

Original Research Article

Malignant neoplasm of the heart: evaluating disparities in place of death in the United States using CDC-WONDER database over 22 years

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ABSTRACT

Background: The aim of this study was to evaluate the disparities in place of death due to malignant neoplasms of heart based on age group, gender, race, and census region of the USA, via CDC-WONDER data.

Methods: Data was collected from CDC-WONDER using the ICD-11 code: C38. Data included all deaths occurring between 1999 and 2020, and was categorized by bridged-race categories. The data was extracted on August 29, 2023, and exported to Microsoft Excel. Statistical analysis included univariate logistic regressions and odds ratios (OR), done via STATA and R software, and prediction of future trends via ARIMA model.

Results: Out of a total of 5,334 patient deaths analyzed, those aged 25-74 experienced death more frequently took place in medical or nursing facilities. Death more frequently occurred at home or in hospice in the Midwest, south, and west USA. Asian or Pacific Islanders and Black or African American patients have experienced death more frequently occurs in medical or nursing facilities.

Conclusions: Hence, there is a need to focus on improving access to end-of-life care regarding malignant neoplasms of the heart in hospitals and nursing facilities for those over 85 and in the Midwest, south, and west and to implement future measures to improve end-of-life care for patients.

Keywords: End-of-life care, Home, Hospital, Malignant neoplasm of heart, Medical facilities, Mortality trends, Nursing facilities

INTRODUCTION

The perception of death as the “final event” has evolved with advancements in medicine. Marked survival benefits seen with restoring blood flow to the heart and lungs via cardiopulmonary resuscitation (CPR) and using a defibrillator on patients exhibiting pulseless electrical activity (PEA) or ventricular fibrillation (VF), for example, have made it difficult to define death as a final state.¹ The study of ethical problems in medicine and

biomedical and behavioral research defined death as either (1) irreversible cessation of both circulatory and respiratory functions or (2) irreversible cessation of all functions of the brain, including the brain stem.² In both instances, achieving optimal end-of-life care has continued to spark conversations.

The concept of attaining a “good” death is one that is personal and equipped with psychosocial support while voicing the place of choice.³ Places in which death can

occur include the home, hospice center, nursing home, hospital, or another medical facility. While hospitals and nursing homes employ skilled clinicians for emergent life-saving measures, home and hospice centers focus on palliative measures aimed at preserving patient autonomy. This is of particular importance for cancer patients who wish to relieve symptoms with the desired existential support when life expectancy is less than 6 months.⁴ However, the time of death in cancer patients is not predictable, and thus death can occur in varying locations.

Malignant neoplasms of the heart exemplify such unpredictability, especially if they are initially suspected to be benign myxomas that later rapidly metastasize.⁵ The obstructive, embolic, and neurological manifestations can prove ominous, presenting as acute myocardial infarctions (MI) or strokes. Morbidity in such cancer patients often stems from delayed diagnosis, leading to poor prognosis, suffering, and unexpected death.⁶ To understand the challenges such cancer patients encounter in deciding on end-of-life care, a closer look at the disparities seen in their place of death is warranted.

Aims and objectives

The aim of this study was to evaluate the disparities in place of death due to malignant neoplasms of heart based on age group, gender, race, and census region of the USA. The study also aimed to identify any associations between the demographic variables.

METHODS

Study design and setting

This cross-sectional observational study was conducted using de-identified data from the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (CDC-WONDER) Database.⁷ The CDC-WONDER is a comprehensive online directory developed by the CDC that contains a wide range of public health data and information provided to the CDC's National Center for Health Statistics through the vital statistics cooperative program. As the study was done using this database, which is a publicly accessible and free-to-use database, the study was deemed exempt from ethical approval.

Data collection

The query-based feature to analyze and aggregate the mortality data on malignant neoplasms of the heart, mediastinum, and pleura (International Classification of Diseases-11 code: C38) between 1999 and 2020 by bridged-race categories.

The data was extracted on August 29, 2023, with the analysis and interpretation taking place between August 29th, 2023 and September 4th, 2023. Inclusion criteria was all deaths reported due to malignant neoplasm of heart

from 1999-2020 in the United States in the Centers for Disease Control and Prevention's Wide-ranging Online Data for Epidemiologic Research (WONDER) database.

The place of death consisted of three categories listed as home or hospice facility, medical or nursing facility (inpatient, outpatient, emergency medical facility, dead on arrival to a medical facility, medical facility not otherwise specified), and others, which included unknown and other locations of death. Patient demographic characteristics were identified as 10-year age groups (15-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, ≥85 years), gender (female, male), census region (Northeast, Midwest, South, and West), and race (American Indian or Alaska Native, Asian or Pacific Islander, Black or African American, and White). The data was exported to the latest version of a Microsoft Excel sheet. Based on the categories of 10-year age group, gender, census region, and race, the total number of deaths was calculated for patients with malignant neoplasms of the heart, mediastinum, and pleura whose site of death was home or hospice from 1999 to 2020. Using the aggregate data, univariate logistic regression analyses were carried out using STATA version 15 and R version 3.6.3. The estimated odds ratios (OR) and related 95% confidence intervals (CI) were derived to look for statistically significant associations (p value <0.05) between place of death and patient demographic factors.

Furthermore, the autoregressive integrated moving average (ARIMA) Model (1,0,0) for predicting future values was employed. This model uses time-series historical data to comprehend a data set more fully or to anticipate future patterns. In our study, the forecasting is done until 2025 using data from 1999 to 2020. It has enabled us to predict the upcoming trends in mortality rates of home or hospice-related deaths in accordance with the above-mentioned four patient demographic characteristics.

RESULTS

Aggregate data on 5571 deaths from 1999-2020 for malignant neoplasms of the heart was obtained from the CDC WONDER database.

Table 1 shows the number of deaths based on place of death: home or hospice, medical facility or nursing home, and others in heart neoplasms. Based on ten-year age groups, the minimum number of deaths in home or hospice care was 12 in the 15-24 age group and the maximum was 629 in the 85+ age group. In the case of medical facilities or nursing homes, zero deaths were reported in 15-24-year-olds, while a maximum of 735 deaths in more than 85-year-olds were reported. In other settings, people in age groups 15-24 years and 25-34 years have a minimum death rate of 0 and a maximum death rate of 61 in age groups older than 85 years. Based on gender, men have a higher number of deaths than females in settings such as home or hospice, a medical

facility or nursing home, and others. In male patients, in home or hospice settings, 1256 deaths were reported,

1675 deaths in medical facilities, and 119 deaths in settings listed as others.

Table 1: Place of death.

Variables	Home or hospice (n=2252)	Medical facility or nursing (n=3077)	Others (n=242)
Age (years)			
15-24	12	0	0
25-34	36	83	0
35-44	65	141	13
45-54	83	191	11
55-64	169	312	14
65-74	334	484	31
75-84	492	604	47
>85	629	735	61
Gender			
Female	1008	1401	117
Male	1256	1675	119
Census region			
Census region 1: northeast	266	566	21
Census region 2: midwest	456	680	63
Census region 3: south	911	1059	120
Census region 4: west	631	771	43
Race			
American Indian or Alaska native	0	13	0
Asian or Pacific Islander	49	98	0
Black or African American	178	360	20
White	2025	2606	222

Table 2: Predictors of home or hospice death.

Variables	Univariate logistic regression		
	Odds ratio	95% confidence interval	P value
Age (years)			
15-24	963789.256	(0, 3.51246360502204e+137)	0.929
25-34	0.536	(0.355, 0.81)	0.003*
35-44	0.522	(0.38, 0.717)	<0.001*
45-54	0.508	(0.382, 0.677)	<0.001*
55-64	0.641	(0.511, 0.804)	<0.001*
65-74	0.802	(0.664, 0.969)	0.022*
75-84	0.935	(0.785, 1.113)	0.448
>85	1.0 (Reference)		
Gender			
Male	1.054	(0.947, 1.174)	0.334
Female	1.0 (Reference)		
Census region			
Census region 1: northeast	1.000 (Reference)		
Census region 2: midwest	1.354	(1.125, 1.631)	0.001*
Census region 3: south	1.705	(1.44, 2.018)	<0.001*
Census region 4: west	1.711	(1.431, 2.045)	<0.001*
Race			
American Indian or Alaska native	0	(0, 4.505083530928e+120)	0.929
Asian or Pacific Islander	0.698	(0.493, 0.989)	0.043*
Black or African American	0.654	(0.543, 0.789)	<0.001*
White	1.000 (Reference)		

The significant p values (<0.05) are marked with asterisk (*).

Based on race, zero deaths were reported in American Indians or Alaska Natives, and the maximum deaths in 2025 were in whites. In a medical facility or nursing home, the minimum number of deaths was 13 for American Indians or Alaska natives and the maximum was 2606 for whites. In others, there were no deaths among American Indians or Alaska natives, Asians, or Pacific Islanders, and a maximum of 222 deaths among whites.

Based on age, considering more than 85 years as a reference, the age group of 15-24 years has the 963789.256 times highest likelihood of deaths and the lowest of 0.508 times in the age group of 45-54 years. Based on gender, males have 1.054 times the likelihood of dying at home or in a hospice center compared to females. Taking northeast census region 1 as reference, west region 4 has 1.711 times more deaths compared to 1.705 deaths in south region 3 and 1.354 deaths in Midwest region 2.

Based on race, taking white as a reference, all other races have a lower likelihood of death: 0 for American Indians or Alaska Natives, 0.698 for Asians or Pacific islanders, and 0.654 for blacks or African Americans.

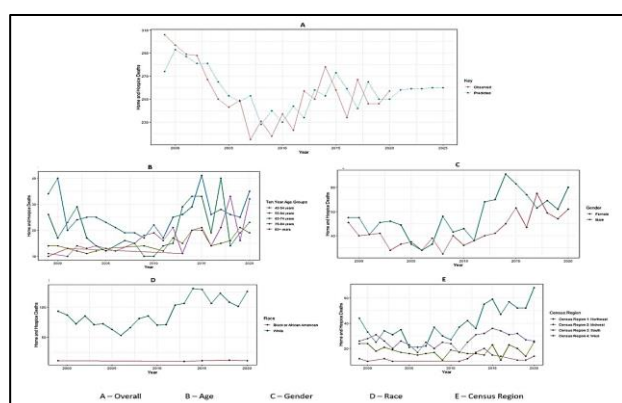


Figure 1: (A) overall trends in mortality (B) mortality trends based on age (C) mortality trends based on gender (D) mortality trends based on race (E) mortality trends based on census region.

Figure 1 highlights home or hospice death trends for heart neoplasms in 1999-2020. Figure 1A highlights the observed vs. predicted deaths from 1999-2020. Figure 1B highlights the variation in trend in age groups 65-74 years and 75-84 years. In age groups older than 85 years, there is an increasing trend. Figure 1C shows the number of deaths in comparison to gender. Figure 1D shows an increasing mortality trend in different races.

DISCUSSION

To study the mortality trends of malignant neoplasms, 22 years of data was collected from the CDC WONDER database.

Overall, the data revealed that majority of deaths due to malignant neoplasm of the heart took place in medical facilities or nursing facilities, followed by home or hospice. When analysing the deaths based on age group, the 85-year-old and above age group had the highest number of fatalities. This mortality trend is shown to have a high fatality rate consistent among all the settings of home and hospice care, medical or nursing facilities, or any other setting as a place of death.

Evaluating the number of deaths under the criteria of gender, it is found that the mortality trend was high in males and consistent regardless of the setting of home and hospice care, medical or nursing facilities, or any other setting as a place of death. In an evaluation under geographical settings, the South Region had a significantly higher number of deaths than other regions. This trend remains consistent among all categories of place of death regarding the cases of malignant neoplasms of the heart over the course of 22 years.

Considering age as a factor, we observe that the odds of death at home or in hospice care increase drastically with age. We have set the reference to 1.0 for the age group. The odds ratio for the age group of 25-34 years was 0.536, which was increased to 0.935 for the age group of 75-84 years. This shows that there is a significant increase in the number of deaths in the home or hospice setting due to malignant neoplasms of the heart in the older age groups. However, it has also been observed that the number of deaths at medical or nursing facilities is higher than the deaths at home or in hospice settings. This can be explained by stating that, as people age more than 65, they experience many health issues for which they prefer regular care and multiple check-ups.⁸ Thus, it is increasing their chances of likely being in a medical or nursing facility at the time of death. This shows the trend of an increasing number of people aged more than 65 dying due to malignant neoplasms of the heart in medical or nursing facilities.⁸

When the criteria of gender are considered, males were found to have a high mortality trend with an odds ratio of 1.054 when compared to the females. A study by Ohman et al, observed that there are disparities within the multidisciplinary field of cardio-oncology.⁹

Among the census regions and the northeast census region being used as references, it is found that the south census region has a higher number of deaths. This data implies that there are higher odds ratios in the south and west, at 1.705 and 1.711, respectively. These regional differences and disparities with increased risk in certain regions suggest further investigation. The Shi et al study states the association between primary care and income inequality on all-cause, heart disease, and cancer mortality at country-level differences in urban and non-urban areas.¹⁰

Among races, there is a high number of deaths noted in the white race, with the white race taken as a reference along with the odds ratios of Asian races and black races being 0.698 and 0.654, respectively. As a setting of death, it is found that more deaths are found in medical or nursing facilities compared to other settings.¹¹

Upon evaluating the data of deaths in home or hospice care each year, there is an increase in number of deaths due to the increasing mortality trend of malignant neoplasms of the heart.

In this study, the latest data from 2021-2023 is not included. Malignant tumors of the heart were not classified based on subcategories of primary or metastatic malignant tumors. Future analysis and studies can be done on the basis of data availability through classification based on subcategories.

CONCLUSION

This study concluded that the absolute number of deaths in home and hospice for patients of malignant neoplasm of heart, was highest for 85+ years age group, males, the south region, and the White population. With the rapid advancements in healthcare, it is pertinent that measures are taken to ensure patients can have a good death with improved quality of dying. It is also important to acknowledge the additional challenges of providing palliative care to individuals with malignant neoplasm.

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