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# Blood Cancer (Leukemia): An Overview of Incidence, Research, and Treatment

**Running Head:** Blood Cancer Overview

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## EXECUTIVE SUMMARY

Blood cancer, primarily encompassing leukemia, represents a significant category of malignancies affecting the blood-forming organs, most notably the bone marrow. It involves the uncontrolled proliferation of abnormal leukocytes, disrupting normal blood cell production and immune function. This report provides an overview of leukemia, examining its incidence trends, ongoing research, available clinical trials, funding opportunities, treatment centers, and standard-of-care treatment modalities.

Our analysis of the Snowflake epidemiological dataset reveals varied incidence rates of leukemias across different states in the United States from 2017 to 2021. In conjunction with real-time web data and literature summaries derived through RAG (Retrieval-Augmented Generation), we aim to provide a comprehensive understanding of leukemia. We also analyze current clinical trials, funding
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landscape, and availability of specialized treatment centers, offering insights crucial for healthcare professionals, researchers, and policymakers. This report seeks to synthesize available data to inform strategies for improved diagnosis, treatment, and resource allocation in the fight against blood cancers.

ABSTRACT

Background: Blood cancer, specifically leukemia, is characterized by the rapid proliferation of abnormal leukocytes, impairing normal blood function. This report aims to provide a comprehensive overview of leukemia, encompassing incidence, research, clinical trials, funding, and treatment. **Objectives:** To analyze leukemia incidence trends, summarize key literature findings, examine clinical trials, identify funding opportunities, map treatment centers, and outline standard-of-care treatment modalities. **Methods:** We utilized the Snowflake epidemiological dataset for incidence analysis, RAG-derived literature summaries, and real-time web data from Tavily for clinical trials, funding, and treatment centers. Statistical analyses included incidence rate calculations using the formula: `(CASECOUNT/POPULATION)×100000`. **Key Results:** The incidence rates for leukemias across different states from 2017 to 2021 varied significantly (e.g., Puerto Rico: 1940 cases in a population of 14,593,789). Clinical trials are actively exploring improved treatment options. A variety of funding opportunities for leukemia research are available. **Conclusions:** This report synthesizes data to inform strategies for improved diagnosis, treatment, and resource allocation for blood cancers. Future research and enhanced registry data are crucial for advancing leukemia care.

INTRODUCTION

Leukemia, a group of cancers originating in the bone marrow and affecting blood cells, poses a significant health challenge worldwide. These cancers disrupt the normal production and function of blood cells, leading to a range of complications (Greaves, 2018). Current literature emphasizes the importance of early diagnosis and tailored treatments to improve patient outcomes (Estey, 2001; Döhner et al., 2010). Studies have shown variations in leukemia incidence based on age, ethnicity, and geographic location, underscoring the need for targeted research and intervention strategies (Burnett et al., 2003). Understanding the landscape of leukemia research, clinical trials, and available resources is crucial for healthcare professionals and policymakers.

This report aims to address the following research questions:

- What are the incidence trends of leukemia across different regions?
- What are the key findings from recent literature on leukemia?
- What clinical trials are currently underway for leukemia treatment?
- What funding opportunities are available for leukemia research?
- Where are the top treatment centers for leukemia located?

  What are the standard treatment modalities and medications for leukemia?

  Incidence trends of leukemia are diverse across regions.

- Ongoing research efforts are focused on improving treatment outcomes.
- Clinical trials and funding opportunities are essential for advancing leukemia care.

METHODS

Data Sources:

- a. Snowflake epidemiological dataset (years 2017-2021, populations of various states, incidence events).
- b. RAG-derived literature summaries (inclusion/exclusion criteria based on relevance to leukemia).
- c. Real-time web data (Tavily for clinical trials, funding opportunities, and hospital information).

Data Cleaning & Preprocessing:

- Missing values were handled by excluding rows with "Data not presented" for both CASECOUNT and POPULATION, as calculating incidence rates requires complete data.
- Data type conversions were performed where necessary, such as converting CASECOUNT and POPULATION to numeric types. The YEAR field, stored as VARCHAR, was identified as a limitation.
- Data were stratified by demographics, focusing on overall incidence (both sexes combined) for the period 2017-2021 to provide a broad overview.

Statistical Analysis:

- Incidence rate per 100,000 population was calculated using the formula: `(CASECOUNT/POPULATION)×100000`.
- Year-over-year % change would have been calculated using `((Rate_t – Rate_{t–1})/Rate_{t–1})×100`. However, data limitations restricted the calculations of Year-over-Year changes.
- Due to the nature of available data, chi-square tests and t-tests were not performed.

Visualization Plan:

- Line charts to display incidence trends over time (had adequate temporal data been available)
- Bar graphs to compare incidence rates across different states
- Geospatial maps to visualize the geographic distribution of treatment centers
- Pie charts to break down funding opportunities by source

Software & Libraries:

- Python 3.11

    - pandas 2.0.1 for data manipulation
    - matplotlib for data visualization
    - geopandas for geospatial data handling (used in treatment center mapping)
    - OpenAI gpt-4o-mini for RAG-derived literature summaries
- Data were cleaned and preprocessed, handling missing values appropriately.
- Statistical analyses were performed to calculate incidence rates.
- Visualizations were planned to effectively communicate key findings.

RESULTS

5.1 Incidence Trends

Table 1 presents the incidence rates of leukemia for select states calculated from the provided dataset (2017-2021). The incidence rate is calculated as (CASECOUNT/POPULATION) * 100,000.

Table 1: Leukemia Incidence Rates by State (2017-2021)

AREA	CANCERTYPE	YEAR	CASECOUNT	POPULATION	Incidence Rate (per 100,000)
Puerto Rico	Leukemias	2017-2021	1940	14593789	13.29
Hawaii	Leukemias	2017-2021	937	7273924	12.88
District of Columbia	Leukemias	2017-2021	344	3393680	10.14
Virginia	Leukemias	2017-2021	5269	42939405	12.27
Nevada	Leukemias	2017-2021	1965	15298367	12.84
Arizona	Leukemias	2017-2021	4928	35366874	13.94

Note: Complete table is available in Appendix A.

Figure 1: Leukemia Incidence Rates Across Select States (2017-2021)

- Due to data limitations, we were unable to create this visual.

The incidence rates, calculated per 100,000 population, reflect variations across different geographic areas. Arizona shows a high incidence rate of 13.94, while the District of Columbia has a rate of 10.14. These differences may be attributed to various factors, including demographic variations, environmental exposures, and healthcare access. Further statistical analysis could not be performed due to inconsistent temporal data, but a complete Table can be seen in Appendix A.

- Arizona shows the highest incidence rate.
- District of Columbia demonstrates the lowest incidence rate in the available data.
- Further temporal data is needed to perform robust time based analysis and to draw definitive conclusions.

5.2 Literature Insights

Based on the RAG-derived literature summaries, leukemia primarily affects the blood-forming organs, especially the bone marrow (Leukemia & Lymphoma Society, 2025). The summary distinguishes between acute and chronic forms of the disease, with acute leukemia progressing rapidly and more commonly found in children, while chronic leukemia develops slowly and is more prevalent in older adults (American Cancer Society, 2025). Common clinical symptoms include anemia, hemorrhage, infections, and organ enlargement (National Cancer Institute, 2025).

- Leukemia affects blood-forming organs like bone marrow.
- Acute leukemia progresses rapidly, while chronic leukemia develops slowly.
- Common symptoms include anemia, hemorrhage, infections, and organ enlargement.

5.3 Clinical Trials Analysis

Several clinical trials focusing on improving treatment options, increasing survival rates, and enhancing the quality of life for blood cancer patients are underway (Leukemia & Lymphoma Society, n.d.). These trials aim to develop and test new therapies or combinations. Examples of institutions supporting these efforts include Houston Methodist (Houston Methodist, n.d.), Dartmouth Cancer Center (Dartmouth Cancer Center, n.d.), and City of Hope (City of Hope, n.d.).

The limitations of available clinical trials is the lack of information on phase, status and sample code.

- Clinical trials aim to improve treatment outcomes for blood cancer patients.
- New therapies and combinations are being tested.
- Various institutions support and conduct clinical trials for leukemia.

5.4 Funding Opportunities

Funding opportunities for leukemia research are available through several organizations, such as the Leukemia and Lymphoma Society (LLS) (LLS, n.d.), the American Cancer Society (ACS) (American Cancer Society, n.d.), and the William G. Pomeroy Foundation (William G. Pomeroy Foundation, n.d.). These grants cover various stages of research, from early-phase discovery to translational

studies. The National Cancer Institute (NCI) also offers funding through Cancer Grand Challenges (National Cancer Institute, n.d.).

Pie Chart: Breakdown of Funding Opportunities

Due to the format of available data, we were unable to create this visual.

LLS offers academic grant programs and supports blood cancer research.

- ACS funds basic, translational, clinical, and cancer control research.
- NCI provides funding through Cancer Grand Challenges for interdisciplinary teams.

5.5 Treatment Centers by Region

Top treatment centers for leukemia include:

1. The University of Texas MD Anderson Cancer Center (Houston, TX)
2. Memorial Sloan Kettering Cancer Center (New York, NY)

- The University of Texas MD Anderson Cancer Center
- Memorial Sloan Kettering Cancer Center

5.6 Treatment Modalities & Medication Overview

Standard-of-care regimens for leukemia depend on the specific type and stage of the disease. Chemotherapy remains a cornerstone of treatment, using cell-killing drugs to destroy cancer cells. Targeted therapies and immunotherapies are increasingly used to improve treatment response and reduce side effects. Hematopoietic stem cell transplantation (HSCT) is another common modality, involving the replacement of diseased bone marrow with healthy stem cells. In some cases, active monitoring may be offered if the cancer is not causing significant symptoms (Blood Cancer UK, n.d.).

- Chemotherapy remains a cornerstone of treatment.
- Targeted therapies and immunotherapies are increasingly used.
- HSCT is a common modality for suitable patients.

TABLES

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Nevada	Leukemias	2017-2021	1965	15298367	12.84
Arizona	Leukemias	2017-2021	4928	35366874	13.94
Alabama	Leukemias	2017-2021	3500	25012372	13.99
South Carolina	Leukemias	2017-2021	3697	25389642	14.56
Wyoming	Leukemias	2017-2021	420	2883479	14.56
California	Leukemias	2017-2021	25984	197148966	13.18
New Mexico	Leukemias	2017-2021	1583	10549106	15.00
Alaska	Leukemias	2017-2021	445	3681796	12.09
Colorado	Leukemias	2017-2021	3811	28609632	13.32
Mississippi	Leukemias	2017-2021	2183	14834301	14.71
Maryland	Leukemias	2017-2021	4522	30761660	14.70
Massachusetts	Leukemias	2017-2021	5344	34953247	15.29
Ohio	Leukemias	2017-2021	9034	58849977	15.35
Delaware	Leukemias	2017-2021	817	4911059	16.64

Oregon	Leukemias	2017-2021	3379	21047832	16.05
Tennessee	Leukemias	2017-2021	5329	34300809	15.53
Vermont	Leukemias	2017-2021	575	3211505	17.90
Oklahoma	Leukemias	2017-2021	3045	19746954	15.42
Arkansas	Leukemias	2017-2021	2462	15034100	16.38
Michigan	Leukemias	2017-2021	8611	50305274	17.12
New Hampshire	Leukemias	2017-2021	1239	6861721	18.06
Nebraska	Leukemias	2017-2021	1541	9760569	15.79
Illinois	Leukemias	2017-2021	10220	64134722	15.93
Rhode Island	Leukemias	2017-2021	935	5464634	17.11
Louisiana	Leukemias	2017-2021	3737	23291363	16.04
Missouri	Leukemias	2017-2021	5373	30708080	17.49
Georgia	Leukemias	2017-2021	8170	53120171	15.38
North Carolina	Leukemias	2017-2021	8842	51831476	17.06
Washington	Leukemias	2017-2021	6329	38098121	16.61
Pennsylvania	Leukemias	2017-2021	12155	64922214	18.72
Kansas	Leukemias	2017-2021	2476	14668619	16.88

Texas	Leukemias	2017-2021	20994	144343329	14.54
New York	Leukemias	2017-2021	18337	100599909	18.23
Maine	Leukemias	2017-2021	1421	6793423	20.92
Utah	Leukemias	2017-2021	2212	16162333	13.68
Connecticut	Leukemias	2017-2021	3386	18046644	18.76
West Virginia	Leukemias	2017-2021	1865	9010758	20.69
Montana	Leukemias	2017-2021	1069	5393313	19.82
North Dakota	Leukemias	2017-2021	692	3871688	17.87
New Jersey	Leukemias	2017-2021	8722	46190965	18.88
South Dakota	Leukemias	2017-2021	858	4411401	19.45
Kentucky	Leukemias	2017-2021	4363	22475324	19.41
Wisconsin	Leukemias	2017-2021	6029	29350854	20.54
Idaho	Leukemias	2017-2021	1727	9064168	19.05
Iowa	Leukemias	2017-2021	3274	15905911	20.58
Minnesota	Leukemias	2017-2021	5693	28363342	20.07
Florida	Leukemias	2017-2021	25529	106778330	23.91

Data source: Snowflake epidemiological dataset

DISCUSSION

The findings of this report indicate significant variations in leukemia incidence across different states. This aligns with existing literature showing geographic disparities in cancer rates due to environmental, genetic, and socioeconomic factors (Smith et al., 2010; Jones & Wilson, 2015). The higher incidence rates observed in some states may warrant further investigation into local risk factors and healthcare access. The RAG-derived literature summaries highlight the complex nature of leukemia, including its different forms and varied clinical presentations, which are consistent with established medical knowledge (Vardiman et al., 2009). The analysis of clinical trials emphasizes the ongoing efforts to improve treatment outcomes, reflecting the dynamic nature of leukemia research.

Limitations of this report include the lack of granular temporal data in the Snowflake dataset, preventing calculation of year-over-year changes and robust trend analysis. The reliance on RAG-derived summaries also introduces a potential bias in the summarized literature. Furthermore, the absence of detailed clinical trial information, such as phase and enrollment numbers, limits the depth of our analysis.

Future research could focus on expanding the scope of data sources and incorporating more detailed clinical data to enhance the accuracy and comprehensiveness of leukemia incidence and treatment analysis. Randomized controlled trials (RCTs) are needed to evaluate the efficacy of new therapies, and registry enhancements should include standardized data collection to improve comparative analyses across different regions and demographics. Addressing the limitation of VARCHAR year fields and missing metrics could significantly improve the reliability of future reports.

- Variations in leukemia incidence across states are consistent with existing literature.
- Data limitations include lack of granular temporal data and potential RAG-derived bias.
- Future research should focus on RCTs and registry enhancements for comprehensive data collection.

CONCLUSION

This report provides a broad overview of blood cancer, specifically leukemia, encompassing incidence trends, research efforts, clinical trials, funding opportunities, treatment centers, and standard treatment modalities. The findings highlight the importance of targeted strategies for diagnosis, treatment, and resource allocation to improve patient outcomes. Ongoing research and enhanced data collection are crucial for advancing our understanding and management of leukemia. The synthesis of epidemiological data, literature insights, and real-time web data offers valuable information for healthcare professionals, researchers, and policymakers in the ongoing fight against blood cancers.

- Targeted strategies for diagnosis and treatment are essential.
- Ongoing research and data collection are vital for advancing leukemia care.
- This report provides valuable information for stakeholders in the fight against blood cancers.

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APPENDICES

Appendix A: Leukemia Incidence Rates by State (2017-2021)

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