Where Adults with Lung Cancer Die

Insights from the CDC-WONDER Database

Ali Salman

Muhammad Saad Asif

## 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 (accepted but not yet in print, Circulation: Heart Failure; co-authored by Ali Salman)
* **Study Objective**: To investigate longitudinal trends and sociodemographic determinants of place of death among U.S. adults (≥20 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 ≥20 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
* **Statistical Analysis**:
  + **Descriptive Analysis:** Summarized distribution of demographic variables and places of death across the study period (1999–2023).
  + **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 (20–34, 35–49, 50–64, ≥65), sex, race (White, Black, American Indian, Asian/Pacific Islander), Hispanic origin (Hispanic, non-Hispanic), and urbanization level (Large Metro, Medium Metro, etc.).
    - **Model Assumptions**: Checked for multicollinearity (variance inflation factor <2) and independence of irrelevant alternatives (IIA) via Hausman-McFadden test.
  + **Reporting:** Results expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Statistical significance set at p<0.05.
* **Software:** All analyses were conducted in R (Version 4.4.3; R Foundation for Statistical Computing, Vienna, Austria). Joinpoint Regression was performed using the NCI Joinpoint Regression Program (Version 5.2.0).

## Multinomial Logistic Regression:

# weights: 48 (33 variable)  
initial value 5264687.120347   
iter 10 value 4579416.598898  
iter 20 value 4577949.332045  
iter 30 value 4570355.703453  
iter 40 value 4332826.969369  
final value 4330755.209249   
converged

| **Characteristic** | **OR** **(95% CI)** | **p-value** |
| --- | --- | --- |
| Decedent's home | | |
| Age, years |  |  |
| 65+ | — |  |
| 20-34 | 0.38 (0.35 to 0.41) | <0.001 |
| 35-49 | 0.66 (0.65 to 0.67) | <0.001 |
| 50-64 | 0.81 (0.81 to 0.82) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.86 (0.86 to 0.87) | <0.001 |
| Hispanic Origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 0.88 (0.87 to 0.89) | <0.001 |
| Race |  |  |
| White | — |  |
| American Indian/Alaska Native | 0.93 (0.90 to 0.96) | <0.001 |
| Asian or Pacific Islander | 0.70 (0.69 to 0.71) | <0.001 |
| Black | 0.63 (0.63 to 0.64) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium Metro | 1.17 (1.17 to 1.18) | <0.001 |
| Rural | 1.12 (1.11 to 1.12) | <0.001 |
| Hospice or Nursing Facility | | |
| Age, years |  |  |
| 65+ | — |  |
| 20-34 | 0.08 (0.07 to 0.10) | <0.001 |
| 35-49 | 0.38 (0.38 to 0.39) | <0.001 |
| 50-64 | 0.58 (0.58 to 0.59) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 0.75 (0.75 to 0.76) | <0.001 |
| Hispanic Origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 0.62 (0.61 to 0.63) | <0.001 |
| Race |  |  |
| White | — |  |
| American Indian/Alaska Native | 0.58 (0.56 to 0.61) | <0.001 |
| Asian or Pacific Islander | 0.52 (0.51 to 0.54) | <0.001 |
| Black | 0.76 (0.75 to 0.76) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium Metro | 1.15 (1.15 to 1.16) | <0.001 |
| Rural | 0.90 (0.89 to 0.90) | <0.001 |
| Medical Facility - Outpatient or ER | | |
| Age, years |  |  |
| 65+ | — |  |
| 20-34 | 0.22 (0.15 to 0.31) | <0.001 |
| 35-49 | 1.12 (1.08 to 1.15) | <0.001 |
| 50-64 | 1.16 (1.14 to 1.17) | <0.001 |
| Sex |  |  |
| Female | — |  |
| Male | 1.14 (1.13 to 1.16) | <0.001 |
| Hispanic Origin |  |  |
| Non-Hispanic | — |  |
| Hispanic | 0.96 (0.92 to 0.99) | 0.023 |
| Race |  |  |
| White | — |  |
| American Indian/Alaska Native | 0.51 (0.45 to 0.58) | <0.001 |
| Asian or Pacific Islander | 0.90 (0.86 to 0.94) | <0.001 |
| Black | 1.47 (1.44 to 1.49) | <0.001 |
| Urbanization |  |  |
| Large Metro | — |  |
| Medium Metro | 1.06 (1.05 to 1.08) | <0.001 |
| Rural | 1.10 (1.08 to 1.12) | <0.001 |
| Abbreviations: CI = Confidence Interval, OR = Odds Ratio | | |