LEUKEMIA

Includes acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), acute myeloid leukemia (AML) and chronic myeloid leukemia (CML).

Background

This case definition was developed by the Armed Forces Health Surveillance Division (AFHSD) for the purpose of descriptive epidemiological reports on invasive cancers among active duty Service members.[1] The case definition uses the "standard" AFHSD oncology case definition.

Clinical Description

Leukemia is a cancer of the bone marrow and blood and is classified into four main groups according to cell type and rate of growth: acute lymphocytic (ALL), chronic lymphocytic (CLL), acute myeloid (AML), and chronic myeloid (CML). Almost 90 percent of cases are diagnosed in adults 20 years of age or older, with the most common types being AML and CML. In children, ALL is the most common type. Symptoms include lymphadenopathy, night sweats, and recurrent infections. The cause of leukemia is unknown; however, risk factors for developing the condition include exposure to ionizing radiation, benzene exposure (particularly with AML), and heredity for CLL. Treatment varies depending on the type and stage of disease. Leukemia was estimated to be the cause of about 3 percent of new cancer cases and 4 percent of all cancer deaths in the United States in 2024.[2]

Case Definition and Incidence Rules *(2012-present)*

For surveillance purposes, a case of leukemia is defined as:

- *One hospitalization* with a case defining diagnosis of leukemia (see ICD9 and ICD10 code lists below) in the *first* diagnostic position; or
- *One hospitalization with a procedure code* indicating radiotherapy, chemotherapy, or immunotherapy treatment (see ICD9 and ICD10 code lists below) in the *first* diagnostic position; AND a case defining diagnosis of leukemia (see ICD9 and ICD10 code lists below) in the *second* diagnostic position; or
- *Three or more outpatient medical encounters*, occurring *within a 90-day period*, with a case defining diagnosis of leukemia (see ICD9 and ICD10 code lists below) in the *first or second* diagnostic position.

Incidence rules:

For individuals who meet the case definition:

- The incidence date is considered the date of the first hospitalization or outpatient medical encounter that includes a case defining diagnosis of leukemia.

(continued on next page)

[1] Armed Forces Health Surveillance Center. Incident diagnoses of cancers and cancer-related deaths, active component, U.S. Armed Forces, 2005-2014. *MSMR.* 2016 July; 23(7): 23-31.

[2] American Cancer Society. Cancer Facts & Figures 2024. https://www.cancer.org/research/cancer-facts-statistics.html. Accessed April 2025.

Case Definition and Incidence Rules *(continued)*

- An individual is considered an incident case *once per lifetime.*

Exclusions:

- None

Codes

The following ICD9 and ICD10 codes are included in the case definition:

Condition	ICD-10-CM Codes	ICD-9-CM Codes
Lymphoid leukemia	*C91 (lymphoblastic leukemia)*	*204 (lymphoid leukemia)*
	C91.0 (*acute* lymphoblastic leukemia [ALL]…)	204.0 (lymphoid leukemia, acute…)
	- C91.00 (not having achieved remission)	- 204.00 (not having achieved remission or failed remission)
	- C91.01 (in remission)	- 204.01 (in remission)
	- C91.02 (in relapse)	- 204.02 (in relapse)
	C91.1 (*chronic* lymphocytic leukemia of B-cell type…)	204.1 (lymphoid leukemia, chronic…)
	- C91.10 (not having achieved remission)	- 204.10 (not having achieved remission or failed remission)
	- C91.11 (in remission)	- 204.11 (in remission)
	- C91.12 (in relapse)	- 204.12 (in relapse)
	C91.3 *(prolymphocytic* leukemia of B-cell type…)	204.8 (other lymphoid leukemia…)
	- C91.30 (not having achieved remission)	- 204.80 (not having achieved remission or failed remission)
	- C91.31 (in remission)	- 204.81 (in remission)
	- C91.32 (in relapse)	- 204.82 (in relapse)
	C91.4 (*hairy cell* leukemia…)	- 202.40 (leukemic reticuloendotheliosis, unspecified site, extranodal and solid organ sites)
	- C91.40 (not having achieved remission)	
	- C91.41 (in remission)	
	- C91.42 (in relapse)	

	C91.5 (*adult T- cell* lymphoma/ leukemia (HTLV-1-associated…)	- 204.8[0-2] (above)
	- C91.50 (not having achieved remission)	
	- C91.51 (in remission)	
	- C91.52 (in relapse)	
	C91.6 (*prolymphocytic* leukemia of T-cell type…)	- 204.8[0-2] (above)
	- C91.60 (not having achieved remission)	
	- C91.61 (in remission)	
	- C91.62 (in relapse)	
	C91.A (*mature B-cell* leukemia Burkitt-type…)	- 204.8[0-2] (above)
	- C91.A0 (not having achieved remission)	
	- C91.A1 (in remission)	
	- C91.A2 (in relapse)	
	C91.Z (*other* lymphoid leukemia…)	204.2 (lymphoid leukemia, subacute…)
	- C91.Z0 (not having achieved remission)	- 204.20 (not having achieved remission or failed remission)
	- C91.Z1 (in remission)	- 204.21 (in remission)
	- C91.Z2 (in relapse)	- 204.22 (in relapse)
	C91.9 (lymphoid leukemia, *unspecified*…)	204.9 (unspecified lymphoid leukemia…)
	- C91.90 (not having achieved remission)	204.90 (not having achieved remission or failed remission)
	- C91.91 (in remission)	- 204.91 (in remission)
	- C91.92 (in relapse)	- 204.92 (in relapse)
Myeloid leukemia	*C92 (myeloid leukemia)*	*205 (myeloid leukemia)*
	C92.0 (*acute* myeloblastic leukemia…)	205.0 (myeloid leukemia, acute…)
	- C92.00 (not having achieved remission)	- 205.00 (not having achieved remission or failed remission)
	- C92.01 (in remission)	- 205.01 (in remission)
	- C92.02 (in relapse)	- 205.02 (in relapse)
	C92.1 (*chronic* myeloid leukemia, *BCR/ABL-positive*…)	205.1 (myeloid leukemia, chronic…)

	- C92.10 (not having achieved remission)	- 205.10 (not having achieved remission or failed remission)
	- C92.11 (in remission)	- 205.11 (in remission)
	- C92.12 (in relapse)	- 205.12 (in relapse)
	C92.2 (*atypical chronic* myeloid leukemia, BCR/ABL-negative…)	205.2 (myeloid leukemia, subacute…)
	- C92.20 (not having achieved remission)	- 205.20 (not having achieved remission or failed remission)
	- C92.21 (in remission)	- 205.21 (in remission)
	- C92.22 (in relapse)	- 205.22 (in relapse)
	C92.3 (myeloid *sarcoma*)	205.3 (myeloid sarcoma…)
	- C92.30 (not having achieved remission)	- 205.30 (not having achieved remission or failed remission)
	- C92.31 (in remission)	- 205.31 (in remission)
	- C92.32 (in relapse)	- 205.32 (in relapse)
	C92.4 (*acute promyelocytic* leukemia…)	205.0[0-2] (above)
	- C92.40 (not having achieved remission)	
	- C92.41 (in remission)	
	- C92.42 (in relapse)	
	C92.5 (*acute myelomonocytic* leukemia…)	205.0[0-2] (above)
	- C92.50 (not having achieved remission)	
	- C92.51 (in remission)	
	- C92.52 (in relapse)	
	C92.6 (*acute* myeloid leukemia *with 11q23 abnormality*…)	205.0[0-2] (above)
	- C92.60 (not having achieved remission)	
	- C92.61 (in remission)	
	- C92.62 (in relapse)	
	C92.A (*acute* myeloid leukemia *with multilineage dysplasia*…)	205.0[0-2] (above)
	- C92.A0 (not having achieved remission)	
	- C92.A1 (in remission)	

	- C92.A2 (in relapse)	
	C92.Z (*other* myeloid leukemia…)	205.8 (*other* myeloid leukemia…)
	- C92.Z0 (not having achieved remission)	- 205.80 (not having achieved remission or failed remission)
	- C92.Z1 (in remission)	- 205.81 (in remission)
	- C92.Z2 (in relapse)	- 205.82 (in relapse)
	C92.9 (myeloid leukemia, *unspecified*…)	205.9 (*unspecified* myeloid leukemia…)
	- C92.90 (not having achieved remission)	- 205.90 (not having achieved remission or failed remission)
	- C92.91 (in remission)	- 205.91 (in remission)
	- C92.92 (in relapse)	- 205.92 (in relapse)
Monocytic leukemia	*C93 (monocytic leukemia)*	*206 (monocytic leukemia)*
	C93.0 (*acute* monoblastic/monocytic leukemia…)	206.0 (monocytic leukemia, acute…)
	- C93.00 (not having achieved remission)	- 206.00 (not having achieved remission or failed remission)
	- C93.01 (in remission)	- 206.01 (in remission)
	- C93.02 (in relapse)	- 206.02 (in relapse)
	C93.1 (*chronic* myelomonocytic leukemia…)	206.1 (monocytic leukemia, chronic…)
	- C93.10 (not having achieved remission)	- 206.10 (not having achieved remission or failed remission)
	- C93.11 (in remission)	- 206.11 (in remission)
	- C93.12 (in relapse)	- 206.12 (in relapse)
	C93.3 (*juvenile* myelomonocytic leukemia…)	206.8 (other monocytic leukemia…)
	- C93.30 (not having achieved remission)	- 206.80 (not having achieved remission or failed remission)
	- C93.31 (in remission)	- 206.81 (in remission)
	- C93.32 (in relapse)	- 206.82 (in relapse)
	C93.Z (*other* monocytic leukemia…)	206.8[0-2] (above)
	- C93.Z0 (not having achieved remission)	
	- C93.Z1 (in remission)	
	- C93.Z2 (in relapse)	

	C93.9 (monocytic leukemia, *unspecified*)	206.2 (monocytic leukemia, *subacute*…) 206.9 (*unspecified* monocytic leukemia…)
	- C93.90 (not having achieved remission)	- 206.20 (not having achieved remission or failed remission) - 206.90 (not having achieved remission or failed remission)
	- C93.91 (in remission)	- 206.21 (in remission) - 206.91 (in remission)
	- C93.92 (in relapse)	- 206.22 (in relapse) - 206.92 (in relapse)
Other specified leukemia	*C94 (other specified leukemia)*	*207 (other specified leukemia)*
	C94.0 (*acute* erythroid leukemia…)	207.0 (other specified leukemia, *acute* erythremia and erythroleukemia …)
	- C94.00 (not having achieved remission)	- 207.00 (not having achieved remission or failed remission)
	- C94.01 (in remission)	- 207.01 (in remission)
	- C94.02 (in relapse)	- 207.02 (in relapse)
	C94.2 (*acute megakaryoblastic* leukemia…)	207.2 (megakaryocytic leukemia…)
	- C94.20 (not having achieved remission)	- 207.20 (not having achieved remission or failed remission)
	- C94.21 (in remission)	- 207.21 (in remission)
	- C94.22 (in relapse)	- 207.22 (in relapse)
	C94.3 (*mast cell* leukemia…)	207.8 (other specified leukemia…)
	- C94.30 (not having achieved remission)	- 207.80 (not having achieved remission or failed remission)
	- C94.31 (in remission)	- 207.81 (in remission)
	- C94.32 (in relapse)	- 207.82 (in relapse)
	C94.4 (acute panmyelosis with myelofibrosis…)	*No comparable ICD9 code; Translated code too broad for inclusion.*
	- C94.40 (not having achieved remission)	
	- C94.41 (in remission)	
	- C94.42 (in relapse)	
	C94.8 (other specified leukemias…)	207.8[0-2] (above)

	- C94.80 (not having achieved remission)	
	- C94.81 (in remission)	
	- C94.82 (in relapse)	
Leukemia of unspecified cell type	*C95 (leukemia of unspecified cell type)*	*208 (leukemia of unspecified cell type)*
	C95.0 (*acute* leukemia of unspecified cell type…)	208.0 (leukemia of unspecified cell type, acute …)
	- C95.00 (not having achieved remission)	- 208.00 (not having achieved remission or failed remission)
	- C95.01 (in remission)	- 208.01 (in remission)
	- C95.02 (in relapse)	- 208.02 (in relapse)
	C95.1 (*chronic* leukemia of unspecified cell type…)	208.1 (leukemia of unspecified cell type, chronic …)
	- C95.10 (not having achieved remission)	- 208.10 (not having achieved remission or failed remission)
	- C95.11 (in remission)	- 208.11 (in remission)
	- C95.12 (in relapse)	- 208.12 (in relapse)
	C95.9 (leukemia, *unspecified*…)	208.2 (leukemia of *unspecified cell type*, subacute …) 208.8 (*other* leukemia of unspecified cell type…) 208.9 (unspecified leukemia…)
	- C95.90 (not having achieved remission)	- 208.[2,8,9]0 (not having achieved remission or failed remission)
	- C95.91 (in remission)	- 208.[2,8,9]1 (in remission)
	- C95.92 (in relapse)	- 208.[2,8,9]2 (in relapse)

Procedures	**ICD-10-CM Codes**	**ICD-9-CM Codes**
Related treatment procedures *(Radiotherapy, chemotherapy, immunotherapy)*	Z51.0 (encounter for antineoplastic radiation therapy)	V58.0 (radiotherapy)
	Z51.1 (encounter for antineoplastic chemotherapy and immunotherapy)	V58.1 (encounter for chemotherapy and immunotherapy for neoplastic conditions)
	- Z51.11 (encounter for antineoplastic chemotherapy)	- V58.11 (encounter for antineoplastic chemotherapy)
	- Z51.12 (encounter for antineoplastic immunotherapy)	- V58.12 (encounter for antineoplastic immunotherapy)

Development and Revisions

- In 2024, the Defense Health Agency (DHA) Health Surveillance & Epidemiology (HSE) cancer surveillance Sub Working Group (SubWG) evaluated and expanded the list of cancers in the AFHSD cancer report to include breast (female), bladder, brain, cervical, colorectal, kidney (renal), leukemia, liver (hepatic), lung/bronchial, non-Hodgkin lymphoma, ovarian, pancreatic, prostate, stomach (gastric) and testicular cancer.

- In a 2019 *Monthly Surveillance Medical Report (MSMR)* article, analysis of the AFHSD standard oncology case revealed the definition had a high positive predictive value (PPV) for capturing cases of common cancers, (e.g., breast, prostate, testicular), and a low-to-moderate PPV for rarer cancers, (e.g., gallbladder, intestinal, laryngeal). Analyses also revealed the case definition was less sensitive for identifying cancers of the brain and nervous system, lung and bronchus, bones and joints, and liver (PPV$\leq$ 50 percent); these cases often represented metastases rather than true incident cases. While the broad application of a single case definition may affect the sensitivity and specificity in varying ways for the individual cancers, the PPV for all the cancers included in the report are >70 percent, and most have a PPV $\geq$ 90 percent.[3]

- In September of 2017 the case definition was updated to include ICD10 codes.

- The standard AFHSD oncology case definition was originally developed in 2011 by the Armed Forces Health Surveillance Center (AFHSC) in collaboration with a working group of subject matter experts from the Office of the Assistant Secretary of Defense for Health Affairs (ASDHA), the United States Army Public Health Command (USAPHC) and the United States Military Cancer Institute for a report on 10 different *invasive* cancers. The case definition was developed based on reviews of the ICD9 codes, the scientific literature and previous AFHSC analyses.

Case Definition and Incidence Rule Rationale

- In the 2019 *MSMR* article, cases of leukemia identified using the standard AFHSD oncology case definition had a total PPV of 79.0 percent [CI 68.5-87.3]: female 73.3 percent [CI 44.9-99.2], male 80.3 percent [CI 68.7-89.1].[3]

- The case finding criteria of *three or more outpatient medical encounters, within a 90-day period,* is used to identify cases that do not meet the other criteria in the definition. Exploratory analysis of Defense Medical Surveillance System (DMSS) data revealed this criterion yielded optimal specificity.[4]

    - A period of 90 days allows for the likelihood that "true" cases of leukemia will have second and third encounters within that timeframe. The timeframe is based on the following standards of care: (1) following a bone marrow biopsy, the average time to obtain a pathology report and definitive diagnosis is 1-3 weeks; (2) individuals whose biopsy results are positive for leukemia are likely to have a follow-up visit for treatment within 4 weeks of a definitive diagnosis; and (3) individuals are likely to have follow-up visits to monitor clinical indicators of disease within the 90-day timeframe.[5]

    - For outpatient encounters, the incident date is considered the first of the three encounters occurring within the 90-day period, (e.g., if an individual has four leukemia codes on 1-Jan-

[3] Webber, B, Rogers, A, Pathak, S, Robbins, A. Positive Predictive Value of an Algorithm Used for Cancer Surveillance in the U.S. Armed Forces. *MSMR* 2019; 26(12):18-23.

[4] Detailed information on these analyses is available through AFHSD; reference DMSS Requests #R230308, #R230378 and #R240009.

[5] Leukemia. National Comprehensive Cancer Network (NCCN) Guidelines Version 2.2023. https://www.nccn.org/guidelines/recently-published-guidelines; Accessed April 2025.

12, 1-Dec-15, 8-Dec-15, and 15-Dec-15, the incident date would be 1-Dec-15; 1-Jan-12 would be considered a screening encounter and dropped).

- To maintain consistency with the standard AFHSD methodology for surveillance of invasive cancers, AFHSD uses a *once per lifetime* incidence rule. The workgroup recognizes individuals, may be considered disease free after treatment or after an extended period of time, (e.g., 5 years), with no clinical evidence of disease. Individuals who develop a second primary tumor after being disease free could, theoretically, be counted as a new incident case. However, for surveillance of cancer using administrative, (i.e., billing), data, it is difficult to identify individuals who are disease free after treatment.

Code Set Determination and Rationale

- In April of 2025, DHA HSE cancer surveillance SubWG, in consultation with experts in the DHA Oncology Clinical Community, reviewed the code set and made the following determinations:

  - ICD10 code C94.4 (acute panmyelosis with myelofibrosis) / ICD9 (No comparable code; translated code too broad for inclusion) was added to the code set because the condition is a rare, fatal subtype of acute myeloid leukemia. It differs from primary myelofibrosis and other myeloproliferative neoplasms (MPNs) which are blood cancers but are not leukemias.

  - ICD10 code C94.6 (myelodysplastic disease) / ICD9 238.79 (other lymphatic and hematopoietic tissue), also known as myelodysplastic syndrome, is not included in the code set because the condition is considered blood cancer, not leukemia. However, myelodysplastic disease is "on the spectrum," meaning the only distinction between the condition and a diagnosis of leukemia is the number of "blast" cells seen on a peripheral blood smear or bone marrow biopsy, with leukemia requiring >20%. Historically the condition was called "pre-leukemia" or "smoldering leukemia' because higher risk patients often progressed to leukemia.

- In April of 2017, code ICD10 D45 (polycythemia vera) / ICD9 207.1x (chronic erythema) was removed from the code set. The disorder is a condition related to the overproduction of red blood cells and, in general, not related to leukemia.

- *Screening for disease* codes ICD10 Z12.xx / ICD9 V76.xx (encounter for screening for malignant neoplasms) are not included in the code set. Screening codes are used for "testing for disease or disease precursors in seemingly well individuals so that early detection and treatment can be provided for those who test positive for the disease, (e.g., screening mammogram)."[6] They would not be used for follow-up medical encounters of a specific disease.

- *Personal history of malignant neoplasms* (ICD10 Z85.xx) codes are not included in the code set. While these codes may be beneficial for identifying individuals with a history of cancer, analysis of administrative data reveal these codes lack the specificity to count incident cancer cases and are inconsistently used by providers. [7] Given these findings, the AFHSD does not use personal history

[6] ICD-10-CM Official Guidelines for Coding and Reporting. FY 2022–Updated April 1, 2022. (October 1, 2021-September 30, 2022. https://stacks.cdc.gov/view/cdc/126426. Accessed April 2025.

[7] Analysis performed by the Defense Centers of Public Health-Dayton. Encounters with at least one Z85.x code in any diagnostic position (dx1- dx20) were pulled from Comprehensive Ambulatory Professional Encounter Records (CAPER) and Standard Inpatient Data Records (SIDR) for all Tri-Service beneficiaries between October 2016 and March 2024. A total of 546,962 encounters were identified. Of these, 68,395 (13%) had at least one neoplasm diagnosis (ICD10 C00-D49). With administrative data, there is no way to determine if the neoplasm codes refer to a resolved malignancy or a new cancer diagnosis. Records with conjunction codes for follow-up (Z08), aftercare (Z51.[0.1] and screening (Z12) were queried: 420,236 (77%) had no conjunction codes in any diagnostic position suggesting providers use personal history codes independent of the purpose of the visit and potentially inconsistently.

codes to exclude prevalent cases, (i.e., individuals with a history of cancer), nor to identify individuals who are disease free after treatment.

Personal history codes are intended to be used by providers for individuals who have a history of cancer *and* documented evidence in the medical record that the malignancy has been "excised or eradicated and all treatment is complete." They are not used for a "self-reported" history of malignancy, and they should be used in conjunction with ICD10 codes for follow-up visits (Z08- encounter for follow-up examination after completed treatment for a malignant neoplasm), aftercare visits (Z51.0 - encounter for antineoplastic radiation therapy; Z51.1- encounter for antineoplastic chemotherapy and immunotherapy), and screening visits (Z12 - encounter for screening for malignant neoplasms).[8]

Reports

The AFHSD reports on leukemia in the following reports:

- Periodic *MSMR* articles.

Review

Apr 2025	Case definition reviewed and updated by the DHA HSE cancer surveillance SubWG; approved by the AFHSD Surveillance Methods and Standards (SMS) working group.
Dec 2022	Case definition reviewed and updated by the AFHSD SMS working group
Apr 2017	Case definition reviewed and updated by the Armed Forces Health Surveillance Branch (AFHSB) SMS working group.
Apr 2013	Case definition reviewed and adopted by the AFHSC SMS working group.
Jun 2012	Case definition developed by the AFHSC, ASDHA, USAPHC and the United States Military Cancer Institute.

Comments

None

[8] Bredehoeft, Emily. Clear Up Confusion as to When Cancer Becomes "History Of." American Academy of Professional Coders (AAPC). https://www.aapc.com/blog/40016-clear-up-confusion-as-to-when-cancer-becomes-history-of/. Accessed April 2025.