Where Adults with Lung Cancer Die

Insights from the CDC-WONDER Database

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## Preamble:

* **Rationale**: Lung cancer remains the leading cause of cancer death in the United States, yet limited data exist on where patients spend their final days. With rising emphasis on palliative and supportive care, understanding whether patients die in hospitals, at home, or in hospice facilities is crucial for identifying care gaps and improving end-of-life experiences. By examining sociodemographic predictors—such as age, race, ethnicity, and urbanization—this project will illuminate disparities, guide resource allocation, and help shape evidence-based policies that foster equitable access to palliative services. Ultimately, these findings will address an urgent need to ensure patients with advanced lung cancer receive care aligned with their needs and preferences, while informing clinical and policy decisions aimed at enhancing the quality and dignity of end-of-life care.
* **Reference Papers:**
  + [Ali et al., 2025](https://doi.org/10.1161/CIRCHEARTFAILURE.124.012447)
* **Study Objective**: To investigate longitudinal trends and sociodemographic determinants of place of death among U.S. adults (≥45 years) with lung cancer (ICD-10: C34), focusing on the associations between age, sex, race, Hispanic origin, urbanization level, and end-of-life location.
* **Data Source**: CDC WONDER Multiple Cause of Death database (1999–2023). This publicly available dataset captures detailed mortality information including underlying and contributing causes of death, patient demographics, and county-level characteristics.
* **Patient Selection**: Included all decedents aged ≥45 years with lung cancer (ICD-10: C34) recorded in the multiple-of-death field.
* **Outcome of Interest:** Place of Death, categorized into four mutually exclusive settings:
  1. Inpatient medical facility (reference category)
  2. Home (decedent’s residence)
  3. Hospice or nursing home
  4. Outpatient medical facility or emergency room
  + The following categories were excluded due to small counts or ambiguous classification: “Dead on Arrival,” “Status unknown,” “Other,” and “Place of death unknown.”
* **Statistical Analysis**:
  + **Descriptive Analysis:** Summarized demographic characteristics across place of death using frequency distributions and compared using Pearson’s chi-square tests.
  + **Age-Adjusted Mortality Rates (AAMRs):** Standardized to the 2000 U.S. standard population. Examined time trends using Joinpoint Regression to estimate Annual Percent Change (APC).
  + **Multinomial Logistic Regression:**
    - **Dependent Variable**: Place of death (4 categories, with inpatient as the reference).
    - **Independent Variables**: Age group (45–54, 55–64, 65–74, 75+), sex, race (White, Black, Asian/Pacific Islander, Other), Hispanic origin (Hispanic, non-Hispanic), and urbanization level (Large Metro, Medium Metro, etc.).
  + **Reporting:** Results expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance set at p<0.05.
* **Software:** All statistical analyses were performed using the R Statistical Language (Version 4.5.0; R Foundation for Statistical Computing, Vienna, Austria). Joinpoint Regression was performed using the NCI Joinpoint Regression Program (Version 5.4.0).

## Baseline table:

| **Characteristic** | **Overall** N = 3,759,828 | **Hospice or Nursing Facility** N = 821972 (22%) | **Decedent's home** N = 1649658 (44%) | **Medical Facility - Inpatient** N = 1191941 (32%) | **Medical Facility - Outpatient or ER** N = 96257 (2.6%) | **p-value***1* |
| --- | --- | --- | --- | --- | --- | --- |
| Age (years), n (%) |  |  |  |  |  | <0.001 |
| 75+ | 1,571,156 (42) | 428,862 (52) | 691,883 (42) | 420,088 (35) | 30,323 (32) |  |
| 65-74 | 1,219,823 (32) | 233,561 (28) | 540,864 (33) | 412,166 (35) | 33,232 (35) |  |
| 55-64 | 733,818 (20) | 124,759 (15) | 318,696 (19) | 266,487 (22) | 23,876 (25) |  |
| 45-54 | 235,031 (6.3) | 34,790 (4.2) | 98,215 (6.0) | 93,200 (7.8) | 8,826 (9.2) |  |
| Sex, n (%) |  |  |  |  |  | <0.001 |
| Female | 1,660,023 (44) | 397,496 (48) | 738,536 (45) | 487,848 (41) | 36,143 (38) |  |
| Male | 2,099,805 (56) | 424,476 (52) | 911,122 (55) | 704,093 (59) | 60,114 (62) |  |
| Race, n (%) |  |  |  |  |  | <0.001 |
| White | 3,276,734 (87) | 727,153 (88) | 1,472,889 (89) | 1,000,291 (84) | 76,401 (79) |  |
| Asian or Pacific Islander | 77,375 (2.1) | 12,163 (1.5) | 31,465 (1.9) | 31,586 (2.6) | 2,161 (2.2) |  |
| Black | 388,273 (10) | 80,313 (9.8) | 136,539 (8.3) | 153,959 (13) | 17,462 (18) |  |
| Other | 17,446 (0.5) | 2,343 (0.3) | 8,765 (0.5) | 6,105 (0.5) | 233 (0.2) |  |
| Hispanic origin, n (%) |  |  |  |  |  | <0.001 |
| Non-Hispanic | 3,639,815 (97) | 802,483 (98) | 1,595,524 (97) | 1,148,725 (96) | 93,083 (97) |  |
| Hispanic | 120,013 (3.2) | 19,489 (2.4) | 54,134 (3.3) | 43,216 (3.6) | 3,174 (3.3) |  |
| Urbanization, n (%) |  |  |  |  |  | <0.001 |
| Large Metro | 1,780,305 (47) | 392,672 (48) | 748,482 (45) | 592,436 (50) | 46,715 (49) |  |
| Medium/Small Metro | 1,208,112 (32) | 279,817 (34) | 543,305 (33) | 355,869 (30) | 29,121 (30) |  |
| Rural | 771,411 (21) | 149,483 (18) | 357,871 (22) | 243,636 (20) | 20,421 (21) |  |
| *1*Pearson's Chi-squared test | | | | | | |

## Multinomial logistic regression:

# weights: 48 (33 variable)  
initial value 5212228.355425   
iter 10 value 4464383.178010  
iter 20 value 4463490.282281  
iter 30 value 4461935.886557  
iter 40 value 4274981.645754  
final value 4274761.933683   
converged

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Decedent's home | | |
| Age (years) |  |  |
| 75+ | — |  |
| 65-74 | 1.43 (1.42 to 1.44) | <0.001 |
| 55-64 | 1.59 (1.57 to 1.60) | <0.001 |
| 45-54 | 1.77 (1.74 to 1.79) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.13 (1.13 to 1.14) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.35 (1.32 to 1.38) | <0.001 |
| Black | 0.82 (0.81 to 0.82) | <0.001 |
| Other | 1.69 (1.62 to 1.77) | <0.001 |
| Hispanic origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 1.42 (1.40 to 1.44) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium/Small Metro | 1.01 (1.00 to 1.01) | 0.030 |
| Rural | 1.23 (1.22 to 1.24) | <0.001 |
| Medical Facility - Inpatient | | |
| Age (years) |  |  |
| 75+ | — |  |
| 65-74 | 1.78 (1.76 to 1.79) | <0.001 |
| 55-64 | 2.13 (2.11 to 2.15) | <0.001 |
| 45-54 | 2.66 (2.62 to 2.69) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.31 (1.30 to 1.32) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.92 (1.88 to 1.97) | <0.001 |
| Black | 1.28 (1.26 to 1.29) | <0.001 |
| Other | 1.74 (1.66 to 1.83) | <0.001 |
| Hispanic origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 1.60 (1.58 to 1.63) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium/Small Metro | 0.86 (0.85 to 0.86) | <0.001 |
| Rural | 1.09 (1.08 to 1.10) | <0.001 |
| Medical Facility - Outpatient or ER | | |
| Age (years) |  |  |
| 75+ | — |  |
| 65-74 | 1.94 (1.91 to 1.97) | <0.001 |
| 55-64 | 2.55 (2.50 to 2.59) | <0.001 |
| 45-54 | 3.33 (3.25 to 3.42) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.49 (1.47 to 1.51) | <0.001 |
| Race |  |  |
| White | — |  |
| Asian or Pacific Islander | 1.76 (1.68 to 1.85) | <0.001 |
| Black | 1.87 (1.84 to 1.91) | <0.001 |
| Other | 0.84 (0.73 to 0.96) | 0.012 |
| Hispanic origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 1.55 (1.49 to 1.61) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium/Small Metro | 0.91 (0.90 to 0.92) | <0.001 |
| Rural | 1.20 (1.18 to 1.22) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |