

ANNUAL HIGHLIGHT

5,644 Army Dependents

received a blood lead test between 1 January and 31 December 2022; 1.5% of those tests indicated an elevated blood lead level. Among child dependents tested within the Military Health System, the rate of eBLL in CY2022 is 15.4 per 1,000 children.

INTRODUCTION

Lead is a naturally occurring heavy metal but can present an environmental and health hazard if it contaminates water, air, soil, or dust. In the U.S., the most common ways that people are exposed to lead are the inhalation or accidental ingestion of contaminated dust and soil as a result of aging or chipping lead-based paint. Lead-based paint was banned from use in the U.S. in 1978, but many homes built prior to the ban still exist in communities across the country. Other potential sources of lead exposure are contaminated water, ammunition, soldering equipment, as well as some foreign-made toys, ceramics, make-up, and packaged foods.

Lead is neurotoxic and can cause cognitive and behavioral issues, as well as gastrointestinal and hematological problems.^{2,3} Children are at higher risk of lead exposure because of their more frequent hand-to-mouth behavior. They are also more susceptible to the harmful effects of lead since the brain is in a period of rapid development during childhood.

Because children are at higher risk of poor health outcomes if exposed to lead, the American Academy of Pediatrics recommends that all children aged 6 months to 6 years, inclusive, be screened for increased risk of lead exposure via a parental questionnaire administered at routine well-child visits.³ Children who screen positive for an increased exposure risk should be tested for an elevated blood lead level (eBLL). Laws regarding lead exposure screening, testing, and reporting are established at the State level, and Army regulation directs installations to comply with State law.³

In 2021, the Centers for Disease Control and Prevention (CDC) lowered the eBLL reference value from 5 micrograms per deciliter ($\mu g/dL$) to 3.5 $\mu g/dL$.⁴ This updated reference value was derived from the 97.5th percentile of the blood lead values among U.S. children aged 1 to 5 years, resulting from the 2015–2016 and 2017–2018 National Health and Nutrition Examination Survey cycles. The CDC reference value should not be interpreted as a "safe" level, and the CDC continues to stress that there is no safe level of lead exposure.

In October 2018, eBLLs were established as a reportable medical event (RME) for Army dependents aged 0 to 6 years, according to the Army Lead Hazard Management Control Program.⁵ Army dependents with eBLLs must be reported to the Disease Reporting System internet (DRSi) according to Armed Forces Health Surveillance Division guidelines. In November 2022, the Tri-Service Reportable Medical Event Working Group updated the case definition of the elevated blood lead RME to reflect the change in the CDC reference value.

This annual report tracks all available BLL laboratory test results within the Army dependent population and monitors the occurrence of eBLLs.

METHODS

Laboratory Data

The Navy and Marine Corps Public Health Center (NMCPHC) provided available BLL laboratory results for Army dependents from the Composite Health Care System (CHCS) Health Level 7 (HL7) chemistry data system and Military



Health System (MHS) GENESIS. Records are dated according to the BLL collection date, and this report covers test results collected from 1 October through 31 December 2022 (CY2022 Q4), as well as a summary of all CY2022 results. The data include all BLL test results above and below the eBLL cutoff collected within the MHS. These include test results for Army dependents who receive care at Army medical treatment facilities (MTFs) and other Department of Defense facilities. Test results were excluded from the analysis when the unit of measure or the result could not be determined, or the biological sample was not blood.⁶ Zinc photoporphyrin (ZPP), point of care (POC), and capillary blood tests (n=98) were also not included as these tests are not considered in the case definition in the Armed Forces Reportable Medical Events – Guidelines and Case Definitions⁷, hereafter referred to as the Armed Forces RME Guidelines.

Only BLL results for Army dependents aged 0 to 6 years were analyzed for this report. According to the Armed Forces RME Guidelines, a child can be counted as an eBLL case only once per calendar year. If an individual had more than one BLL result (e.g., duplicate record or follow-up blood test) during CY2022 Q4, the highest BLL result was retained. The frequency of BLL test results is displayed by BLL range ($<3.5 \mu g/dL$, $3.5-9 \mu g/dL$, $10-19 \mu g/dL$, $20 \mu g/dL$), Regional Health Command (RHC), and installation. Results $23.5 \mu g/dL$ are considered elevated. All CY2022 Q4 eBLL test results are reported.

Disease Reporting System, Internet Data

The DRSi is a tri-service reportable medical event system. Since 18 October 2018, eBLLs have been reportable through the DRSi for children aged 0 to 6 years. Only Army dependent cases reported to DRSi are included in this report. Among Army dependents, DRSi cases with medical event report dates from 1 October through 31 December 2022 were counted.

DRSi Reporting Compliance

DRSi report dates can differ from the BLL test collection date. Taking this into consideration, cases with test collection dates during CY2022 Q4 were considered in the measure of compliance with the eBLL reporting policy. Reporting compliance was determined using the proportion of eBLL laboratory results within CHCS and MHS GENESIS collected during CY2022 Q4 that were also reported via a medical event report in DRSi.

Army Public Health Nurses Program Status Report (APHN-PSR)

Starting in April 2019, specific questions regarding childhood lead exposure were included in the APHN-PSR to assess the Environmental Health Hazard Management Control Program.⁸ As part of installation safety and housing office-led environmental investigations, the installation's Department of Public Health (Preventive Medicine Services) conducts parent/guardian interviews after a child 6 years of age or younger is confirmed to have an eBLL. The APHN-PSR captures the following Lead Hazard Management Control Plan metrics: (1) number of pediatric BLL tests conducted in the past fiscal quarter reported to the State/local authorities; (2) number of confirmed elevated pediatric BLL test results in the past fiscal quarter reported to the State/local authorities per the State/local reporting requirements.

RESULTS

Laboratory Test Results

During CY2022, 5,644 Army dependents aged 0 to 6 years received a blood lead test within the MHS; 87 of those results (1.5%) indicated an elevated BLL (\geq 3.5 µg/dL), as shown in Table 1. Because of the lower reference value for eBLL, 48 additional children with an eBLL were identified. In CY2022, no child's BLL exceeded the level at which chelation therapy is typically recommended (\geq 45 µg/dL) or fell within the highest range (\geq 20 µg/dL, Table 1). When repeat blood tests were examined 15 out of the 87 children (17%) with elevated results within the calendar year had a follow-up blood lead test result below the CDC cut-off for elevated blood lead by the end of CY2022 (i.e., <3.5 µg/dL).

Table 1. Total Count of Pediatric (ages 0–6) Blood Lead Levels in CY2022				
	BLL Ranges (μg/dL)	CY2022 Q4 n (%)	CY2021 n (%)	

BLL Ranges (μg/dL)	CY2022 Q4 n (%)	CY2021 n (%)
<3.5	958 (96.6%)	5,557 (98.5%)
3.5–9	33 (3.3.%)	80 (1.4%)
10–19	1 (0.1%)	7 (0.1%)
≥20	0	0
Total	992 (100%)	5,644 (100%)

In CY2022 Q4, 992 Army dependents received a blood lead test within the MHS, and 34 of those results (3.4%) were elevated (\geq 3.5 µg/dL) (Table 1). Thirty of the elevated results in CY2022 Q4 are new eBLL cases. Four Army dependents with an elevated result in CY2022 Q4 had an elevated result reported previously in CY2022. Figure 1 summarizes the number of elevated test results from each month in CY2022.

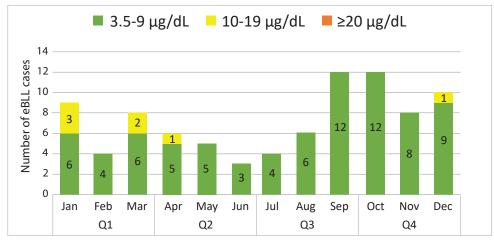


Figure 1. Number of Elevated Blood Lead Cases (\geq 3.5 μ g/dL) by Month in CY2022 Data source: CHCS HL7 and MHS GENESIS

The highest BLL test results from CY2022 were retained for each child dependent; Table 2 summarizes these BLLs by RHC and installation. The elevated BLL results were from Fort (Ft.) Belvoir (3), Ft. Bliss (1), Ft. Bragg (11), Ft. Drum (2), Ft. Hood (4), Ft. Leavenworth (3), Ft. Lee (2), Ft. Leonard Wood (2), Ft. Meade (1), Ft. Polk (11), Ft. Riley (1), Ft. Sill (5), Ft. Stewart (3), Ft. Wainwright (3), Joint Base (JB) Charleston (1), JB Langley-Eustis (1), JB Lewis-McChord (6), JB McGuire-Dix-Lakehurst (1), JB San Antonio (20), Schofield Barracks (2), Scott Air Force Base (AFB) (1), Walter Reed National Military Medical Center (NMMC) (1), and West Point (2). Appendix A shows a list of U.S. Air Force (USAF), Marine Corps, and Navy locations where Army dependents received BLL testing during CY2022.

Table 2. Pediatric (ages 0–6) Blood Lead Levels (BLL), by Region and Installation, CY2022

	BLL Ranges				
REGION	<3.5 μg/dL	3.5-9 μg/dL	10-19 μg/dL	≥20 µg/dL	Total
ATLANTIC					
Aberdeen Proving Ground	87	0	0	0	87
Carlisle Barracks	5	0	0	0	5
Ft. Belvoir*	241	3	0	0	244
Ft. Benning	223	0	0	0	223
Ft. Bragg*	321	10	1	0	332
Ft. Campbell	175	0	0	0	175
Ft. Detrick	28	0	0	0	28
Ft. Drum*	341	2	0	0	343
Ft Gordon	2	0	0	0	2
Ft. Jackson	12	0	0	0	12
Ft. Knox	112	0	0	0	112
Ft. Lee*	64	1	1	0	66
Ft. Meade*	132	1	0	0	133
Ft. Rucker	97	0	0	0	97
Ft. Stewart*	173	2	1	0	176
Redstone Arsenal	12	0	0	0	12
Walter Reed NMMC*	99	1	0	0	100
West Point*	66	2	0	0	68
CENTRAL					
Ft. Bliss*	549	1	0	0	550
Ft. Carson	166	0	0	0	166
Ft. Hood*	451	2	2	0	455
Ft. Huachuca	12	0	0	0	12
Ft. Irwin	9	0	0	0	9
Ft. Leavenworth*	92	3	0	0	95
Ft. Leonard Wood*	105	2	0	0	107
Ft. Polk*	81	11	0	0	92

Table 2 (continued). Pediatric (ages 0–6) Blood Lead Levels (BLL), by Region and Installation, CY2022

		BLL Ranges			
REGION	<3.5 μg/dL	3.5-9 μg/dL	10-19 μg/dL	≥20 µg/dL	Total
Ft. Riley*	153	1	0	0	154
Ft. Sill*	163	5	0	0	168
White Sands Missile Range	1	0	0	0	1
PACIFIC					
Camp Zama	4	0	0	0	4
Ft. Shafter	59	0	0	0	59
Ft. Wainwright*	76	2	1	0	79
Schofield Barracks*	134	2	0	0	136
USAG Humphreys	11	0	0	0	11
EUROPE					
Grafenwoehr	58	0	0	0	58
Hohenfels/Amberg	1	0	0	0	1
Kaiserslautern	2	0	0	0	2
Landstuhl	105	0	0	0	105
Vicenza	54	0	0	0	54
Vilseck	51	0	0	0	51
JOINT BASES					
JB Elmendorf-Richardson	57	0	0	0	57
JB Langley-Eustis*	142	1	0	0	143
JB Lewis-McChord*	27	6	0	0	33
JB Little Creek-Ft. Story	6	0	0	0	6
JB McGuire-Dix-Lakehurst*	15	1	0	0	16
JB Meyer-Henderson Hall	12	0	0	0	12
JB San Antonio*	397	19	1	0	417
USAF MTF**					
	287	2	0	0	289
NAVAL/MARINE CORPS MTF**					
	87	0	0	0	87

^{*} elevated blood lead level (eBLL ≥3.5 μg/dL) result in CY2022

DRSi Reporting Results

Among Army dependents, 48 eBLL cases were reported in DRSi during CY2022 Q4. Due to the differences in the report date compared to the test collection date in the DRSi system, one child had a BLL test result from CY2022 Q2 reported, five children had BLL test results from CY2022 Q3 reported, and the remaining 42 had test results from CY2022 Q4 reported. A total of 68 eBLL cases among Army dependents were reported in DRSi during CY2022. Table 3 summarizes the locations of the cases.

Table 3. Locations Where Elevated Blood Lead Levels (eBLL) Were Reported through DRSi, CY2022

	Number of eBLL* reports	
INSTALLATION	CY2022 Q4	CY2022
Ft. Bliss	1	3
Ft. Bragg	16	18
Ft. Drum	0	1
Ft. Hood	1	2
Ft. Leonard Wood	1	1
Ft. Polk	17	17
Ft. Riley	0	1
Ft. Shafter	0	1
Ft. Sill	0	1
JB Langley-Eustis	0	1
JB San Antonio	7	15
Total	48	68

^{*}eBLL≥3.5 μg/dL

Note: Case counts are based on DRSi reporting date and may not reflect the counts in Table 1.

^{**} See Appendix A for the list of USAF, Navy, and Marine Corps locations where Army dependents received BLL tests in CY2022.

DRSi Reporting Compliance

Twenty-four out of the thirty new eBLL cases identified in the CHCS and MHS GENESIS laboratory data system were reported in DRSi; an 80% reporting compliance for CY2022 Q4. Ft. Leavenworth, Ft. Sill, Ft. Wainwright, JB Lewis-McChord, Scott AFB, and West Point each had one unreported eBLL case from CY2022 Q4.

Army Public Health Nurses Program Status Report (APHN-PSR)

The results of the APHN-PSR indicated that a total of 913 BLL test results were reported to State and/or local authorities during CY2022 Q4 (Table 4). The APHN-PSR question related to pediatric lead is relevant for installations located in State and local jurisdictions that require reporting of all BLL test results, including those below 3.5 μ g/dL (e.g., Louisiana, New York, North Carolina). RHC-Central reported the most BLL test results to State and local authorities (n=735), followed by RHC-Atlantic (n=178). Sixty-seven (7.3%) of those results (n=913) indicated elevated BLLs.

Table 4. Blood Lead Levels (BLL) Reported through the APHN-PSR by Region and Installation, CY2022 Q4

REGION	Number of BLL tests reported to the State/local authorities	Number of eBLL tests reported to the State/local authorities	
ATLANTIC			
Ft. Belvoir	93	0	
Ft.Bragg	29	29	
Ft. Detrick	2	6	
Ft. Rucker	21	0	
JB Langley-Eustis	33	0	
CENTRAL			
Ft. Bliss	275	1	
Ft. Carson	96	0	
Ft. Hood	170	1	
Ft. Huachuca	8	8	
Ft. Leonard Wood	1	1	
Ft. Polk	0	7	
Ft. Riley	111	0	
JB San Antonio	74	10	
PACIFIC			
JB Lewis-McChord	0	4	

Note: Installations that are not listed did not report BLL tests or eBLL (≥3.5 µg/dL) tests.

DISCUSSION

Approximately 1.5% of the results of BLL tests performed in CY2022 (1 January – 31 December 2022) indicated eBLLs. Because of the lower reference value for eBLL, 48 additional children with an eBLL were identified. The number of Army dependents tested during CY2022 (n=5,644 BLL tests) compared to CY2021 (n=8,669 BLL tests) decreased by 35%. The decrease in blood lead test results may be because more dependents are seeking care outside the MHS or a lag or decrement in the laboratory data received from installations that have transitioned to the MHS GENESIS electronic health record. For example, five eBLL cases from both Ft. Polk and JB San Antonio, and ten cases from Ft. Bragg were reported to DRSi, but were not included in the MHS GENESIS laboratory data sent by NMCPHC, indicating a potential gap in the data.

Since there is no safe level of lead in the blood, the Army will continue its Lead Hazard Management Control Program to both prevent childhood lead exposure and monitor children with an eBLL to ensure each case receives proper treatment and management. Reporting eBLLs to DRSi is an important aspect of that control and prevention program. This quarter, reporting compliance was high, with Army MTFs reaching 80% reporting compliance (Q1–Q3 reporting compliance range: 10–100%). eBLL case reporting is critical to reliably identifying installations where children may be at increased risk of lead exposure. Children with an eBLL are reportable to DRSi once per calendar year. Contact the Disease Epidemiology Branch (usarmy.apg.medcom-aphc.mbx.disease-epidemiologyprogram13@health.mil) for any questions regarding DRSi reporting of eBLLs.

LIMITATIONS

This report may not include all Army dependent BLL test results. The NMCPHC extracted the blood lead laboratory results from CHCS one month after the end of Q4 to minimize the chance of missing any results collected during that quarter. However, the NMCPHC sent 458 results from Q1 – Q3 along with the laboratory results for CY2022 Q4 not previously accounted for in those quarters, indicating a longer lag in the data. In addition, only BLLs collected within the MHS are available through either CHCS or MHS GENESIS, meaning blood samples collected and tested outside the MHS are not represented in this report.

The MHS GENESIS data provided by the NMCPHC were included in this report to provide some visibility on the installations that have converted to that electronic medical record system. However, the NMCPHC has communicated concerns about the quality and completeness of these data. At the time of this publication, installations that transitioned to MHS GENESIS include Ft. Benning, Ft. Bliss, Ft. Bragg, Ft. Carson, Ft. Drum, Ft. Gordon, Ft. Hood, Ft. Huachuca, Ft. Irwin, Ft. Jackson, Ft. Leavenworth, Ft. Leonard Wood, Ft. Polk, Ft. Riley, Ft. Rucker, Ft. Shafter, Ft. Sill, Ft. Stewart, Ft. Wainwright, JB Elmendorf-Richardson, JB Langley-Eustis, JB Lewis-McChord, JB San Antonio, Presidio of Monterey, Redstone Arsenal, Schofield Barracks, and West Point.

To improve BLL surveillance, the Army established a RME for eBLLs in children 0 to 6 years old. The USAF similarly reports eBLLs through DRSi. The Navy relies solely on laboratory data and does not report eBLLs through DRSi, so it is possible that those cases will not be immediately visible to the APHC. However, the data from CHCS/MHS GENESIS show that there were no eBLLs among the Army dependents who received BLL tests at Navy or Marine Corps MTFs.

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Appendix A

U.S. Air Force, Navy, and Marine Corps locations where Army Dependents Received a Blood Lead Test, CY2021

USAF Bases			
Aviano AB	Maxwell AFB		
Barksdale AFB	McConnell AFB		
Beale AFB	Mountain Home AFB		
Buckley AFB	Nellis AFB		
Davis-Monthan AFB	Offutt AFB		
Dover AFB	Osan AB		
Dyess AFB	Patrick AFB		
Eglin AFB	Peterson AFB		
FE Warren AFB	RAF Alconbury		
Fairchild AFB	Ramstein AB		
Goodfellow AFB	Robins AFB		
Grand Forks AFB	Scott AFB		
Hanscom AFB	Seymour Johnson AFB		
Hill AFB	Sheppard AFB		
JB Anacostia-Bolling	Spangdalhem AB		
JB Andrews	Tinker AFB		
JB Charleston	Travis AFB		
Kadena AB	USAF Academy		
Keesler AFB	Vance AFB		
Little Rock AFB	Wright-Patterson AFB		
Los Angeles AFB	Yokota AB		

Naval/Marine Corps Stations			
Camp Lejeune			
Chesapeake			
Indian Head			
JB Marianas Guam-Andersen			
JB Pearl Harbor-Hickam			
Lemoore			
Norfolk			
Okinawa			
Patuxent River			
Portsmouth VA			
Quantico			
Sigonella			
Suffolk			
Virginia Beach			