Trends and Disparities in Vaccine-Preventable Mortality Among Leukemia Patients in the United States, 1999–2023

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Introduction

Leukemia patients are particularly vulnerable to infections due to the immunosuppressive effects of both the disease and its treatments. Although vaccines can prevent many of these infections, vaccine-preventable diseases (VPDs) remain a leading cause of mortality in this population. Despite advancements in cancer treatment, leukemia patients continue to experience a disproportionate burden of VPD-related deaths. Understanding trends in mortality from VPDs among leukemia patients and identifying disparities based on age, sex, race, and region is essential for guiding targeted public health interventions. This study analyzes U.S. mortality trends related to leukemia and VPDs from 1999 to 2023, focusing on these key demographic and geographic disparities to inform future vaccination and care strategies.

Objectives

The main objectives of this study were:

1. To analyze trends in mortality from vaccine-preventable diseases in leukemia patients in the U.S. from 1999 to 2023.
2. To examine the disparities in mortality by age, sex, race/ethnicity, region, and urbanization.
3. To assess the impact of demographic factors such as frailty and immunosuppression on mortality trends in this population.
4. To inform future public health interventions aimed at reducing vaccine-preventable deaths in leukemia patients.

Methods

Mortality data from the CDC WONDER database (1999–2023) were used for the analysis. ICD-10 codes for leukemia (C90.1–C95) and vaccine-preventable diseases (J10.0, J12, U07.1) were employed to identify relevant deaths. Age-adjusted mortality rates (AAMRs) per 100,000 population were calculated using the 2000 U.S. standard population. Joinpoint regression software (v5.3.0) was used to estimate annual percentage changes (APCs) and average annual percentage changes (AAPCs) with 95% confidence intervals (CIs). The analysis was stratified by **age, sex, race/ethnicity, region (Northeast, West, South, Midwest), and urbanization (rural vs. urban areas).** Statistical significance was determined at $p < 0.05$.

Results

Total Mortality: Between 1999 and 2020, there were 50,437 deaths from vaccine-preventable diseases among leukemia patients in the United States.

Trends in Mortality Rates:

- The overall AAMR for vaccine-preventable diseases in leukemia patients increased from 0.68 per 100,000 in 1999 to 0.88 per 100,000 in 2023.
- Racial Disparities: White individuals experienced the greatest increase in AAMR (AAPC: 1.48; 95% CI: 0.97 to 2.40), while Asian or Pacific Islander individuals showed a non-significant decline (AAPC: -2.21; 95% CI: -4.43 to 0.36).

Regional Differences:

- The West region showed the steepest increase in mortality (AAPC: 1.64; 95% CI: 0.73 to 2.93), while the Northeast showed the smallest non-significant change (AAPC: 0.39; 95% CI: -0.10 to 1.03).

Urban vs. Rural:

- Rural areas showed a slight nonsignificant increase in mortality (AAPC: 0.0041; 95% CI: -0.73 to 0.76).
- Urban areas showed a small nonsignificant decline (AAPC: -0.26; 95% CI: -0.85 to 0.33).

Sex-based Trends: Females exhibited a slightly higher AAPC than males (1.12 vs. 0.99).

Age-related Mortality Trends:

- The 85+ age group had the highest crude mortality rate in both 1999 (6.64) and 2023 (10.70).
- The 15–24 and 25–34 age groups had the lowest mortality rates in 1999 (0.08) and 2020 (0.06), respectively.
- The 85+ age group had the greatest increase in mortality over time (AAPC: 2.04; 95% CI: 0.89 to 3.60), while the 15–24 age group showed the steepest non-significant decline (AAPC: -1.23; 95% CI: -3.28 to 0.72).

Discussion

- Vaccine-preventable deaths among leukemia patients have continued to rise despite advances in cancer care.
- Older adults, males, rural populations, and non-Hispanic Black individuals are disproportionately affected.
- Key contributing factors include frailty, immunosuppression, and structural barriers to vaccination.
- Persistent disparities highlight the need for targeted interventions to improve vaccination access and uptake among vulnerable groups.
- Addressing gaps in care delivery and ensuring timely, effective vaccination is critical for at-risk leukemia patients.
- Equity-focused public health strategies are essential to reduce disparities and improve outcomes across all demographic and geographic groups.
- Further research and long-term follow-up are needed to evaluate the effectiveness of vaccination and preventive care interventions in this high-risk population.

References

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