Master of Public Health

Integrative Learning Experience Report

Provider Lead Testing Among Children Under Six Through GIS Mapping and Analysis in Sedgwick County, Kansas

by

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MASTER OF PUBLIC HEALTH

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Abstract

Childhood lead exposure remains a preventable public health issue with persistent inequities related to housing, health care access, and surveillance practices. This project examined childhood blood lead testing patterns in Sedgwick County, Kansas to identify geographic and provider-level opportunities for targeted prevention and outreach. Using secondary surveillance data reported to the Sedgwick County Health Department from 2022–2025, blood lead test records were cleaned, summarized, and analyzed using geographic information system mapping to assess testing distribution by provider ZIP Code.

The analysis identified substantial variation in testing by year, specimen type, provider specialty, and geographic location. Testing was concentrated within a limited number of provider facility ZIP Codes, reflecting the distribution of health care infrastructure rather than residential risk patterns. Capillary specimens accounted for most reported tests, and pediatric and family medicine providers submitted many records, while unknown or out-of-county providers highlighted challenges in surveillance completeness.

To complement surveillance findings, a structured survey was developed to assess medical providers' knowledge, attitudes, and practices related to childhood lead testing and prevention. Although not distributed during the project period, the instrument is prepared for future implementation. Overall, this project demonstrates how surveillance data and geographic information system mapping can guide place-based prevention strategies and support data-driven childhood lead prevention efforts in Sedgwick County.

Subject Keywords: Childhood lead poisoning; Lead screening; Pediatric preventative care; Provider practices; Lead exposure prevention, Geographic information systems (GIS)

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Chapter 1 - Literature Review

Childhood lead poisoning remains a preventable yet persistent public health concern in the United States. Lead is a naturally occurring metal historically used in products such as paint, gasoline, pipes, toys, imported jewelry, and some folk remedies due to its durability and resistance to moisture. Lead becomes toxic when ingested or inhaled, entering the bloodstream and disrupting multiple biological systems. Common exposure sources for children include lead-contaminated dust, paint, soil, and water (Centers for Disease Control and Prevention [CDC], 2024). Young children are especially vulnerable due to rapid neurological development, frequent hand-to-mouth behaviors, and increased gastrointestinal absorption (CDC, n.d.; World Health Organization [WHO], n.d.; American Academy of Pediatrics [AAP], 2016). Exposure during early childhood can result in irreversible neurodevelopmental effects, including cognitive impairment, behavioral problems, and long-term educational and health consequences (Bellinger, 2008; Lanphear et al., 2005; Gould, 2009).

To support early identification and prevention, the CDC currently uses a blood lead reference value (BLRV) of 3.5 µg/dL as the level of public health concern, defined as the 97.5th percentile of blood lead levels among U.S. children aged 1–5 years; importantly, no level of lead exposure is considered safe (CDC, n.d.; Ruckart et al., 2024). This value was lowered from 5 µg/dL in 2021, reflecting declining population blood lead levels, improved surveillance sensitivity, and increased emphasis on prevention and health equity (CDC, 2024). Although national blood lead levels have declined substantially in the United States since the 1970s, exposure persists and remains unevenly distributed across communities (CDC, 2021; Jacobs et al., 2022).

Blood lead surveillance data consistently demonstrate geographic variation in exposure risk and testing coverage, highlighting the importance of local data analysis to guide prevention efforts (CDC, 2021; Miranda et al., 2011; Roberts et al., 2018). Housing remains the dominant source of exposure, particularly deteriorating lead-based paint, household dust, and contaminated soil in homes built before 1978 (CDC, 2004; U.S. Environmental Protection Agency [EPA], 2023; Jacobs et al., 2002). The year 1978 marks the federal ban on the residential use of lead-based paint in the United States, making housing constructed prior to this year significantly more likely to contain lead hazards (EPA, 2023). Areas with a higher concentration of pre-1978 housing and higher poverty levels experience higher rates of elevated blood lead levels; however, these areas do not always correspond with higher screening rates, suggesting that children at greatest risk may be under-tested (Betts et al., 2016; CDC, 2012).

Geographic analyses have demonstrated that elevated blood lead levels often cluster in specific neighborhoods characterized by older housing and higher poverty levels (Miranda et al., 2011; CDC, 2021). In Sedgwick County, Kansas, priority mapping identified eight ZIP codes with significantly higher risk for elevated blood lead reports among children under six years of age. Incident rate ratios in these areas ranged from 4.14 to 10.02 compared with other ZIP codes in the county. These high-risk ZIP codes also had a greater proportion of housing built prior to 1980 and higher poverty levels than the county overall, highlighting how housing conditions and socioeconomic factors contribute to geographic disparities in lead exposure risk (Sparks et al., 2019).

Public health surveillance systems rely on blood lead testing conducted in clinical settings to monitor exposure trends and guide intervention efforts (CDC, 2012). Adoption of the updated BLRV has improved detection of harmful exposures but has also increased demands for follow-up testing and public health response (Jacobs et al., 2022; Ruckart et al., 2024). Most U.S. jurisdictions have adopted the updated BLRV and mandate blood lead reporting, with testing policies prioritizing children under age six due to their increased biologic susceptibility, greater lead absorption, and elevated risk of lasting neurodevelopmental harm even at low exposure levels (CDC, 2022; Ruckart et al., 2024).

Variation in screening practices across provider types is well documented. Pediatric providers are generally more familiar with lead screening recommendations than family medicine or acute care providers, as pediatric well-child visits align closely with recommended screening schedules (AAP, 2016; Kempe et al., 2014). Differences in training, clinical priorities, and awareness of guidelines contribute to inconsistent testing practices (Betts et al., 2016). Barriers include competing clinical priorities and challenges associated with off-site laboratory testing, while on-site testing is associated with higher completion rates (Haboush-Deloye et al., 2017; Roberts et al., 2018).

Clinical management for lead includes blood lead testing, confirmatory venous testing, follow-up monitoring, and coordination with public health agencies (AAP, 2016; CDC, 2012). Blood lead testing in children is typically performed using either capillary or venous specimens. Capillary testing, obtained through a finger-stick, is commonly used for initial screening because it is less invasive and easily performed in outpatient settings. However, capillary samples are more susceptible to environmental contamination and require confirmatory venous testing when elevated results are detected. Venous testing, obtained through venipuncture, is considered the diagnostic standard for confirming elevated blood lead levels. As a result, surveillance datasets often include both specimen types, reflecting the two-step screening and confirmation process used in childhood lead testing.

Many children with elevated BLLs are asymptomatic; therefore, routine screening remains essential. While medical management identifies affected children, the literature consistently supports primary, housing-based prevention as the most effective strategy for eliminating childhood lead poisoning (CDC, 2004; EPA, 2023). Coordinated efforts between healthcare providers and health departments, informed by local surveillance and geographic analysis, are critical for sustaining reductions in exposure and advancing prevention. Persistent geographic disparities and variability in screening practices highlight the need for localized, data-driven approaches to childhood lead prevention. This project addresses that need by examining blood lead testing patterns and geographic distribution in Sedgwick County to identify screening gaps and inform targeted, equitable public health strategies.

Chapter 2 - Learning Objectives, Project Description, Methods

This project aimed to identify where children in Sedgwick County receive blood lead testing and to assess geographic and provider-based opportunities for targeted outreach and education. The analysis supports the Sedgwick County Health Department's (SCHD) mission to prevent childhood lead exposure through surveillance, provider engagement, and data-driven public health interventions. Sedgwick County, located in south-central Kansas, includes a mix of urban and surrounding communities **(Figure 2.1).**

Figure 1.1. Location of Sedgwick County within the State of Kansas

The objectives for this project were adapted from the original Applied Practice Experience (APE) agreement to reflect the scope of work completed during the practicum period. Minor wording revisions were made to clarify the methodological focus and intended public health application of each objective.

Objective 1. Analyze the geographic distribution of medical providers in Sedgwick County offering childhood lead testing through geographic information system (GIS) mapping.

Objective 2. Design and develop a structured survey for medical providers in Sedgwick County to assess their knowledge, attitudes, and practices related to childhood lead testing and prevention.

Methods & Activities

Objective 1: Data Analysis and GIS Mapping of Childhood Lead Testing Providers

Data Sources and Data Cleaning Procedures

To achieve Objective 1, secondary surveillance data were obtained from the SCHD Epidemiology Program. The dataset included all reported childhood blood lead test results from January 1, 2022, through December 31, 2025. Under Kansas state reporting requirements, all blood lead test results for children must be reported to the local health department. These data are maintained in EpiTrax, a statewide disease surveillance and case management system.

The initial dataset was exported from EpiTrax into *Microsoft Excel for Microsoft 365* (Version 16.0; Microsoft Corporation, 2023) as *TKW_Capstone_Data.xlsx* and contained 21,005 test records. After application of the SCHD data-cleaning macro titled *Provider_Blood_Lead* and removal of duplicate records using the CombinedKey variable, the dataset included 20,845 records. Some children had multiple legitimate tests during the study period (e.g., repeat capillary screening or confirmatory venous testing), and these records were retained.

Consistent exclusion criteria were applied across all analyses to ensure accurate representation of testing occurring within Sedgwick County. Tests conducted at McConnell Air Force Base (ZIP code 67221), tests reported by laboratories located outside Sedgwick County without an associated Sedgwick County provider, and tests for which the provider's name was unknown were excluded prior to analysis. This included 2,393 tests conducted in 2024–2025 that were reported by laboratories located outside Sedgwick County and an additional 155 tests reported through a separate external laboratory. After applying these exclusions, the final analytic dataset contained 17,181 childhood blood lead test records. All data provided were de-identified and contained no personal patient identifiers.

The macro first standardized provider and facility information by linking the export dataset to two external reference files: (1) a National Provider Identifier (NPI) dataset and (2) a facility type dataset. The NPI dataset, which contained 3,784 provider names, was used to standardize provider names and correct common data entry inconsistencies, including misspellings, inconsistent capitalization, abbreviated names, reversed name order, and inclusion or omission of professional titles. Records containing the placeholder NPI value "9999999999" were recoded as "Unknown Provider NPI." Provider specialty data were obtained from the 2025_MSSC_Provider_Speciality.csv file, compiled from the Medical Society of Sedgwick County (MSSC) physician database.

Facility classifications were standardized using a reference dataset containing 431 facilities categorized as clinic, hospital, public health clinic, laboratory, or other. Because facilities were inconsistently labeled in the raw data (e.g., hospital vs. clinic), the macro standardized facility names and applied a structured classification order prior to analysis. When a reporting provider was not listed, the medical consult provider for Kansas local health departments was assigned using the Kansas Organized Network for Clinical and Administrative Collaboration (KONZA) to ensure a provider record was documented.

Laboratory result values were cleaned by removing non-numeric characters (e.g., “<” or “>”), standardizing numeric formats, and converting date variables into consistent date fields. Blood lead test results were categorized into clinically relevant ranges (<3.5 µg/dL, 3.5–4.9 µg/dL, 5.0–9.9 µg/dL, and ≥10 µg/dL) using conditional logic embedded within the macro. To identify exact duplicate records, a unique “CombinedKey” variable was created using patient record number, laboratory collection date, specimen source, and test value. After sorting by patient identifier and collection date, duplicate records based on this key were removed (n = 160). Additional structured processing was used to identify each child’s most recent and prior tests for analytic purposes.

All providers were retained in the analytic dataset regardless of testing volume. However, to protect confidentiality, cell counts less than or equal to six were suppressed in reported tables in accordance with standard public health reporting practices.

Variables included in the final analytic dataset were EpiTrax record number, test count, blood lead test result, ordering clinician, National Provider Identifier (NPI), standardized provider name (mode by NPI), standardized facility name (mode by NPI), ordering facility name, provider ZIP Code, facility type, provider specialty, and county. Both capillary and venous specimens were included.

Using Microsoft Excel, pivot tables were created to summarize testing activity by provider, facility, specialty, and ZIP Code. Filters and sorting functions were used to identify duplicate NPIs, assess data completeness, and examine patterns in testing volume. Lookup and concatenation formulas were applied to link provider NPIs to standardized provider and facility names using a master NPI reference file. These Excel-based analytical techniques supported efficient aggregation and interpretation of surveillance data. **Table 2-1** summarizes the Microsoft Excel functions used during data preparation and analysis. Descriptive analyses were conducted to summarize childhood blood lead testing volume by year, specimen type, provider specialty, and provider facility ZIP Code. These summaries informed the tables, figures, and geographic visualizations presented in the Results section.

Table 2.1 Summary of Microsoft Excel Skills Used for Data Preparation and Analysis

Skill	**Description**	**Example**
Pivot Table Creation and Manipulation, Including Graph Creation	Used to easily view selected variables out of raw data and then graph these values	Created a table containing the count of providers per ZIP Code. Created a table comparing the providers specialty and testing count frequency. Created a table with the total number of blood lead tests

Filters	Allows for only specific values from one column of data to be viewed, without creating a new table each time	Used to view information gaps in data that needed to be filled.
Sorting	Sorts entire dataset by one of more columns while keeping each record intact	Sorting data by the medical providers NPI number to find duplicates
V Lookup Formula	"=VLOOKUP(RC[-1],'[NPI DATA.xlsx]Master List'!C3:C4,2,0)"	Used to search for NPI values from one spreadsheet to the master spreadsheet
Concatenate Formula	Formula=CONCATENATE .Range("C2:C" & LastRow).FormulaR1C1 = "=RC[-2] & ""-"" & RC[-1]" .Range("C2:C" & LastRow).Value = .Range("C2:C" & LastRow).Value	Used to join values into one cell

Following completion of the Excel-based analysis, summarized provider ZIP Code–level testing data were imported into *ArcMap* (version 10.8.1; Esri 2020) for geographic visualization.

A Sedgwick County boundary shapefile was obtained from the Sedgwick County GIS Open Data Portal (Sedgwick County, n.d.) to ensure geographic accuracy and consistency. Provider testing counts were joined to the county ZIP Code shapefile, and a choropleth map **(Appendix 3)** was created to visualize the distribution of childhood lead testing providers across Sedgwick County. This spatial analysis enabled identification of geographic clustering of testing activity and informed potential outreach and surveillance priorities.

Objective 2: Survey Design and Development for Medical Providers

To achieve Objective 2, a structured survey **(Appendix 4)** was developed to assess medical providers' knowledge, attitudes, and practices related to childhood lead testing and prevention in Sedgwick County. While the GIS analysis identified where lead testing occurred, the survey was designed to examine factors influencing testing practices and to identify provider-level barriers, facilitators, and educational needs.

Survey content was informed by CDC childhood lead poisoning prevention guidelines, relevant peer-reviewed literature, and priorities identified by SCHD staff. A previously developed SCHD provider survey was also reviewed to inform question structure, terminology, and content areas, supporting continuity with prior assessment efforts while allowing updates to reflect current public health practice needs.

The finalized survey included questions on familiarity with lead screening recommendations, confidence in ordering and interpreting blood lead tests, perceived responsibility for lead prevention, counseling practices with families, and interest in receiving local lead prevention resources or training. The instrument primarily used multiple-choice and Likert-scale questions to support quantitative analysis, with a small number of open-ended questions to capture additional perspectives. The survey was designed to require 5–7 minutes to complete to minimize respondent burden.

The SCHD preceptor reviewed and approved the draft survey to proceed during the APE timeframe. Because the Epidemiology Program operates within the Health Protection Division, the survey is also expected to undergo additional review by the Health Protection Director prior to final deployment. At the time of this project, the survey had not yet been programmed in Alchemer, SCHD's survey software, or distributed; however, it was fully developed and designed for voluntary, anonymous participation by medical providers involved in pediatric care or childhood lead testing in Sedgwick County and is ready for future electronic implementation by SCHD to support ongoing childhood lead prevention efforts.

Chapter 3 - Products and Results

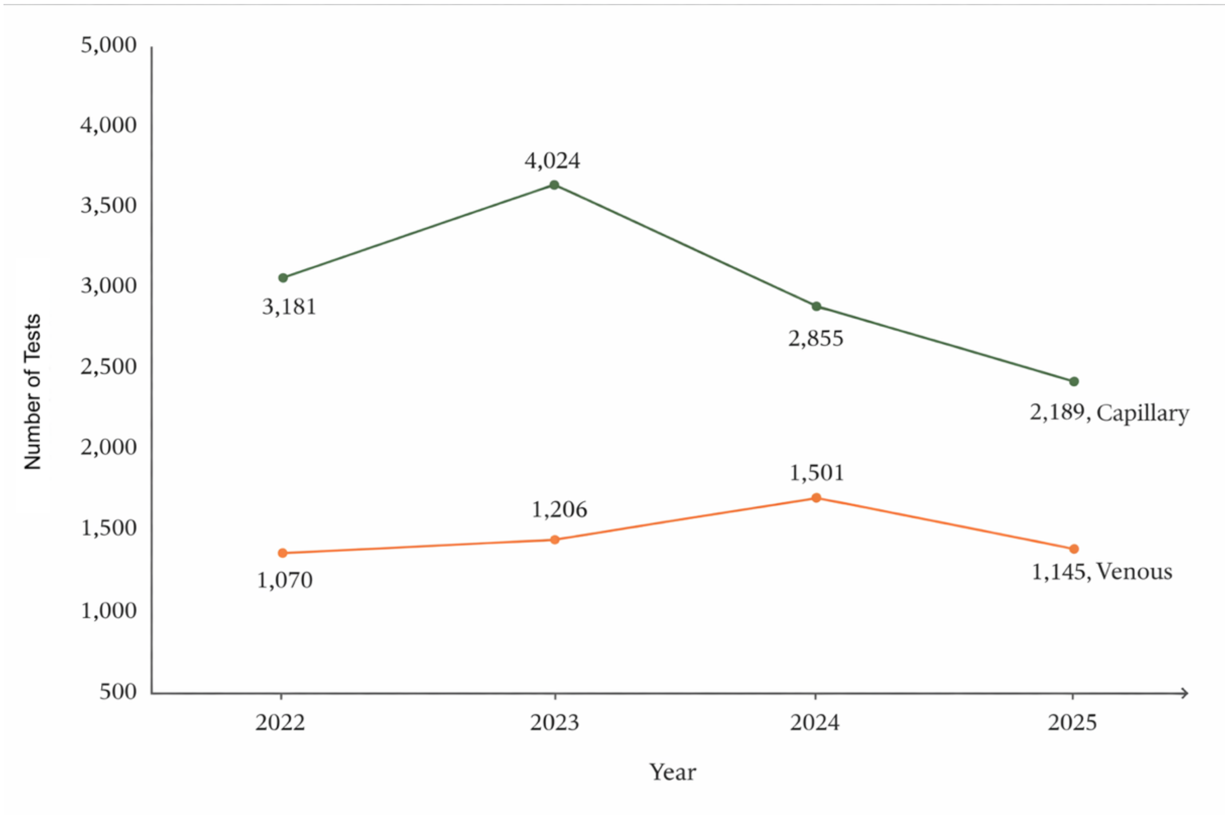
Overview of Surveillance Data

Blood lead surveillance data reported to the SCHD from January 1, 2022, through December 31, 2025, were analyzed. The dataset included 17,181 blood lead tests, recognizing that individual children may have received more than one test during the study period.

Blood Lead Testing Volume by Year and Specimen Type

Annual blood lead testing volume varied across the study period and by specimen type. In 2022, 3,181 capillary tests and 1,070 venous tests were reported, a period that coincided with SCHD resuming routine public health operations following COVID-19 related disruptions. That same year, SCHD hired a Lead Poisoning Prevention Specialist, which expanded investigative capacity, increased home visits, strengthened partnerships with local clinics, and enhanced community outreach efforts. Testing increased in 2023, with 4,024 capillary tests and 1,206 venous tests reported, representing the highest annual capillary testing volume observed during the study period. In 2024, overall testing volume decreased; however, venous testing increased to 1,501 tests, the highest annual venous total reported. In 2025, both specimen types declined, with 2,189 capillary tests and 1,145 venous tests reported. Across all four years, capillary specimens accounted for the majority of reported blood lead tests **(Figure 3.1)**. Interpretation of testing trends in 2024 and 2025 should be made with caution because exclusions applied during data cleaning may have reduced the number of tests included in the analytic dataset for those years.

Figure 2.1. Number of Reported Capillary and Venous Childhood Blood Lead Tests by Year, Sedgwick County, 2022-2025



[1] *Data reflect total tests rather than unique children; some children received multiple tests during 2022–2025, which may overestimate the number screened and inflate elevated counts. Data exclude tests reported by laboratories outside Sedgwick County or at McConnell Air Force Base, and tests with unknown provider name.*

Distribution of Test Results by Blood Lead Level and ZIP Code

ZIP Code–level summaries of blood lead test results stratified by blood lead value category are presented in **Table 3.1**. Of the 17,181 total tests, 16,227 (94.5%) were reported with blood lead levels below 3.5 µg/dL, 416 (2.4%) were between 3.5–4.9 µg/dL, and 538 (3.1%) were ≥5.0 µg/dL. Several provider ZIP Codes accounted for a larger proportion of total testing volume, including 67206, 67214, and 67208. The distribution of elevated test results also varied across ZIP Codes; for example, ZIP Code 67214 had a higher proportion of tests in the ≥5.0 µg/dL category compared with other high-volume testing areas. Percentages presented in the table reflect the proportion of tests within each ZIP Code relative to the ZIP-specific total.

Table 3.1 Total Number of Blood Lead Level Tests Reported in Sedgwick County, Kansas, January 1, 2022-December 31, 2025

Provider ZIP Code	**< 3.5 µg/dL (%)**	**3.5- 4.9 µg/dL (%)**	**≥ 5.0 µg/dL (%)**	**Total**
67206	6,241 (97.8%)	85 (1.3%)	55 (0.9%)	6,381
67214	2,691 (85.7%)	160 (5.1%)	290 (9.2%)	3,141
67208	2,629 (95.4%)	55 (2.0%)	73 (2.6%)	2,757
67212	813 (96.7%)	11 (1.3%)	17 (2.0%)	841
67207	682 (94.2%)	20 (2.8%)	22 (3.0%)	724
67235	608	≤6	≤6	--
67218	541 (92.8%)	20 (3.4%)	22 (3.8%)	583
67037	512	≤6	≤6	--
67211	319 (92.5%)	16 (4.6%)	10 (2.9%)	345
67203	279 (94.3%)	8 (2.7%)	9 (3.0%)	296
67205	277	≤6	7	--
67219	201	13	≤6	--
67226	90	0	≤6	--
67204	71	6	≤6	--
67210	73	≤6	≤6	--

67215	59	≤6	≤6	--
67213	46	≤6	7	--
67052	36	≤6	8	--
67217	26	≤6	3	--
67216	28 (100%)	0 (0.0%)	0 (0.0%)	28
67110	≤6	≤6	0	--
67026	≤6	0	0	--
67060	≤6	0	0	--
Total	16,227	416	538	17,181

[1] Values are presented as n (%), where percentages represent the proportion of blood lead level tests within each ZIP Code relative to the ZIP-specific total. *Data reflect total tests rather than unique children; some children received multiple tests during 2022–2025, which may overestimate the number screened and inflate elevated counts. Data exclude tests reported by laboratories outside Sedgwick County or at McConnell Air Force Base, and tests with unknown provider name. Cells with counts ≤6 were suppressed to protect confidentiality. Row totals were also suppressed where necessary to prevent back-calculation of small cell counts.*

Geographic Distribution of Testing by Provider Facility ZIP Code

A choropleth map was developed to visualize the total number of blood lead tests reported by provider facility ZIP Code across Sedgwick County for the combined study period **(Appendix 3).** The map includes both capillary and venous specimens and reflects the same exclusion criteria applied to tabular analyses. Testing volume varied by provider location. A small number of central Sedgwick County ZIP Codes accounted for the majority of reported tests, while many ZIP Codes reported minimal testing activity.

Provider Specialty and Facility Characteristics

Blood lead testing was reported by providers across multiple clinical specialties **(Table 3-2)**. Pediatrics (40.0%) and family medicine (22.1%) accounted for most reported tests. A substantial proportion of tests (34.5%) were associated with providers categorized as unknown specialty.

Table 3.2 Number and Percentage of Childhood Blood Lead Tests by Provider Specialty in Sedgwick County, Kansas, January 1, 2022-December 31, 2025

Specialty	Count of Tests (%)
Pediatrics	6,872 (40.0%)
Family Medicine	3,787 (22.1%)
Surgery, Surgical Critical Care	423 (2.5%)
Infectious Disease	155 (0.9%)
Internal Medicine	6 (0.0%)
Otolaryngology	4 (0.0%)
Emergency Medicine	2 (0.0%)
Psychiatry & Neurology	2 (0.0%)
Unknown Specialty	5,930 (34.5%)
Total	17,181 (100.0%)

[2] *Data exclude tests that had providers outside Sedgwick County or at McConnell Air Force Base, and tests with unknown provider name.*

In addition to specialty distribution, the geographic location of provider facilities submitting childhood lead tests were examined (**Table 3.3**). Testing activity was concentrated within a limited number of ZIP Codes. Provider facilities in ZIP Code 67214 accounted for the largest proportion of reported testing locations (35.2%), followed by ZIP Codes 67208, 67218, and 67206.

Table 3.3 Provider Facility ZIP Codes Reporting Childhood Blood Lead Tests, Sedgwick County, Kansas, January 1, 2022- December 31, 2025

ZIP	Count (%) Providers
67214	236 (35.2%)
67208	76 (11.3%)
67218	60 (9.0%)
67206	56 (8.4%)
67211	39 (5.8%)
67212	36 (5.4%)
67205	26 (3.9%)
67213	18 (2.7%)
67207	15 (2.2%)

67037	15 (2.2%)
67235	13 (1.9%)
67215	13 (1.9%)
67204	12 (1.8%)
67217	11 (1.6%)
67203	9 (1.3%)
67052	9 (1.3%)
67226	8 (1.2%)
67210	7 (1.0%)
67216	6 (0.9%)
67110	2 (0.3%)
67026	1 (0.1%)
67060	1 (0.1%)
67219	1 (0.1%)
Total	670 (100.0%)

“Medical Provider Perspectives on Childhood Lead Testing & Prevention” Survey

The project developed a structured survey to assess medical provider perspectives on childhood lead testing and prevention in Sedgwick County **(Appendix 4)** in collaboration with SCHD’s Epidemiology Program. In consultation with the project preceptor, formal Institutional Review Board (IRB) review was deemed unnecessary because the project involved only de-identified surveillance data and no direct interaction with human subjects. An initial eligibility question was designed to ensure that only providers whose clinical scope included children at highest risk for lead exposure would complete the survey. Skip logic and an early-exit message were incorporated to minimize respondent burden and protect data validity. Introductory text and informed consent language were included to clearly communicate the survey’s purpose, voluntary nature, and confidentiality protections.

The survey was designed to collect clinic location ZIP Code using a short-answer format with instructions to enter a five-digit ZIP Code only, supporting geographic analysis while avoiding collection of personally identifiable information. Likert-scale matrix questions were developed to assess provider familiarity with CDC and Kansas childhood lead screening guidelines and confidence in identifying children at increased risk for lead exposure. Screening practices were intended to be measured using frequency-based response options, while “check all that apply” questions were included to reflect the complexity of clinical decision-making.

Additional questions were designed to distinguish between capillary and venous testing methods due to implications for test accuracy, confirmatory testing, and follow-up care. Provider attitudes toward lead screening and prevention were planned to be assessed using Likert-scale matrices to evaluate prioritization of lead-related services within routine pediatric care. The survey also included questions intended to assess perceived barriers to screening and follow-up, such as time constraints, caregiver awareness, guideline uncertainty, access to confirmatory testing, insurance coverage, and language or cultural barriers, with an optional open-ended item for additional context.

The survey instrument included questions designed to assess prevention counseling practices, including counseling frequency and topics such as housing-related risks, nutrition, water safety, and exposure from imported products. Insurance-related items were included to evaluate structural barriers to equitable access to lead testing. Skip logic was incorporated to limit follow-up questions to providers interested in receiving resources or training. Although the survey was not distributed during the study timeframe, the finalized instrument is ready for future implementation to support provider education, outreach, and childhood lead prevention efforts. The finalized instrument incorporates eligibility screening, branching logic, and multiple response formats and is included as a project deliverable in the appendix.

Chapter 4 - Discussion

This project analyzed childhood blood lead level (BLL) testing patterns in Sedgwick County to identify geographic and provider-level factors influencing screening distribution and case detection within the local surveillance system. The findings demonstrate how routine surveillance data can inform targeted, place-based prevention strategies and strengthen local public health practice by identifying system-level factors that influence testing patterns.

Interpretation of Key Findings

Geographic analysis showed concentrations of elevated BLL test results based on the locations of providers reporting tests within specific ZIP Codes in Sedgwick County. Since the analysis was based on provider facility locations rather than children's residential addresses, the geographic patterns reflect where screening and case detection occurred rather than the underlying spatial distribution of exposure risk. Testing activity was concentrated within a relatively small number of provider facility ZIP Codes, suggesting that screening patterns are influenced by the geographic distribution of healthcare services and laboratory reporting pathways.

Patterns in the distribution of blood lead test results by ZIP Code should therefore be interpreted cautiously. Higher counts of elevated BLLs in certain areas may reflect differences in child population size, provider concentration, and access to screening rather than true differences in exposure risk. When examined descriptively alongside housing age and socioeconomic indicators, some ZIP Codes—particularly 67214—show a higher proportion of elevated BLLs relative to the number of tests conducted. While this pattern may suggest potential environmental or housing-related risk factors, the analysis was descriptive and did not assess statistical significance. These findings should therefore be interpreted as indicators for further investigation rather than definitive evidence of geographic differences in exposure.

Annual blood lead testing patterns also varied by specimen type. Across all study years, capillary specimens accounted for most reported tests, a pattern commonly observed in childhood lead screening. Capillary testing is frequently used for initial screening because it can be performed quickly during routine outpatient visits, whereas venous testing is recommended for confirmatory follow-up after an elevated capillary result (CDC, 2025; AAP, 2025). This screening workflow contributes to higher capillary testing volumes in surveillance datasets.

Pediatric and family medicine providers accounted for most reported tests; however, a substantial proportion were associated with providers classified as unknown or located outside Sedgwick County. This finding highlights an operational challenge within surveillance systems: children often receive care across multiple health systems, and provider attribution is not always consistently captured in laboratory reporting data. As a result, provider-specific outreach alone may not reach all clinicians involved in childhood lead screening.

Together, these findings highlight how system-level complexities may influence observed screening patterns within the surveillance data, rather than a lack of screening activity. Provider mobility, multi-site practice, incomplete provider attribution, and variability in electronic laboratory reporting (ELR) complicate efforts to monitor screening patterns and coordinate follow-up care.

Relation to Literature and Practice

These findings align with existing literature documenting persistent disparities in childhood lead exposure and the influence of social determinants of health, including housing quality and access to preventive healthcare services (CDC, 2024; Hauptman et al., 2023). Previous studies have shown that areas with older housing stock and socioeconomic disadvantage often experience higher risk of lead exposure (Marshall et al., 2020), yet screening coverage may not always align with those risk patterns (CDC, 2024). This project contributes to that literature by demonstrating how fragmented healthcare delivery and incomplete provider attribution can influence observed screening patterns within local surveillance data.

Within Sedgwick County Health Department (SCHD) practice, the analysis illustrates how routine surveillance data can be used to identify priority areas for provider outreach, guide interpretation of testing patterns, and support equitable lead prevention planning.

Public Health Implications

The findings support prioritizing outreach and prevention messaging among providers serving ZIP Codes with higher concentrations of elevated BLL test results, alongside targeted education, housing-related interventions, and integration of lead counseling into maternal and child health programs. Potential strategies include distributing screening reminders to providers serving high-volume areas, partnering with housing agencies to promote remediation resources for older housing stock, and incorporating anticipatory guidance on lead exposure into programs such as WIC, home visiting, and prenatal care services.

Given provider mobility and multi-site practice patterns, system-level education and centralized outreach—such as countywide provider webinars, standardized screening toolkits, or collaboration with large healthcare systems—may be more effective than clinic-specific strategies. More broadly, these findings demonstrate the value of applied surveillance analysis for developing practical, resource-efficient public health strategies that align outreach efforts with observed testing patterns.

Recommendations and Next Steps

Review of blood lead testing patterns from 2022–2025 highlights opportunities to strengthen targeted prevention efforts and improve surveillance interpretation in Sedgwick County. Routine annual review of testing distribution, paired with updated GIS mapping, could help SCHD identify areas with persistently elevated BLLs and tailor outreach accordingly. Sharing concise data summaries with providers serving ZIP Codes with higher proportions of elevated BLLs may reinforce screening recommendations and promote more consistent testing practices.

Patterns in provider attribution and laboratory reporting also highlight challenges related to surveillance completeness. Variation in testing volume, incomplete provider classification, and the number of tests processed by laboratories outside Sedgwick County suggest that pediatric care and laboratory services operate within broader regional networks. While structural modifications to the state surveillance system may not be immediately feasible, continued coordination with the Kansas Department of Health and Environment (KDHE) and periodic review of laboratory reporting processes may improve confidence in data completeness and interpretation of local trends. Internally, SCHD can continue refining data management procedures and prioritizing outreach to large clinic systems and provider networks to promote consistent screening and confirmatory testing practices.

Implementation of the provider survey developed during this project represents an additional opportunity to better understand local barriers and educational needs. If distributed electronically through existing professional networks or healthcare system contacts, survey findings could inform targeted educational materials or brief training sessions for providers involved in pediatric care.

Methodological Considerations and Limitations

This project used a large, real-world surveillance dataset, enhancing its relevance to public health practice. However, several limitations should be considered. Exclusion of tests conducted at McConnell Air Force Base and by laboratories located outside Sedgwick County reduced dataset completeness. In addition, incomplete provider attribution and suppression of low-volume ZIP Codes limited the level of geographic detail that could be reported.

Interpretation of temporal testing trends should also be made cautiously because exclusions related to laboratory reporting disproportionately affected data from 2024 and 2025. A total of 2,393 blood lead tests conducted during these years were excluded because the reporting laboratories were located outside Sedgwick County, with an additional 155 tests excluded due to reporting through a separate external laboratory. These exclusions likely contributed to lower observed testing volumes in later years.

Since the analysis used test-level rather than individual-level data, some children may have been counted more than once if they received repeat capillary screenings or confirmatory venous tests. As a result, the number of tests may overestimate the number of unique children screened. Additionally, the provider survey developed for this project was not distributed during the study period; if implemented, survey responses could be subject to response bias and self-report bias.

Conclusion

This APE demonstrates the use of epidemiologic and geographic methods to inform targeted, equity-focused childhood lead prevention in Sedgwick County. Analysis of local surveillance data identified ZIP Code–level concentrations of elevated blood lead levels based on provider testing locations rather than residential addresses and highlighted system-level factors influencing screening patterns and case detection. These findings support strategic resource allocation, provider education, and place-based prevention efforts. Overall, the project illustrates how routine surveillance data combined with geographic analysis can generate actionable insights for local health departments and strengthen data-driven childhood lead prevention strategies.

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Appendix 1 - Synthesis and/or Integration of Competencies

Table A.01 Synthesis and Integration of Competencies

Competency	**Description of Synthesis and Integration**
MPH Competency #1 Apply epidemiological methods to settings and situations in public health practice	I applied epidemiological methods to examine pediatric blood lead testing patterns and exposure risk in Sedgwick County. I synthesized national guidance, peer-reviewed literature, and local surveillance data to analyze geographic variation, provider screening practices, and policy influences on blood lead testing. By integrating descriptive epidemiology with geographic priority mapping. By synthesizing epidemiologic findings with geographic context, I identified testing gaps and areas of elevated risk to inform targeted prevention strategies.
MPH Competency #4 Interpret results of data analysis for public health research, policy, or practice	I interpreted results from the analysis of pediatric blood lead testing and surveillance data to inform public health research and practice in Sedgwick County. I evaluated trends in testing volume, geographic distribution, and provider

	screening patterns to identify disparities and gaps in case ascertainment. By synthesizing quantitative findings with existing literature and policy guidance, I integrated the findings within broader prevention approaches and applied the combined evidence to develop concrete recommendations for provider engagement, targeted response efforts, and program development.
IDZ Competency # 3- Examine the influence of environmental and ecological forces on infectious diseases.	I examined how environmental and ecological forces influence disease distribution and risk by analyzing geographic, housing, and community-level conditions that shape population health outcomes. I interpreted spatial patterns and contextual factors to evaluate how place-based risks, resource distribution, and environmental conditions contribute to disease vulnerability. By synthesizing surveillance data with existing literature, I applied an ecological framework to understand how environmental determinants inform public health research, guide prevention strategies, and support targeted interventions.

Appendix 2 - Demonstration of Competency Attainment

Table A.01 Attainment of Competencies

Practice-based products that demonstrate competency attainment	
Specific products	**Competency**
Provider survey; ZIP Code testing analysis and map	MPH Competency #1- Epidemiological principles were applied to examine screening patterns, surveillance gaps, and geographic variation in blood lead testing.
Provider survey; ZIP Code testing analysis and map	MPH Competency #3 - Quantitative surveillance data were analyzed using informatics and geographic mapping tools to examine pediatric blood lead testing patterns by ZIP Code. The provider survey was structured to generate analyzable quantitative and qualitative data, with response formats aligned to future statistical and thematic analysis.
Provider survey; ZIP Code testing analysis and map	MPH Competency #4 - The products were designed to support interpretation of analytic findings to identify gaps in testing coverage, provider knowledge, and screening practices, with the goal of informing public health practice, policy planning, and prevention strategies.

Provider survey; ZIP Code testing analysis and map	MPH Competency #7 - Provider-level needs, resources, and capacities related to childhood lead screening were assessed through the survey, while the ZIP Code analysis assessed geographic distribution of testing access and capacity across the community.
Provider survey; ZIP Code testing analysis and map	MPH Competency #9 - Both products were intentionally designed to inform population-based childhood lead prevention efforts, including targeted provider education, outreach strategies, and data-driven allocation of public health resources.

Appendix 3 – Total Blood Lead Tests by Medical Provider

Appendix 4 - “Medical Provider Perspectives on Childhood Lead Testing & Prevention” Survey

Survey: Medical Provider Perspectives on Childhood Lead Testing & Prevention

The Sedgwick County Health Department investigates reportable conditions, including elevated blood lead levels in children. There is no safe level of lead; the Centers for Disease Control and Prevention (CDC) identifies **3.5 µg/dL** as the reference value for public health action.

This survey focuses on medical providers who care for children under 6 years of age and will take **5–7 minutes to complete.** It aims to understand **lead testing practices, knowledge, attitudes, and barriers** in Sedgwick County. Your responses are **confidential**. At the end, you may request educational materials or training resources; any contact information provided will **not be linked to your survey responses**.

By continuing, you consent to participate.

SECTION 1: Provider Eligibility

Q1. Do you currently provide care to children under age 6?

Multiple choice

- Yes
- No

If “No,” end survey with the early-exit message. → “Thank you for your interest in this survey. Currently, this survey is intended for medical providers who care for children under the age of 6. We appreciate your time and commitment to public health.”

SECTION 2: Clinic Location

Q2. What is the ZIP code of the clinic where you primarily provide care to children?

Short answer

Helper text: Please enter the 5-digit ZIP code only.

SECTION 3: Knowledge, Awareness & Confidence

Q3. Please indicate your level of agreement with the following statements related to childhood lead screening guidelines and risk identification:

Matrix

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am familiar with CDC childhood lead screening guidelines	☐	☐	☐	☐	☐

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am familiar with Kansas childhood lead screening guidelines	☐	☐	☐	☐	☐
I am confident in identifying children at increased risk for lead exposure	☐	☐	☐	☐	☐

SECTION 4: Screening & Testing Practices

Q4. How often do you screen children for lead exposure according to Kansas Department of Health and Environment (KDHE) recommendations?

Multiple choice

- Always
- Often
- Sometimes
- Rarely
- Never

Q5. Who does your clinic test for lead exposure? (Check all that apply)

- Children <3 years
- All children 3-18 years
- Children with risk factors (e.g., living in a home built before 1978, sibling with elevated blood lead)
- Children with symptoms (e.g., lack of appetite, fatigue, anemia)
- Any client who requests
- Other _________

Q6. What type of lead testing do you primarily use?

Multiple choice

- Capillary (finger stick)
- Venous (blood draw)
- Both
- Not sure

SECTION 5: Attitudes Toward Lead Screening & Prevention

Q7. Please indicate your level of agreement with the following statements:

Matrix

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Lead screening is a critical preventive service for children in Sedgwick County	☐	☐	☐	☐	☐
Lead exposure prevention should be discussed during well-child visits	☐	☐	☐	☐	☐

SECTION 6: Barriers to Screening & Prevention

Q8. Please rate the significance of the following barriers to childhood lead screening in your practice:

Matrix

Barrier	Very Significant	Somewhat Significant	Slightly Significant	Not Significant
Time constraints during visits	☐	☐	☐	☐
Caregiver awareness or concern	☐	☐	☐	☐
Uncertainty about screening guidelines	☐	☐	☐	☐
Access to confirmatory testing	☐	☐	☐	☐
Follow-up after elevated results	☐	☐	☐	☐
Insurance or reimbursement issues	☐	☐	☐	☐
Language or cultural barriers	☐	☐	☐	☐

Barrier	Very Significant	Somewhat Significant	Slightly Significant	Not Significant
Other barrier (please specify below)	☐	☐	☐	☐

Q8a. If you selected "Other," please describe the barrier. *(Optional short answer)*

SECTION 7: Prevention & Counseling

Q9. How often do you discuss lead exposure prevention with parent(s) or guardian?

Multiple choice

- Always
- Often
- Sometimes
- Rarely
- Never

Q10. Which lead exposure prevention topics do you discuss with clients?

Check all that apply

- Blood lead testing and screening recommendations
- Older housing and deteriorating paint
- Safe renovation practices
- Nutrition to reduce lead absorption (iron, calcium, vitamin C)
- Cleaning of surfaces and toys
- Proper hand hygiene
- Safe drinking water practices
- Occupational or hobby-related take-home lead exposure
- Risks from imported products (pottery, spices, cosmetics, folk remedies)
- Household items that may contain lead (vintage toys or jewelry)

- None

Q11. Do you provide written or digital educational materials about lead exposure?

Multiple choice

- Yes
- No

SECTION 8: Insurance & Access to Testing

Q12. Is testing provided to all patients regardless of insurance status?

Multiple choice

- Yes
- No
- Both

Q13. Which patient insurance types are eligible for lead testing in your practice?

Check all that apply

- Medicaid
- Medicare
- Private insurance
- No insurance / self-pay
- Other (short answer)

SECTION 9: Interest in Resources & Training

Q14. Would you be interested in receiving local lead prevention resources or training from Sedgwick County?

Multiple choice

- Yes
- No

→ If "Yes," display Q15. If no, skip to "Closing message"

Q15. What types of resources would be most beneficial?

Multi-select dropdown

- Newsletter
- Brochures or fact sheets for families and clients
- Printable posters or handouts for clinics, schools, or community sites
- Age-specific materials (pregnant people, parents of young children)
- Multilingual or culturally tailored educational materials
- Clinical quick-reference tools (e.g., screening algorithms, flowcharts)
- Webinars or virtual trainings

Closing Message

Thank you for your time and commitment to protecting children from lead exposure. Your input will help guide local public health strategies and support ongoing prevention efforts in Sedgwick County. If you have any questions about this survey or local lead prevention resources, please contact Roxanne.Greene@sedgwick.gov or Danielle.Gauna@sedgwick.gov.