (19.8%), colon-rectum (10.8%), head and neck (8.4%), and stomach (6.9%). Approximately two-thirds (62.4%) of cancer decedents had a metastatic disease. The proportions of patients who survived 1–6, 7–12, 13–24, and ≥25 months post-diagnosis were 36.0%, 17.9%, 18.3%, and 27.9%, respectively. Most cancer decedents' primary hospitals were teaching hospitals (90.4%), and the majority had no inpatient hospice unit (59.0%) (Table 1).

### Measures

*Outcome variables.* Outcome variables were those developed by Earle et al.[24] as indicators of quality EOL care in the last month of life and currently available in administrative data in the last month of life: (1) overuse of chemotherapy; (2) inappropriate treatment resulting in >1 emergency room (ER) visits, >1 hospital admissions, >14 days of hospitalization, an intensive care unit (ICU) admission, or death in a hospital; and (3) underuse of hospice services as measured by lack of or very late referral to hospice (≤3 days before death). Drawing on evidence for the futility of life-extending treatments for terminally ill cancer patients, we also included cardiopulmonary resuscitation (CPR)[25] and intubation for mechanical ventilation.[26]

*Chemotherapy.* Use of chemotherapy was identified from both inpatient and outpatient claims, which specified the codes for all routes of chemotherapy administration but oral.

*ER visits and inpatient hospital admissions.* ER visits were identified from inpatient and outpatient claims. Dates of hospitalization and discharge were identified from inpatient claims. Length of stay for each hospitalization was measured from date of hospital admission until discharge. Admission and discharge on the same day was counted as one day. If a cancer patient had multiple inpatient hospital admissions in the last month of life, lengths of stay were summed across those admissions.

*ICU admission.* ICU admission was ascertained from inpatient hospital claims. Admissions to either coronary care or traditional ICUs were considered ICU admissions.

**Table 1.** Demographic and clinical characteristics of study participants

| Characteristic | *n* | % | Characteristic | *n* | % |
|---|---|---|---|---|---|
| Gender | | | Cancer group | | |
| Male | 130,953 | 64.3 | Lung | 40,673 | 20.0 |
| Female | 72,790 | 35.7 | Liver | 40,363 | 19.8 |
| Age (years) | | | Colon-rectum | 21,989 | 10.8 |
| 18–64 | 81,965 | 40.2 | Head and neck | 17,032 | 8.4 |
| 65–74 | 55,400 | 27.2 | Gastric | 13,991 | 6.9 |
| 75–84 | 52,073 | 25.6 | Pancreatic/bile duct | 11,981 | 5.9 |
| ³85 | 14,305 | 7.0 | Hematological | 10,917 | 5.4 |
| Marital status | | | Breast | 7701 | 3.8 |
| Married | 141,153 | 69.3 | GU system | 7086 | 3.5 |
| Single | 13,489 | 6.6 | Esophageal | 6661 | 3.3 |
| Divorced/separated | 6843 | 3.4 | Cervical | 5049 | 2.5 |
| Widowed | 38,674 | 19.0 | Prostate | 4617 | 2.3 |
| Unknown | 3584 | 1.8 | Brain | 2419 | 1.2 |
| | | | Ovarian | 1897 | 0.9 |
| | | | Other | 11,367 | 5.6 |
| Metastasis | | | Primary hospital teaching status | | |
| No | 76,684 | 37.6 | No | 19,525 | 9.6 |
| Yes | 127,059 | 62.4 | Yes | 183,807 | 90.4 |
| Post-diagnosis survival (months) | | | Ownership of the primary hospital | | |
| 1–2 | 29,840 | 16.2 | Public | 65,657 | 32.2 |
| 3–6 | 36,637 | 19.8 | Non-profit proprietary | 109,801 | 53.9 |
| 7–12 | 32,974 | 17.9 | Private | 28,285 | 13.9 |
| 13–24 | 33,741 | 18.3 | Primary hospital with an inpatient hospice unit | | |
| ³25 | 51,576 | 27.9 | No | 120,246 | 59.0 |
| Comorbidities‡ | | | Yes | 83,497 | 41.0 |
| 0 or 1 | 95,303 | 46.8 | Hospital beds | | |
| 2 | 39,348 | 19.3 | <Q1 | 50,912 | 25.1 |
| ³3 | 69,092 | 33.9 | Q1–Q3 | 99,515 | 49.0 |
| Primary physician's specialty | | | >Q3 | 52,675 | 25.9 |
| Other | 158,257 | 77.7 | Regional hospital beds | | |
| Oncologist | 45,486 | 22.3 | <Q1 | 50,688 | 24.9 |
| | | | Q1–Q3 | 97,563 | 48.0 |
| | | | >Q3 | 55,022 | 27.1 |

GU: genitourinary

***CPR, intubation, and mechanical ventilation.*** CPR, intubation, and mechanical ventilation were identified from inpatient claims by the codes specified for those procedures.

***Use of hospice services.*** Clinical consultant teams with palliative care specialty credentials were not available in Taiwan in 2001–2006. Therefore, hospice services included hospice home care and inpatient hospice unit care only. Regardless of which hospice service a patient was enrolled in, each patient was counted only once. Survival after hospice enrollment was calculated as the interval between the date of first enrollment in hospice care and date of death. Survival for cancer patients enrolled in hospice care and discharged or died on the same day was counted as one day.

***Referral to hospice services in the last three days of life.*** Cancer patients were recognized as referred to hospice services in the last three days of life if their survival after hospice enrollment was $\leq$3 days.

***Death in an acute hospital.*** Place of death was categorized into home and hospital. Death at a nursing

home was not an option in the NRDD, as nursing home services in Taiwan are uncommon and not reimbursed by the NHI. Due to the highly recognized cultural value of dying at home,[27] dying hospitalized patients in Taiwan are commonly discharged 'against medical advice' with artificial respiratory support to allow the patient to die at home. Therefore, if the date of discharge for the last admission was also the date of death,[28] the patient was recognized as dying in the hospital.

*Primary independent variable.* Age, the primary independent variable, was categorized into four groups (18–64, 65–74, 75–84, and ≥85 years). This categorization was based on the observed overall treatment intensity of middle-aged (45–64 years) cancer patients receiving overall treatment intensity more similar to that of younger (18–44 years) adults than of older (>65 years) patients.[29] Furthermore, patients over 65 years old have been suggested to be divided into younger-old (65–74 years), mid-old (75–84 years), and old-old (>85 years) groups to better reflect the complexity of cancer, comorbidity, and old age.[6,30]

*Confounding variables.* Outcome variables were adjusted with five groups of confounding variables[14]: (1) patient demographic and disease characteristics; (2) characteristics of the primary hospital; (3) primary physician specialty; (4) healthcare resources at the hospital and regional level; and (5) historical trend.

*Patient demographics.* Differences in outcome variables were examined across gender and marital status at time of death.

*Disease characteristics.* Disease characteristics included comorbidities, cancer diagnosis, and post-diagnosis survival. Comorbidities were identified from ICD-9 codes for the primary and secondary diagnoses, excluding cancer-related codes, in NHI claims in months 1–12 before death to calculate the Deyo–Charlson comorbidity index.[31]

Diagnosis and date of diagnosis were identified from the CRS database, and metastatic status was identified by ICD-9 codes (196.xx-199.xx). Survival was calculated as the interval (in months) between dates of diagnosis and death.

*Primary physician's specialty.* The patient's primary physician was defined as the first physician seen in the patient's last month of life. The primary physician's specialty was dichotomized into medical oncologist (including hematologists but excluding radiation oncologists, surgical oncologists, gynecological oncologists) and other.

*Characteristics and healthcare resources of the primary hospital.* Characteristics of the primary hospital were teaching status, ownership (public, non-profit proprietary, or private), availability of an inpatient hospice unit, and bed size. Hospice home care in Taiwan was limited. Therefore, 'availability of an inpatient hospice unit' represented the primary hospital's hospice resource. Number of beds was categorized as <first quartile, first to third quartiles, or >third quartile.

*Healthcare resources in the primary hospital's region.* Patients were assigned to a region that included the county where their primary hospital was located, and in turn to a quartile for hospital beds. Regional hospice beds per 10,000 population were calculated for each region where the patient's primary hospital was located.

*Historical trend.* A year-indicator variable was used to examine national trends in EOL care.

### Statistical analysis

The impact of age on each quality indicator of EOL care was examined by multivariate logistic regression using the generalized estimating equation (GEE) method[32] with robust standard errors that account for correlation in the error term due to clustering of individuals in the same hospital and with simultaneous adjustment for all other factors in the model.

## Results

Among the 203,743 adult Taiwanese cancer decedents who died during 2001–2006, the proportions of patients 18–64, 65–74, 75–84, and ≥85 years old were 40.2%, 27.2%, 25.6%, and 7.0%, respectively (for details of participants' demographic and clinical characteristics, see Table 1). About one-fourth (25.4%) of cancer patients <65 years received chemotherapy in the last month of life (Table 2), whereas only 3.3% of cancer decedents >85 years received such treatment in their last month. Approximately one-third and one-half of cancer decedents were admitted to hospital more than once and stayed in hospital more than 14 days in their last month, respectively. About 1 in 5–6 cancer patients made multiple ER visits in their last month of life and approximately two-thirds (63.7%–68.0%) died in a hospital.

Considering life-extending treatments, approximately one-10th of Taiwanese cancer patients used ICU care (8.6%–12.9%) or underwent CPR (9.7%–12.2%) in their last month, whereas 23.5%–26.2% and 27.9%–31.3% were intubated and used a mechanical ventilator to support respiratory function in their

**Table 2.** Impact of age on aggressiveness of end-of-life care for adult Taiwanese cancer decedents, 2001–2006 ($N = 203,743$)

| | Chemotherapy | | | >1 Hospital admissions | | | >14-day hospitalizations | | |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) |
| 18–64[a] | 25.4 | | | 35.7 | | | 58.1 | | |
| 65–74 | 15.1 | 0.45 (0.40–0.50) | 0.59 (0.57–0.62)* | 32.8 | 0.87 (0.84–0.90) | 0.86 (0.83–0.89)* | 52.6 | 0.81 (0.79–0.84) | 0.79 (0.76–0.81)* |
| 75–84 | 8.9 | 0.22 (0.17–0.27) | 0.35 (0.32–0.37)* | 30.8 | 0.79 (0.76–0.82) | 0.80 (0.77–0.82)* | 52.5 | 0.80 (0.76–0.83) | 0.75 (0.72–0.78)* |
| 385 | 3.3 | 0.25 (0.13–0.48) | 0.15 (0.12–0.17)* | 27.1 | 0.65 (0.61–0.69) | 0.69 (0.65–0.74)* | 49.2 | 0.70 (0.66–0.74) | 0.69 (0.65–0.73)* |
| Age (years) | >1 ER visits | | | Hospital death | | | ICU care | | |
| | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) |
| 18–64[a] | 20.7 | | | 68.0 | | | 12.9 | | |
| 65–74 | 19.3 | 0.92 (0.88–0.95) | 0.90 (0.88–0.93)* | 63.7 | 0.82 (0.79–0.86) | 0.83 (0.75–0.87)* | 11.6 | 2.45 (0.96–6.22) | 0.86 (0.80–0.92)* |
| 75–84 | 17.6 | 0.84 (0.80–0.89) | 0.83 (0.80–0.86)* | 64.7 | 0.83 (0.80–0.87) | 0.84 (0.80–0.88)* | 10.8 | 1.76 (0.93–3.31) | 0.77 (0.71–0.85)* |
| 385 | 16.5 | 0.79 (0.73–0.85) | 0.80 (0.75–0.85)* | 63.9 | 0.80 (0.75–0.84) | 0.83 (0.78–0.89)* | 8.6 | 1.45 (0.80–2.63) | 0.64 (0.54–0.75)* |
| Age (years) | CPR | | | Intubation | | | Mechanical ventilator | | |
| | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) |
| 18–64[a] | 9.7 | | | 23.5 | | | 27.9 | | |
| 65–74 | 9.9 | 0.96 (0.93–0.98) | 0.91 (0.88–0.95)* | 24.6 | 1.03 (1.00–1.07) | 0.92 (0.88–0.95)* | 29.4 | 1.05 (1.01–1.09) | 0.95 (0.90–0.99)** |
| 75–84 | 11.8 | 1.03 (1.00–1.06) | 0.93 (0.89–0.97)* | 26.2 | 1.11 (1.07–1.15) | 0.91 (0.87–0.95)* | 31.3 | 1.14 (1.10–1.19) | 0.93 (0.88–0.98)* |
| 385 | 12.2 | 1.00 (0.95–1.05) | 0.86 (0.80–0.92)** | 25.5 | 1.05 (0.99–1.12) | 0.81 (0.75–0.88)* | 31.2 | 1.12 (1.04–1.20) | 0.85 (0.78–0.92)* |
| Age (years) | Hospice care | | | Referral to hospice care within the last 3 days of life ($n = 31,688$) | | | | | |
| | % | OR (95% CI) | AOR (95% CI) | % | OR (95% CI) | AOR (95% CI) | | | |
| 18–64[a] | 16.4 | | | 17.7 | | | | | |
| 65–74 | 15.6 | 0.99 (0.89–1.09) | 1.08 (1.03–1.14)* | 18.2 | 1.03 (0.99–1.09) | 1.00 (0.95–1.06) | | | |
| 75–84 | 14.9 | 0.96 (0.85–1.08) | 1.14 (1.07–1.22)* | 17.2 | 0.97 (0.89–1.06) | 0.94 (0.85–1.03) | | | |
| 385 | 12.8 | 0.83 (0.70–0.98) | 1.10 (1.01–1.20)** | 16.7 | 0.93 (0.83–1.05) | 0.87 (0.75–0.99)** | | | |

[a]Reference

*$p < 0.001$; **$p < 0.05$

OR: unadjusted odds ratio, AOR: adjusted odds ratio, ICU: intensive care unit

last month, respectively (Table 2). However, only 12.8%–16.4% of cancer patients received hospice care in their last year of life and 16.7%–18.2% were referred to hospice care within their last three days.

After adjusting for patient demographics, disease-related characteristics, physician specialty, availability of healthcare resources at the hospital and regional levels, and historical trend, every aspect of EOL care examined differed significantly among the four age groups. Compared to Taiwanese cancer patients 18–64 years old, elderly (≥65 years) cancer patients were significantly less likely to have received aggressive treatment in their last month of life, including chemotherapy, >1 ER visits, >1 hospital admissions, >14 days of hospitalization, hospital death, and life-extending treatments (i.e. ICU care, CPR, intubation, and mechanical ventilation; Table 2).

In contrast to receiving aggressive treatment at EOL, elderly Taiwanese cancer patients were significantly more likely than patients 18–64 years old to receive hospice care in their last year of life (AOR [95% CI]: 1.08 [1.03–1.14] to 1.14 [1.07–1.22]). However, the other three age groups had comparable propensities to be referred to hospice care within their last three days of life, except for Taiwanese cancer patients ≥85 years, who were significantly less likely to be referred to hospice care close to death than those 18–64 years.

## Discussion

Elderly Taiwanese cancer patients, like their Western counterparts, received fewer aggressive treatments and resource-intensive care at EOL as evidenced by markedly decreasing use of chemotherapy[14,28,33] and fewer life-extending treatments, such as ICU care,[14,34–37] CPR,[38] intubation, and mechanical ventilator support[12,39,40] in their last month. In addition, treatment of health crises associated with the dying process decreased with increasing age at death, as indicated by fewer multiple ER visits[41] and hospital admissions,[12,29,37] as well as longer hospitalization[29] at EOL.

However, Taiwanese cancer patients ≥65 years old were significantly more likely than younger patients to use hospice care and to die at home (as evident by lower hospital death rates), in contrast to the trend in reports from Western countries for older cancer patients to be less likely to use or be referred to hospice/palliative care programs[15,16,42] or to die at home.[43,44]

The existing pattern of less aggressive cancer care with age at EOL may represent appropriate clinical decisions by patients, families, and healthcare professionals to curtail aggressive care in older patients who are unlikely to benefit from such care.[45] However, Western industrialized countries currently have limited healthcare resources, which gives rise to major issues of fairness and justice in their distribution to elderly patients.[6] Compared with their younger counterparts, elderly cancer patients are less likely to receive optimal medical,[46] psychological,[47] and spiritual[6,15] treatment/care. However, chronological age should not be the sole criterion to preclude aggressive cancer care, since successful treatment as well as good functional status and quality of life after aggressive treatment have been demonstrated for elderly cancer patients.[48]

In contrast, the less aggressive treatment for elderly Taiwanese cancer decedents may be derived from cultural consideration of ageing and the respected social status given to elders in Taiwan. In traditional Asian culture (such as in Taiwan), time is often experienced as more cyclical, in contrast to the Western world's concept of time as linear and non-repetitive.[19] This cyclical view of human experience is manifested in the traditional belief of the endless cycle of birth, death, and rebirth commonly found in both Buddhism and Hinduism.[19] Therefore, ageing is recognized as a natural process,[18,19] and advanced age may be associated with a greater acceptance of the evolution of illness and impending mortality.[6,18] In Asian cultures, people tend to have less expectation that 'everything' be done for the elderly nearing EOL. Death in older age is more likely to be accepted in Taiwan as 'nature taking its course'. Aggressive curative treatments (such as chemotherapy) and life-extending treatments, which can only be conducted in hospitals, are commonly avoided for terminally ill, elderly cancer patients in Taiwan, in contrast to an expectation that 'everything' be done for young adults nearing EOL. Consequently, elderly Taiwanese cancer patients at EOL have a lower propensity to receive aggressive treatment and to die in an acute care hospital.

Furthermore, the higher propensity for elderly Taiwanese cancer patients than for younger patients to receive hospice care and to die at home may result from the respected social status of elders in Taiwan. Taiwanese elders are especially respected as the repositories of inherited wisdom and life experiences passed down from one generation to the next.[18,19] Taiwanese culture highly values filial piety (*xiao*), familism (*tian lun zhi le* – harmonious family relations and happy family life), and *shou zhong zheng qin* (dying naturally of old age at home in one's bed) – a death that is the most glorious and fortunate way of dying.[27] Currently, 64.3% of elderly Taiwanese live with their children, whereas only one-fifth and one-quarter of the elderly live with an adult child in the USA and Europe, respectively.[49,50] Taiwanese people are highly motivated and have more family caregivers available at home to let their elder family member enjoy *tian lun zhi le* until very close to EOL and to fulfill their wish of *shou zhong zheng qin* as one aspect of the important virtue of filial piety.

Therefore, elderly Taiwanese cancer patients were more likely to die at home as facilitated by hospice care, especially for patients ≥85 years old, who were significantly more likely than other age groups to use hospice care earlier to facilitate home death.

The Taiwanese databases allowed us to examine various indicators of EOL care for an entire adult cancer population, and could effectively be used to monitor Taiwan's progress in EOL cancer care. Such routine reporting may help prioritize targets for improving EOL care of terminally ill adult cancer patients across different age groups. However, no information is available to prospectively investigate patients' needs and preferences for each service and place of death, although some proxy indicators of needs (i.e. comorbidities, cancer diagnosis, and post-diagnosis survival) were included as confounding variables. Our study used administrative data to assess EOL care, which can be an imprecise approach because it depends on the quality of coding and important clinical features regarding patients' needs are frequently not collected in administrative data.[15] Furthermore, people who die cannot always be considered terminally ill. The appropriateness of aggressive treatment at EOL depends on an accurately defined population of patients dying from complications of curative cancer treatment or dying of cancer.[51] This distinction is not ascertained by the NHI claims database.

Despite using rigorous statistical methods and including a broad range of potential confounders, observational studies can never exclude the possibility of residual confounders, such as differences in primary physicians' evaluation of the appropriateness of using chemotherapy, hospitalizations, ER visits, life-extending treatments, and hospice care for cancer patients at EOL. Further prospective research is needed to incorporate patient preferences and physician attitudes towards EOL care services, as well as service-related factors influencing variations in the use of EOL care. This research should be based on an appropriate theory of equity in healthcare utilization and use both quantitative and qualitative research designs to better understand how age influences patterns and outcomes of treatments at EOL. Future studies are also warranted to evaluate the cost effectiveness of interventions aimed at meeting the needs of elderly people, especially considering comorbidity levels, by providing adequate supportive care but avoiding 'overtreatment' and 'over-hospitalization' of terminally ill elderly cancer patients.

## Conclusion

Taiwanese elderly cancer patients, like their counterparts from Western countries, received less chemotherapy, less aggressive management of health crises associated with the dying process (i.e. multiple admissions and ER visits, and prolonged hospitalization), and fewer life-extending treatments (i.e. ICU care, CPR, and intubation with mechanical ventilation support) in their last month of life. However, they were more likely to receive hospice care in their last year and to die at home. Under the Taiwanese cultural norms of recognizing death at older age as 'nature taking its course' and offspring's obligation to fulfill the important virtue of filial piety to achieve their elder family member's wish of *shou zhong zheng qin*, Taiwanese elderly cancer patients may receive culturally appropriate EOL care and achieve the culturally highly valued goal of dying at home.

### Funding

This work was supported by the Bureau of Health Promotion, Department of Health, Taiwan, R.O.C. (grant number DOH96-HP-1510) with partial support from the National Health Research Institute (grant number NHRI-EX99-9906PI) and the National Science Council (grant number NSC 98-2314-B-182-052).

### Conflict of interest statement

None declared.

### References

1. Smith BD, Smith GL, Hurria A, et al. Future of cancer incidence in the United States: burdens upon an aging, changing nation. *J Clin Oncol* 2009; 27: 2758–2765.
2. Yancik R and Ries LA. Cancer in older persons: an international issue in an aging world. *Semin Oncol* 2004; 31: 128–136.
3. Department of Health. 'Cancer Registration Reports', http://crs.cph.ntu.edu.tw/uploadimages/Y95-Table_01.pdf (accessed 16 September 2009).
4. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2009. *CA Canc J Clin* 2009; 59: 225–249.
5. Sheinfeld GS, Gauthier J, Hay J, et al. Cancer screening and aging: research barriers and opportunities. *Cancer* 2008; 113(12 Suppl): 3493–3504.
6. Surbone A, Kagawa-Singer M, Terret C, et al. The illness trajectory of elderly cancer patients across cultures: SIOG position paper. *Ann Oncol* 2007; 18: 633–638.
7. Berger D, Lau M and El-Serag HB. Secular trends in the use, quality, and outcomes of gastrectomy for noncardia gastric cancer in the United States. *Ann Surg Oncol* 2007; 14: 2519–2527.
8. Etzioni DA, El-Khoueiry AB and Beart Jr RW. Rates and predictors of chemotherapy use for stage III colon cancer: a systematic review. *Cancer* 2008; 113: 3279–3289.
9. Bird CE, Shugarman LR and Lynn J. Age and gender differences in health care utilization and spending for Medicare beneficiaries in their last years of life. *J Palliat Med* 2002; 5: 705–712.

10. Levinsky NG, Yu W, Ash A, et al. Influence of age on Medicare expenditures and medical care in the last year of life. *J Am Med Assoc* 2001; 286: 1349–1355.
11. Payne G, Laporte A, Deber R, et al. Counting backward to health care's future: using time-to-death modeling to identify changes in end-of-life morbidity and the impact of aging on health care expenditures. *Milbank Q* 2007; 85: 213–257.
12. Moorin RE and Holman CD. The cost of in-patient care in Western Australia in the last years of life: a population-based data linkage study. *Health Pol* 2008; 85: 380–390.
13. Polder JJ, Barendregt JJ and van Oers H. Health care costs in the last year of life–the Dutch experience. *Soc Sci Med* 2006; 63: 1720–1731.
14. Earle CC, Neville BA, Landrum MB, et al. Trends in the aggressiveness of cancer care near the end of life. *J Clin Oncol* 2004; 22: 315–321.
15. Burge FI, Lawson BJ, Johnston GM, et al. A population-based study of age inequalities in access to palliative care among cancer patients. *Med Care* 2008; 46: 1203–1211.
16. Burt J and Raine R. The effect of age on referral to and use of specialist palliative care services in adult cancer patients: a systematic review. *Age Ageing* 2006; 35: 469–476.
17. Levy BR, Ashman O and Slade MD. Age attributions and aging health: contrast between the United States and Japan. *J Gerontol B Psychol Sci Soc Sci* 2009; 64: 335–338.
18. Yun RJ and Lachman ME. Perceptions of aging in two cultures: Korean and American views on old age. *J Cross Cult Gerontol* 2006; 21: 55–70.
19. Helman CG. Cultural aspects of time and ageing. Time is not the same in every culture and every circumstance; our views of aging also differ. *EMBO Rep* 2005; 6 Spec No: S54–S58.
20. Blackhall LJ, Murphy ST, Frank G, et al. Ethnicity and attitudes toward patient autonomy. *J Am Med Assoc* 1995; 274: 820–825.
21. Teunissen SC, de Haes HC, Voest EE, et al. Does age matter in palliative care? *Crit Rev Oncol Hematol* 2006; 60: 152–158.
22. Bureau of National Health Insurance. 'NHI Profile', http://www.nhi.gov.tw/webdata/AttachFiles/Attach_10162_1_2007NHIprofile.pdf (accessed 16 September 2009).
23. Bureau of Health Promotion. 'Cancer Registry Annual Report, 2003 Taiwan', http://crs.cph.ntu.edu.tw/crs_c/annual.html (accessed 16 September 2009).
24. Earle CC, Park ER, Lai B, et al. Identifying potential indicators of the quality of end-of-life cancer care from administrative data. *J Clin Oncol* 2003; 21: 1133–1138.
25. Reisfield GM, Wallace SK, Munsell MF, et al. Survival in cancer patients undergoing in-hospital cardiopulmonary resuscitation: a meta-analysis. *Resuscitation* 2006; 71: 152–160.
26. Soares M, Depuydt PO and Salluh JI. Mechanical ventilation in cancer patients: clinical characteristics and outcomes. *Crit Care Clin* 2010; 26: 41–58.
27. Tang ST, Liu TW, Lai MS and McCorkle R. Discrepancy in the preferences of place of death between terminally ill cancer patients and their primary family caregivers in Taiwan. *Soc Sci Med* 2005; 61: 1560–1566.
28. Barbera L, Paszat L and Qiu F. End-of-life care in lung cancer patients in Ontario: aggressiveness of care in the population and a description of hospital admissions. *J Pain Symptom Manag* 2008; 35: 267–274.
29. Rose JH, O'Toole EE, Dawson NV, et al. Age differences in care practices and outcomes for hospitalized patients with cancer. *J Am Geriatr Soc* 2000; 48(5 Suppl.): S25–S32.
30. Given B, Given C, Azzouz F, et al. Physical functioning of elderly cancer patients prior to diagnosis and following initial treatment. *Nurs Res* 2001; 50: 222–232.
31. Deyo RA, Cherkin DC and Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *Clin Epidemiol* 1992; 45: 613–619.
32. Burton P, Gurrin L and Sly P. Extending the simple linear regression model to account for correlated responses: an introduction to generalized estimating equations and multi-level mixed modeling. *Stat Med* 1998; 17: 1261–1291.
33. Emanuel EJ, Young-Xu Y, Levinsky NG, et al. Chemotherapy use among Medicare beneficiaries at the end of life. *Ann Intern Med* 2003; 138: 639–644.
34. Angus DC, Barnato AE, Linde-Zwirble WT, et al. Use of intensive care at the end of life in the United States: an epidemiologic study. *Crit Care Med* 2004; 32: 638–643.
35. Dy SM, Wolff JL and Frick KD. Patient characteristics and end-of-life health care utilization among Medicare beneficiaries in 1989 and 1999. *Med Care* 2007; 45: 926–930.
36. Sharma G, Freeman J, Zhang D and Goodwin JS. Trends in end-of-life ICU use among older adults with advanced lung cancer. *Chest* 2008; 133: 72–78.
37. Van den Block L, Deschepper R, Drieskens K, et al. Hospitalisations at the end of life: using a sentinel surveillance network to study hospital use and associated patient, disease and healthcare factors. *BMC Health Serv Res* 2007; 7: 69.
38. Goodlin SJ, Zhong Z, Lynn J, et al. Factors associated with use of cardiopulmonary resuscitation in seriously ill hospitalized adults. *J Am Med Assoc* 1999; 282: 2333–2339.
39. Chalfin DB and Carlon GC. Age and utilization of intensive care unit resources of critically ill cancer patients. *Crit Care Med* 1990; 18: 694–698.
40. Hamel MB, Davis RB, Teno JM, et al. Older age, aggressiveness of care, and survival for seriously ill, hospitalized adults. SUPPORT Investigators. Study to understand prognoses and preferences for outcomes and risks of treatments. *Ann Intern Med* 1999; 131: 721–728.
41. Burge F, Lawson B and Johnston G. Family physician continuity of care and emergency department use in end-of-life cancer care. *Med Care* 2003; 41: 992–1001.
42. Walshe C, Todd C, Caress A and Chew-Graham C. Patterns of access to community palliative care services: a literature review. *J Pain Symptom Manag* 2009; 37: 884–912.
43. Davies E, Linklater KM, Jack RH, Clark L and Møller H. How is place of death from cancer changing and what affects it? Analysis of cancer registration and service data. *Br J Canc* 2006; 95: 593–600.

44. Mystakidou K, Parpa E, Tsilika E, et al. Where do cancer patients die in Greece? A population-based study on the place of death in 1993 and 2003. *J Pain Symptom Manag* 2009; 38: 309–314.
45. Krzyzanowska MK, Regan MM, Powell M, et al. Impact of patient age and comorbidity on surgeon versus oncologist preferences for adjuvant chemotherapy for stage III colon cancer. *J Am Coll Surg* 2009; 208: 202–209.
46. Payne G, Laporte A, Foot DK, et al. Temporal trends in the relative cost of dying: evidence from Canada. *Health Pol* 2009; 90: 270–276.
47. Hewitt M and Rowland JH. Mental health service use among adult cancer survivors: analyses of the National Health Interview Survey. *J Clin Oncol* 2002; 20: 4581–4590.
48. Bernardi D, Errante D, Tirelli U, et al. Insight into the treatment of cancer in older patients: developments in the last decade. *Canc Treat Rev* 2006; 32: 277–288.
49. Department of Statistics, Ministry of the Interior. http://www.moi.gov.tw/stat/ (accessed 11 March 2008)
50. Pezzin LE, Pollak RA and Schone BS. Efficiency in family bargaining: living arrangements and caregiving decisions of adult children and disabled elderly parents. *CESifo Econ Stud* 2007; 53: 69–96.
51. Gagnon B, Mayo NE, Laurin C, et al. Identification in administrative databases of women dying of breast cancer. *J Clin Oncol* 2006; 24: 856–862.