



## Technical Assistance Brief: Determining the Effectiveness of Lead Hazard Control Interventions that Target High-Risk Blocks to Reduce Childhood Blood Lead Levels

### Purpose

This technical assistance brief provides state and local childhood lead poisoning prevention programs that systemically target entire street blocks, or groups of street blocks within their high-risk area(s), for lead hazard control interventions with a means to evaluate the impact of their interventions. Understanding the impact of this approach can be useful to programs in determining if adjustments in the targeting strategy are needed and in defending the choice to target contiguous blocks in a high-risk area versus taking a more scattershot approach.

### Background

Evidence exists that targeting contiguous housing can have an additional protective effect on the blood lead levels of children. It may also be more efficient for a lead hazard control program to focus on a well-defined target area. To assess the impact of interventions on target areas compared to nontarget areas, blood lead

levels of children in these areas should be analyzed both before and after the interventions.

### Limitations and Assumptions

Before beginning your evaluation, the following limitations and assumptions should be considered:

- Without using statistical analysis, there are no rigid rules as to how to determine whether geographic areas are “similar” or “different.” This method is a basic example of things to consider; not everything one could or should consider. The data will not be perfect and may be questioned, but will still give valuable insights to your data. Prepare to defend your analysis and choices.
- Screening rates, sample sizes, time period, and other considerations will impact evaluation results. If you are working in very small areas, you will have small sample sizes and it will be difficult to see differences. We recommend using as large a cohort and as many years of data as

possible. Three years is the recommended study period for both the pre- and post-intervention timeframes. The larger the sample size, the more likely it is that you will identify differences between targeted and nontargeted areas.

- When examining blood lead levels across multiple children, we use geometric means rather than arithmetic means (or averages) because they are the best measure to use when examining the center of the distribution of blood lead levels.
- The impact of lead hazard control interventions may be marginal if interior lead-based paint hazards were not adequately corrected. Significant evidence links interior dust lead levels with blood lead levels.

Other considerations influencing the impact of interventions may include the strength of the window intervention (interim controls versus abatement treatments) and the contribution of exterior sources such as soils and porches.

- This method recognizes that family transiency will likely result in turnover of children from the beginning to end of the timeframe under study.

## Conducting the Assessment

The following guidelines can be used to determine both the geometric mean blood lead level and the percentage of children with blood lead levels  $\geq 5$   $\mu\text{g}/\text{dL}$  and/or  $\geq 10$   $\mu\text{g}/\text{dL}$  in targeted versus nontargeted blocks, before and after interventions take place.

**Step 1.** Identify the geographic boundaries of the neighborhood or census blocks within the high-risk area that you have targeted (or plan to target) with lead hazard control interventions.

**Step 2.** Identify groups of blocks within the high-risk area that you have not targeted (or that you do not plan to target) which you believe are similar to your targeted area. You may want to consider using non-targeted blocks that are in very close proximity or immediately adjacent to the targeted blocks. This group of blocks will be used as the nontargeted comparison for your targeted area.

**Step 3.** Utilize census data to confirm that the housing units located in the nontargeted blocks are similar to those targeted. Suggested metrics for comparison include housing characteristics such as housing age and tenure as well as socioeconomic

## Useful Terms

### PRE-INTERVENTION:

Refers to the time period before lead hazard control treatment activities first occurred in the targeted area.

### POST-INTERVENTION:

Refers to the time period after lead hazard control treatment activities concluded in the targeted area.

### TARGETED INTERVENTION ACTIVITY:

Designated period of time between the initial and final occurrences of lead hazard control treatment activities in a specifically chosen and defined area.

### GEOMETRIC MEAN:

Mathematical center of a set of numbers defined as the  $n$ th root of the product of  $n$  numbers (e.g., the geometric mean of three numbers is equal to the cube root of the product of those three numbers).

characteristics of the population residing in these homes, such as race and ethnicity, annual household income, percentage of individuals below the poverty line, and age. Census data can be obtained from the U.S. Census Bureau at <https://data.census.gov/cedsci/>. Refer to Attachment B for an example of how to use the Census Bureau's data site.

If you are conducting this evaluation prospectively, you can use the visual assessment form, *General Visual Inspection of Structure and Neighborhood (Attachment A)*,<sup>ii</sup> to assess if the blocks and housing units are in similar exterior condition prior to the start of your interventions and targeting strategy. If choosing this method, one form is filled out for each property in both the targeted and nontargeted areas. Each "yes" answer for questions 1a and questions 2-6 = 1 point. (Note: You may decide to exclude question 1a [lead point sources] from the counts of "yes" to questions 2-6. Lead point sources may increase the dust lead levels in and around the home but would not be affected by any lead hazard control interventions except cleaning.) The results must then be aggregated for the targeted neighborhood and the nontargeted neighborhood to find the average number of deteriorations per property for each neighborhood that can be used for comparisons.

**Step 4.** If the targeted and nontargeted areas are in different Census blocks, you can go straight to the

prevalence data to document the baseline health status. If not, you can document baseline health status by determining the geometric mean blood lead level of children less than six years of age and the number and percentage of kids with lead levels  $\geq 5$   $\mu\text{g}/\text{dL}$  and/or  $\geq 10$   $\mu\text{g}/\text{dL}$  in targeted versus nontargeted blocks (see Attachment C for an example of calculating the geometric mean). Baseline data should include blood lead screening data obtained from your state or local lead poisoning prevention program *before* the block-level targeting program began for both the targeted and nontargeted areas. This is usually the prevalence rate for the three years prior to the intervention. Blood lead data should be de-duplicated; that is, use only one lead level – the highest value – per child tested. If the data is accessible, you can also use screening rates to inform your choices.

**Step 5.** Document the same health status information for both the targeted and nontargeted areas post-intervention. The hypothesis is that, after targeting

and remediation, children living in homes located in targeted blocks will have lower geometric mean blood lead levels and a lower percentage of children with lead levels  $\geq 5$   $\mu\text{g}/\text{dL}$  and/or  $\geq 10$   $\mu\text{g}/\text{dL}$  than children in nontargeted blocks.

**Step 6.** Use Fisher’s exact test to compare the percentage of children with blood lead levels  $\geq 5$   $\mu\text{g}/\text{dL}$  in targeted versus nontargeted areas and quantify the impact of the lead hazard control interventions on targeted areas. See Attachment D for an example calculation.

Online calculator for Fisher’s exact test:  
<http://graphpad.com/quickcalcs/contingency1.cfm>

**Step 7.** Use a t-test to compare the geometric mean blood lead levels in targeted versus nontargeted areas and evaluate the impact of targeting contiguous housing. See Attachment E for an example calculation.

**NOTE:** *At this point, a program may decide to do step 6 only, step 7 only, or both steps 6 and 7. Additionally, it is important to note that an individual with at least basic statistical analysis experience should be conducting the following calculations. These example calculations are provided as simple examples. Should you need additional technical assistance, contact NCHH at [info@nchh.org](mailto:info@nchh.org).*

### Additional Resources Attached

- A. General Visual Inspection of Structure and Neighborhood
- B. Example: Using the U.S. Census Bureau’s Data Site
- C. Example: Geometric Mean Calculation
- D. Example: Fisher’s Exact Test Calculation
- E. Example: T-Test Calculation

#### Technical Assistance Brief

Determining the Effectiveness of Targeting High-Risk Blocks

For additional resources, please visit:

<https://nchh.org/tools-and-data/technical-assistance/nys-clpppp/>

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## Attachment A General Visual Inspection of Structure and Neighborhood

Street Number	Street Name	City	State	ZIP Code

### Local Lead Point Sources

1a. **Is there a potential lead point source in the vicinity of the dwelling structure?**   
 (within 4 blocks or 1500 feet of the building)  
 Y = Yes, N = No

1b. **If yes, specify**  
*Potential point sources include:*  
**Permanent:** radiator shops; battery plants; secondary smelters; auto shops, et cetera.  
**Temporary:** demolition, exterior rehabilitation, or exterior painting of nearby buildings; bridge repainting.

1c. **Is this point source permanent or temporary?**   
 (P = Permanent, T = Temporary, B = Both)

### Structural Condition, Exterior of Dwelling Unit

For each building component listed below, report whether there is obvious deterioration.  
 Y = Yes, N = No, D = Does Not Apply

2. **Roofs, gutters, downspouts:**   
 Roof missing parts of weathering surfaces or has extensive holes or cracks; gutters or downspouts broken or missing.

3. **Walls and siding:**   
 Large cracks or holes; missing or broken components requiring reports or substantial painting.

4. **Windows and doors:**   
 Two or more windows or doors broken, missing, or boarded up.

5. **Porch or steps:**   
 Major elements broken or missing.

6. **Foundation:**   
 Major cracks or missing material.

**Total “Y” answers for questions 1a and questions 2-6 = \_\_\_\_\_**

*Note: If you choose to transfer this form to an Excel spreadsheet, calculations in Excel may be easiest if you enter 1 for a “yes” response and 0 for a “no” response.*

## Attachment B

### Example: Using the U.S. Census Bureau's Data Site

This example uses the U.S. Census Bureau's data site to find the percentage of families with an income below the poverty level. (Note: The Google Chrome browser was used in the development of these instructions.)

1. Visit the U.S. Census Bureau's data site at <https://data.census.gov/cedsci/>.
2. Select "Advanced Search" under the main search bar.
3. Click "Geography" on the left side of the page under "BROWSE FILTERS." When the "GEOGRAPHY" window appears, click "Show Summary Levels," then select "140 – Census Tract." When the "140 – CENSUS TRACT (STATE)" menu appears in the window, select the state of interest.
4. In the "[STATE] (COUNTY)" window that appears, select either "All Census Tracts within [State]" or the specific county of interest from the populated list. Within the "[County], (STATE)" window you may select one or multiple Census tracts within the county of interest. Once you have finished with your selections, click "SEARCH" at the bottom right of the page.
5. On the next page, at the top of the screen in the search bar, type "B17022" and click "SEARCH." Under "Tables," find the table with the title "RATIO OF INCOME TO POVERTY LEVEL IN THE PAST 12 MONTHS OF FAMILIES BY FAMILY TYPE BY PRESENCE OF RELATED CHILDREN UNDER 18 YEARS BY AGE OF RELATED CHILDREN" and click on it. The table for the most recent ACS 5-Year estimate should populate (currently, 2019). At the top of the page under "Product," the dropdown menu will allow you to confirm the dataset shown and/or select a different year. If a different dataset/year is selected under "Product," your page should refresh automatically to that dataset.
6. On the left side of the page, click "DOWNLOAD." Check the box next to "RATIO OF INCOME TO POVERTY LEVEL IN THE PAST 12 MONTHS OF FAMILIES BY FAMILY TYPE BY PRESENCE OF RELATED CHILDREN UNDER 18 YEARS BY AGE OF RELATED CHILDREN" and then click on "DOWNLOAD SELECTED." In the "Download/Print/Share" window that appears, confirm that the year you previously selected under "Product" is checked and the radio button for "CSV" is selected. Then click "DOWNLOAD" to start the download file preparation and "DOWNLOAD NOW" when it shows that your files are 100% prepared.
7. Open the downloaded ZIP file to access the dataset. Delete unnecessary rows/columns as appropriate.

## Attachment C

### Example: Geometric Mean Calculation

The geometric mean, percentage of results equal to or above 10 µg/dL, and percentage of results equal to or above 5 µg/dL of a set of blood lead level (BLL) data can be calculated as follows:

1. Enter BLL data into column A of an Excel spreadsheet. (In this example, data begins in cell A2 and ends in cell A10; adjust accordingly based on your final range.)
2. Enter the following three formulas into a separate column in the same Excel spreadsheet:
  - (a) =GEOMEAN(A2:A10)
  - (b) =COUNTIF(A2:A10,">=10")/COUNT(A2:A10)
  - (c) =COUNTIF(A2:A10,">=5")/COUNT(A2:A10)

*Note: Do not copy/paste these formulas into your Excel spreadsheet or Excel will recognize the text as plain text rather than a formula; instead, type them (with your specific cell ranges) directly into Excel.*

*Note: The geometric mean can only be calculated if all values are above zero. If the dust lead loading value reported by your laboratory was less than the detection limit or equal to 0, then you should replace that value with the detection limit divided by the square root of two before calculating the geometric mean.*

#### Example Data

BLL
3.0
4.4
5.1
3.2
5.7
10.2
0.1
0.2
0.3

3. The results, using the example data above:
  - (a) 1.62 µg/dL = geometric mean
  - (b) 11.11% = percentage of BLLs ≥ 10 µg/dL
  - (c) 33.33% = percentage of BLLs ≥ 5 µg/dL

The Excel function GEOMEAN calculates the geometric mean of a specified range of cells. For example, if you want to find the geometric mean of cells A2 to A10, you would type into the cell: =GEOMEAN(A2:A10). The resulting value is 1.62.

The Excel function COUNT calculates the number of non-missing numeric values from a specified range of cells. For example, if you want to find the number of non-missing values in cells A2 to A10 you would type into the cell: =COUNT(A2:A10). The resulting value is 9.

The Excel function COUNTIF calculates the number of cells in the specified range (where you want to look) that meet the specified criteria (what you want to look for). For example, if you want to look in cells A2 to A10 for values >=5, you would type into the cell =COUNTIF(A2:A10,">=5"). The resulting value is 3.

## Attachment D

### Example: Fisher’s Exact Test Calculation

Fisher’s exact test can be used to compare the percentage of children with blood lead levels  $\geq 5$   $\mu\text{g/dL}$  in targeted versus nontargeted areas and quantify the impact of the lead hazard control interventions on targeted areas as follows:

1. Enter BLL data for Group 1 into column A of an Excel spreadsheet. (In this example, data begins in cell A2 and ends in cell A10; adjust accordingly based on the final range.)
2. Enter BLL data for Group 2 into column B of an Excel spreadsheet. (In this example, data begins in cell B2 and ends in cell B12; adjust accordingly based on the final range.)
3. The Excel function COUNTIF calculates the number of cells in the specified range (where you want to look) that meet the specified criteria (what you want to look for). For example, if you want to look in cells A2 to A10 for values  $\geq 5$ , you would type into the cell =COUNTIF(A2:A10," $\geq 5$ "). The resulting value is 3.

Tally the following four counts for use in the Fisher's exact test calculator by entering the following four formulas into a separate column in the same Excel spreadsheet:

#### Example Data

BLL Group 1	BLL Group 2
3.0	2.0
4.4	1.0
5.1	4.5
3.2	2.2
5.7	11.9
10.2	9
0.1	6.1
0.2	5.1
0.3	6.8
	4.8
	8.1

	BLL $\geq 5$	BLL $< 5$
Group 1	=COUNTIF(A2:A10," $\geq 5$ ")	=COUNTIF(A2:A10," $< 5$ ")
Group 2	=COUNTIF(B2:B12," $\geq 5$ ")	=COUNTIF(B2:B12," $< 5$ ")

*Note: Do not copy/paste these formulas into your Excel spreadsheet or Excel will recognize the text as plain text rather than a formula; instead type them (with your specific cell ranges) directly into Excel.*

## Attachment D *(continued)*

### Example: Fisher's Exact Test Calculation

4. The resulting counts:

*Note: Depending on the size of your dataset, you may want to test your use of the COUNTIF function on a subset of your data and manually verify that your results match.*

	BLL ≥ 5	BLL < 5
Group 1	3	6
Group 2	6	5

5. Enter the counts into the online calculator at <http://graphpad.com/quick-calcs/contingency1.cfm>.

## QuickCalcs

[1. Select category](#)   
 [2. Choose calculator](#)   
 [3. Enter data](#)   
 [4. View results](#)

### Analyze a 2x2 contingency table

Enter your data

Enter the number of subjects actually observed. Don't enter proportions, percentages or means. [Learn how to create a contingency table.](#)

	Outcome 1	Outcome 2
Group 1	3	6
Group 2	6	5

6. Select the Fisher's exact test with a two-tailed p-value and click the "Calculate" button. See Figure 2.

### Which test

There are three ways to compute a P value from a contingency table. Fisher's test is the best choice as it always gives the exact P value, while the chi-square test only calculates an approximate P value. Only choose chi-square if someone requires you to. The Yates' continuity correction is designed to make the chi-square approximation better. With large sample sizes, the Yates' correction makes little difference. With small sample sizes, chi-square is not accurate, with or without the correction.

- Fisher's exact test (recommended)
- Chi-square with Yates' correction
- Chi-square without Yates' correction

A P value can be calculated with either one or two tails. We suggest always using two-tailed (also called two-sided) P values. [Read more about P values.](#)

- Two-tailed (recommended)
- One-tailed

Calculate



## Attachment D *(continued)*

### Example: Fisher's Exact Test Calculation

#### 7. Interpret the results.

If the p-value is  $<0.05$ , then we would conclude that the percentage of  $BLL \geq 5 \mu\text{g/dL}$  are significantly different between Group 1 and 2.

For this example,  $p=0.4059$  so we conclude that the percentage of  $BLL \geq 5 \mu\text{g/dL}$  in Group 1 and 2 are not significantly different.

## QuickCalcs

[1. Select category](#)    [2. Choose calculator](#)    [3. Enter data](#)    **4. View results**

### Analyze a 2x2 contingency table

	Outcome 1	Outcome 2	Total
Group 1	3	6	9
Group 2	6	5	11
Total	9	11	20

Fisher's exact test

The two-tailed P value equals 0.4059

The association between rows (groups) and columns (outcomes) is considered to be not statistically significant.

[Learn how to interpret the P value.](#)

Fisher's test is said to be exact, but some say it provides [an exact answer to the wrong question](#). While everyone agrees on how to compute one one-sided (one-tailed) P value, there are actually three methods to compute "exact" two-sided (two-tailed) P value from Fisher's test. This calculator uses the method of summing small P values [Read more](#). Prior to 5-April-2004 this QuickCalc used the "mid-P" calculation which resulted in a different two-tailed P value.

## Attachment E

### Example: T-Test Calculation

*Note: This example uses the same data used in Attachment D.*

1. Enter BLL data for Group 1 into column A of an Excel spreadsheet. (In the example below, data begins in cell A2 and ends in cell A10; adjust accordingly based on the final range.)
2. Enter BLL data for Group 2 into column B of an Excel spreadsheet. (In the example below, data begins in cell B2 and ends in cell B12; adjust accordingly based on the final range.)

#### Example Data

BLL Group 1	BLL Group 2
3.0	2.0
4.4	1.0
5.1	4.5
3.2	2.2
5.7	11.9
10.2	9
0.1	6.1
0.2	5.1
0.3	6.8
	4.8
	8.1

3. Use the T.TEST function<sup>1</sup> in Excel =T.TEST(LOG(A2:A10),LOG(B2:B12),2,3)
4. The resulting p-value from the T.Test function = 0.118
5. Calculate the geometric means of the two groups (see Attachment B)
6. Interpret the results.

If the p-value is <0.05, then we would conclude that the GMs are significantly different. For this example, p-value=0.118, so we conclude that the GMs for Group 1 and Group 2 are not significantly different.

<sup>1</sup>Note that the "2" in the T.TEST function specifies a two-tailed test and the "3" specifies a two-sample test with unequal variances.