Trends in Place of Death for Individuals With Cardiovascular Disease in the United States

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Cardiovascular disease (CVD) is the leading cause of death globally and medical advances have changed why, when, and how patients with CVD die (1). However, little is known about where patients with CVD die. Place of death affects the end-of-life experience and often does not align with patient preferences (2). Our objective was to assess trends and factors associated with location of death among CVD patients in the United States.

METHODS

study setting.

We analyzed the Mortality Multiple Cause-of-Death Public Use Record from 2003 to 2017 from the National Center for Health Statistics, which provides mortality data for all deaths in the United States, merged with death certificate data from the Centers for Disease Control and Prevention Wide-Ranging OnLine Data for Epidemiologic Research database. We included natural deaths between 2003 and 2017 for which CVD was identified as underlying cause of death, defined as the disease or injury that initiated the events leading directly to death as entered by the physician on the death certificate. In cases of multiple comorbidities, common in persons with CVD, underlying cause is determined by sequence of conditions on

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the certificate, implantable cardioverter-defibrillator provisions, and associated selection rules and modifications (3). Deaths due to accident, suicide, self-inflicted injury, homicide, pending investigation, or that could not be determined, as well as observations with unknown place of death were excluded.

key measures.

Place of death categories included hospital, home, nursing facility or long-term care, inpatient hospice facility, and other (including outpatient medical facility, emergency department, and dead-on-arrival at the hospital). Categories do not include any services, such as hospice care, that may have been provided therein. We subdivided CVD deaths, by diagnosis subtypes using International Classification of Diseases-Tenth Revision codes.

Decedent demographic characteristics included race, ethnicity, sex, marital status, education level, and rural-urban status. Geographic variables were incorporated as summary statistics because patient-level data were not available in the public use file.

statistical approach.

We used multivariable logistic regression to evaluate associations between demographic characteristics and place of death for years 2013 to 2017. Models adjusted for decedent demographics, marital status, education level, CVD subtype, and year of death. Odds ratios (ORs) with 95% confidence intervals (CIs) were generated with unique model for each place of death, defined as a binary indicator. We chose binary over multinomial models for interpretability. Huber-White standard errors were generated to estimate CI robust to unknown correlations in the outcome. Analyses were conducted using Stata software package version 15.0 (Stata Corp., College Station, Texas). Two-tailed p value of <0.05 was considered statistically significant. There was no adjustment for multiple comparisons.

RESULTS

Between 2003 and 2017, 12.3 million deaths were attributed primarily to CVD (Table 1). Nearly one-half of these were attributed to ischemic heart disease (48.2%), followed by cerebrovascular disease or stroke (16.7%), and heart failure or cardiomyopathy (10.6%).

In 2003, 330,905 CVD deaths occurred in the hospital (36.5%), decreasing to 234,703 (27.3%) in 2017, whereas nursing facility deaths reduced from 228,140 (25.1%) to 176,787 (20.6%). Deaths at home increased from 192,986 (21.3%) in 2003 to 265,133 (30.9%) in 2017, whereas deaths in hospice facilities increased to 51,243 (6.0%) by 2017.

Trends in place of death by urbanization largely remained unchanged over time. In 2017, a greater percentage of decedents in large central metropolitan areas (29.2%) died in the hospital and a lower percentage (18.3%) died in a nursing facility. Among decedents in nonmetro areas, a greater percentage died in a nursing facility (23.4% in micropolitan and 22.7% in noncore areas) and fewer died in a hospice facility (4.0% in micropolitan and 3.2% in noncore areas). Hospice facility was the location of death for a greater proportion of decedents in medium (7.6%) and large fringe (7.1%) metropolitan areas.

The Mountain census region had the greatest proportion of home deaths (37%) and lowest proportion of hospital deaths in 2017 (23.6%). The East South Central region had the greatest proportion of hospital deaths in 2017 (32.1%). New England had the smallest percentage of home deaths in the country with only 27.2% in 2017 and experienced the smallest reduction in hospital deaths from 2003 to 2017 (5.6%). In 2017, 11.9% of deaths in the South Atlantic occurred in a hospice facility whereas only 2% of deaths in the Pacific division were in hospice facilities.

Whereas the difference in hospital deaths between Hispanics and non-Hispanics reduced from 10.2% to 7.8%, the difference in hospital deaths between blacks and whites actually increased from 4.9% to 5.3% between 2003 and 2017. Increases in use of hospice facilities and reductions in nursing facility and hospital deaths were similar across racial groups.

Increasing home and/or hospice facility deaths and decreasing nursing facility and/or hospital deaths were seen across most CVD diagnoses. The greatest increases in home deaths occurred among deaths due to ischemic heart disease or hypertensive disorders, increasing about 10 percentage points over the period. The proportion of patients dying in the hospital reduced over the period in all CVD subtypes except for conduction disorders, which showed a slight increase from 34.2% in 2003 to 34.5% in 2017. The rate of hospital deaths declined by about 10 percentage points over the period among deaths due to stroke, heart failure, ischemic heart disease, and hypertensive disorders. Rates of hospice facility deaths increased the most among stroke and heart failure deaths, reaching 11.9% and 8.2%, respectively, in 2017.

logistic regression results.

Of 4,118,803 CVD deaths between 2013 and 2017, 3,787,493 (92.0%) met inclusion criteria for regression analysis. Cardiovascular diagnosis, age, sex, race and ethnicity, marital status, and education level were all significantly associated with place of death. Odds of home and hospital deaths declined with age while odds of nursing facility and hospice facility deaths increased with age. For example, decedents >85 years of age had greater odds of nursing facility (OR: 9.81; 95% CI: 9.40 to 10.25) or hospice facility (OR: 3.10; 95% CI: 3.02 to 3.19) death compared with decedents <65 years of age. Relative to female decedents, the odds of a home or hospice facility death were greater for male decedents (OR: 1.17; 95% CI: 1.17 to 1.18) and (OR: 1.01; 95% CI: 1.01 to 1.04), respectively, whereas the odds of a hospital or nursing home death were lower (OR: 0.96; 95% CI: 0.95 to 0.96) and (OR: 0.82; 95% CI: 0.81 to 0.83), respectively. Relative to white decedents, nonwhite decedents had reduced rates of death in a home, nursing facility, or hospice facility and increased rates of death in the hospital. For example, black decedents had increased odds of a hospital death (OR: 1.29; 95% CI: 1.27 to 1.30), and reduced odds of home death (OR: 0.84; 95% CI: 0.81 to 0.87), and nursing facility death (OR: 0.75; 95% CI: 0.73 to 0.77) relative to white decedents. Decedents of Hispanic ethnicity had reduced odds of death in a home (OR: 0.94; 95% CI: 0.93 to 0.96), nursing facility (OR: 0.58; 95% CI: 0.57 to 0.59) or hospice facility (OR: 0.84; 95% CI: 0.83 to 0.86) and greater odds of death in a hospital (OR: 1.49; 95% CI: 1.47 to 1.50) compared with non-Hispanics.

Relative to nonmarried decedents, married decedents had increased odds of death in a hospital (OR: 1.38; 95% CI: 1.37 to 1.39) or hospice facility (OR: 1.08; 95% CI: 1.06 to 1.11) and reduced odds of death at home (OR: 0.87; 95% CI: 0.85 to 0.89) or in a nursing facility (OR: 0.59; 95% CI: 0.59 to 0.60). Relative to decedents with less than high school education, decedents with some college had reduced odds of death in a hospital (OR: 0.96; 95% CI: 0.96 to 0.97) or nursing facility (OR: 0.89; 95% CI: 0.88 to 0.89) and increased odds of death in a home (OR: 1.08; 95% CI: 1.06 to 1.09).

Relative to ischemic heart disease, patients with aortic stenosis (OR: 2.47; 95% CI: 2.39 to 2.56) and stroke patients (OR: 2.14; 95% CI: 2.07 to 2.20) had greater odds of hospital death, whereas stroke patients had greater odds of hospice facility (OR: 3.30; 95% CI: 3.22 to 3.29) and nursing facility (OR: 1.25; 95% CI: 1.24 to 1.25) death. Stroke patients also had lower odds of home death (OR: 0.43; 95% CI: 0.42 to 0.45) versus those with ischemic heart disease. Patients dying of hypertensive heart disease had the greatest odds of home death (OR: 1.37; 95% CI: 1.35 to 1.39) and lowest odds of hospital death (OR: 0.57; 95% CI: 0.56 to 0.58).

DISCUSSION

The analysis shows that home surpassed the hospital as the most common place of death for CVD patients, accounting for 30.9% of CVD deaths in 2017. Though less frequent, deaths in hospitals and nursing facilities remain common.

Disparities in place of death persisted by sex, race, and educational status. We confirmed that underserved racial and ethnic groups were more likely to die in the hospital and less likely to die at home (4). A home death may be beneficial in situations where adequate resources and supports are available; CVD patients often have acute and intense needs at the end of life that are challenging to manage in the home and may strain the patient and caregivers. Higher education, often reflecting better socioeconomic status, was associated with higher odds of dying at home than in medical facilities, likely indicating greater access to resources.

Women outnumber men considerably in caregiving both due to greater survival and sociological reasons, and caregiver support from women may allow married men greater ability to die at home, as we observed. As CVD patients grow older, the decreasing ability to perform daily activities may drive greater use of facilities at the time of death that we observed.

Disparities in place of death among CVD subtypes are also driven by the nature of the disease. For example, stroke patients are the least likely to die at home and the most likely to die in a nursing or hospice facility. This finding might speak to the sudden and debilitating consequences of a stroke. Palliative care is underutilized in patients with aortic stenosis, and our finding of greater hospital deaths among patients with aortic stenosis may reflect a need for earlier use of palliative services (5). These data suggest more research is needed to better assess the end-of-life preferences and experience of CVD patients, and specific subtypes such as stroke, aortic stenosis, and conduction disorders to identify potential gaps in their

care across settings. Lastly, palliative care can increase concordance between preferred and actual place of death (6), and early nonhospice palliative care can also increase referrals to hospice, though it remains underutilized in patients with CVD (7).

study limitations.

Despite potential errors in documentation on death certificates, mortality data compiled from them offers a more complete picture of place of death trends than other sources. We could not determine concordance between patients' preferred and actual place of death. Hospice is most commonly provided at home, skilled nursing homes, or assisted living settings; however, these data did not indicate whether hospice or other services were used in these settings. Finally, we did not have measures of wealth, though educational level is a robust measure of socioeconomic status.

CONCLUSIONS

Home has become the most common place of death for CVD patients, reinforcing the need for more information about the experiences of these patients. Even if home is the preferred location of death for many patients, concerns remain regarding potential limited access to resources and caregivers during acute exacerbations. Care preferences and experiences of minority patients and caregivers deserve further attention. Demographic and disease-related factors should be considered in designing patient-centered interventions to improve end-of-life care.

Acknowledgments

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table 1

Place of Death of Decedents With Cardiovascular Disease (2003 to 2017)

	Total	Hospital	Home	Nursing Facility	Hospice Facility
No. of patients	12,365,572	3,903,892 (31.5)	3,188,169 (25.8)	2,812,328 (22.7)	392,753 (3.2)
Age, yrs					
<65	2,300,630 (18.6)	747,311 (19.1)	734,087 (23.0)	91,286 (3.2)	28,083 (7.2)
65–84	5,223,138 (42.2)	1,942,230 (49.8)	1,344,345 (42.2)	921,065 (32.8)	163,261 (41.6)
85	4,841,220 (39.2)	1,214,260 (31.1)	1,109,474 (34.8)	1,799,934 (64.0)	201,407 (51.3)
Sex					
Male	6,070,859 (49.1)	1,963,399 (50.3)	1,722,075 (54.0)	987,664 (35.1)	178,757 (45.5)
Female	6,294,713 (50.9)	1,940,493 (49.7)	1,466,094 (46.0)	1,824,664 (64.9)	213,996 (54.5)
Race					
White	10,556,006 (85.7)	3,241,790 (36.8)	2,746,979 (86.2)	2,546,359 (90.5)	352,176 (89.7)
Black	1,487,261 (12.0)	531,814 (35.8)	361,700 (11.3)	217,736 (7.7)	35,063 (8.9)
Ethnicity					
Non-Hispanic	11,690,006 (94.5)	3,639,234 (93.2)	3,009,251 (94.4)	2,719,119 (96.7)	371,208 (94.5)
Hispanic	642,480 (5.2)	255,102 (6.5)	168,621 (5.3)	86,957 (3.1)	20,848 (5.3)
CVD subtype					
Ischemic heart disease	5,957,746 (48.2)	1,628,612 (41.7)	1,738,655 (54.5)	1,265,451 (45.0)	121,878 (31.0)
Hypertensive heart disease	995,714 (8.1)	179,471 (4.6)	366,192 (11.5)	226,527 (8.1)	24,541 (6.2)
Heart failure	1,305,224 (10.6)	416,639 (10.7)	351,133 (11.0)	333,929 (11.9)	55,913 (14.2)
Stroke	2,065,286 (16.7)	888,614 (22.8)	288,368 (9.0)	596,083 (21.2)	128,046 (32.6)
Aortic stenosis	194,447 (1.6)	76,926 (2.0)	49,541 (1.6)	41,789 (1.5)	7,946 (2.0)
Conduction disorders	676,959 (5.5)	230,300 (5.9)	144,202 (4.5)	141,737 (5.0)	13,653 (3.5)

Values are N or n (%). Age not stated: 584; ethnicity not stated: 33,086; other category includes outpatient medical facility or emergency department, dead-on-arrival, other, and unknown.

CVD = cardiovascular disease.