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H. Okatch  
B. Nkala  
J. Beltrami  
E. Poy  
D. Parmer

*See next page for additional authors*

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**Authors**

H. Okatch, B. Nkala, J. Beltrami, E. Poy, D. Parmer, J. Nkala, and F. Olawole



# Assessing the effect of four types of direct mail messages to promote the uptake of residential lead remediation funds

H. Okatch<sup>a,b,\*</sup>, B. Nkala<sup>c</sup>, J. Beltrami<sup>d</sup>, E. Poy<sup>d</sup>, D. Parmer<sup>d</sup>, J. Nkala<sup>e</sup>, F. Olawole<sup>b</sup>

<sup>a</sup> Thomas Jefferson University, College of Population Health, Philadelphia, PA, USA

<sup>b</sup> Biology Department/ Public Health Program, Franklin & Marshall College, Lancaster, PA, USA

<sup>c</sup> The Shipley School, Bryn Mawr, PA, USA

<sup>d</sup> City of Lancaster, Lancaster, PA, USA

<sup>e</sup> Biology Department, Loyola University Maryland, Baltimore, MD, USA

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## ABSTRACT

**Objective:** To examine the efficacy of direct mailing using four types of messaging on promoting the uptake of residential lead remediation (RLR) funds in Lancaster, PA, USA.

**Study design:** We designed a quasi-experiment to assess the effect of 4 RLR messages sent to households in Lancaster, PA by direct mail between September and December 2020: a brief flyer (F); a detailed brochure + the flyer (BF); a health infographic + the flyer (IF); and an application form + the flyer (AFF).

**Methods:** Mailers were sent to addresses in four census tracts; each census tract received a different message. Both English and Spanish versions were sent. The outcomes were the event rate defined as the number of phone call inquiries received, and the number of applications received. The association between type of messaging and household type (owner-vs renter-occupied) was assessed using a chi square test.

**Results:** The event rates for the renter-occupied households were lower than for owner-occupied households, regardless of treatment. The event rates for renter-occupied households in the F, BF, IF and AFF groups were 0.00%, 0.35%, 0.12% and 0.18% respectively compared to 0.93%, 0.45%, 0.86% and 1.32% for homeowners. More applications were received from homeowners, and the event rate of the owner-occupied households was significantly different from that of renter-occupied homes (p-value = 0.001).

**Conclusions:** Event rates and applications received were higher for owner-occupied households than they were for renter-occupied households. Direct mailing of RLR information is feasible especially if households at high risk for lead poisoning are targeted.

## 1. Introduction

The Centers for Disease Control and Prevention reports that over 500,000 children under the age of 6 have elevated blood lead levels of  $\geq 5$   $\mu\text{g}/\text{dL}$  [1]. Symptoms of lead exposure, such as attention deficits, cognitive impairments, and aggression are not always obvious and, if present, are often irreversible [2,3] and have lasting adverse health, economic and social implications [4]. Lead exposures include lead-based paint dust, soils, food and herbal remedies, water, and some recreational activities [5–7]. Risk factors for lead exposure include low-income status, age of housing stock, and non-White race [8–11]. Older homes in disrepair present a higher level of risk of lead exposure [12]. However, research has demonstrated that residential lead

remediation is an effective intervention which reduces lead dust loading in homes and blood lead levels in children [13–15].

Since 1992, the Department of Housing and Urban Development (HUD) has awarded funds for residential lead remediation (RLR) and has targeted high risk areas including inner city neighborhoods [16]. Typically, eligible owner-occupied homes do not have to contribute towards remediation costs, however landlords are required to contribute, minimally. A previous study conducted in the City of Lancaster (CoL), reported that a majority of the residents were unaware of the RLR funds, or possessed limited information about the program [17]. Furthermore, Allegheny county, PA may have missed an opportunity to apply for additional RLR funds because they were unable to meet their quota of homes in a previous funding cycle [18]. This suggests that slow

**Abbreviations:** RLR, Residential Lead Remediation; HUD, Department of Housing and Urban Development; CoL, City of Lancaster; LHC, Lead Hazard Control.

\* Corresponding author. 901 Walnut Street, Philadelphia, PA, 19107, USA.

**E-mail addresses:** [okatcharriet@gmail.com](mailto:okatcharriet@gmail.com), [harriet.okatch@jefferson.edu](mailto:harriet.okatch@jefferson.edu) (H. Okatch).

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uptake of funds may have had an impact on the municipalities' eligibility to compete for additional funds regardless of the burden of lead poisoning, and the positive impact of RLR.

Public campaigns such as mass media and social media [19–21] typically used to promote public health initiatives such as RLR funding might not reach all the eligible; low-income populations, at higher risk for lead poisoning, might not have access to these modes. Direct mailing is an attractive option because it is cost effective, low risk and can contain specific and relevant information for the recipient to promote behavioral change [22–25]. During the COVID-19 pandemic, pre-vaccines and during the stay-at-home orders, direct mailing was a practical and safe communication mode.

The aim of this study, therefore, was to explore the use of direct mailing to communicate the availability of the Lead Hazard Control (LHC) RLR funds, and to assess which messaging about the LHC Program, mailed to residents in four census tracts in the CoL, is effective at increasing the uptake of lead remediation funds.

## 2. Methods

### 2.1. Setting: the City of Lancaster

Of the major municipalities in the state of Pennsylvania, the City of Lancaster ranks fourth in rates of elevated blood lead levels (EBLL). Among children under the age of 6, and screened for blood lead levels, 8.92% had an EBLL (>5 µg/dL) [26]. The CoL was the recipient of a \$9.7 M LHC grant for lead remediation in at least 710 homes in four Census Tracts over a 5-year period (2019–2024). Between January 2020 and August 2020, prior to this study, 10 applications had been received; 3 from renter-occupied homes and 7 from owner-occupied homes.

### 2.2. Experimental design

The onset of the COVID-19 pandemic in March 2020 forced the closure of organizations and interrupted community outreach plans to promote uptake of the LHC RLR funds. A quasi-experiment was designed, by researchers at Franklin and Marshall College, Lancaster, PA to study the effect of direct mailing of four different messages to homes in eligible census tracts aimed at increasing the uptake of the LHC funds for RLR. The census tracts were randomized to receive one of the following treatments described below: Flyer only (F), Brochure + Flyer (BF), Infographic + Flyer (IF), and Application form + Flyer (AFF). The analytic sample were the homes/households.

#### 2.2.1. Control group-flyer (F)

A flyer containing minimal text with information about the availability of the LHC funds and the eligibility criteria was prepared and mailed to all the eligible homes. The following information was included in the flyer: i) the LHC award amount; ii) the purpose of the funds; iii) financial eligibility criteria; iv) the program eligibility criteria – the home should have been built before 1978, and needed to have a child under the age of 6 years living in the house, or have a child under the age of 6 years who visits the home for at least 6 h each week; v) specific additional information for both tenants and homeowners; and vi) contact information for the CoL LHC program personnel.

#### 2.2.2. Treatment A-brochure + flyer (BF)

In addition to the flyer received by the control group, this group received a detailed brochure providing information about the process of RLR. The content of the brochure was informed by qualitative data collected in a previous study in this setting including responses to questions such as “As a tenant can I apply for the funds”, “After I apply, how long does it take before the work begins”, and “Where do I stay during this time”. The goal of the brochure was to identify if specific detailed information about the grant and the steps involved from application to remediation completion would motivate eligible applicants to apply.

The content in the brochure was prepared at a 7th grade reading level as assessed by the Flesch Kincaid Readability test [27].

#### 2.2.3. Treatment B-infographic + flyer (IF)

Residents in this group received two documents: i) the flyer, and ii) an infographic. The infographic contained information about household lead exposures; health effects of lead exposure; preventative practices related to lead and lead poisoning; and contacts for additional information about lead poisoning. This health infographic, designed by the Partnership for Public Health, a non-for-profit organization, in Lancaster, was prepared at 4th grade reading level as assessed using the Flesch Kincaid Readability test.

#### 2.2.4. Treatment C-application form + flyer (AFF)

Owner-occupied homes received a hardcopy of the CoL “LHC Program Homeowner Application” form while renter-occupied homes received the “LHC Program Tenant Application” form. These homes also received the flyer.

The association between lead exposure and negative health impacts is well described in the literature [2–4] and hence having a control group receiving a placebo or no information would be considered unethical. The flyer contained the same information that would typically be shared with the public when marketing the availability of the RLR funds and hence we consider the flyer to be equivalent to the ‘usual care’. The flyer is directly mailed, as are the other messages, and therefore we believe it is an acceptable control. Furthermore, since the information contained in the flyer is the usual care, it can be imagined that during pandemic times when in person outreach is non-existent or minimal at best, a direct mailing effort to publicize the RLR funds would employ an equivalent to the flyer.

The materials were assessed, approved and translated into Spanish by the Communications team with the CoL, and professionally designed and formatted by a design and communication company in Lancaster. The demographic, social, economic and housing characteristics of the four census tracts are shown in Table 1 [28–31].

The CoL maintains a registry of all addresses in Lancaster and the corresponding housing tenure (renting vs ownership), however, the registry only contained the names of homeowners and not the names of the tenants. Therefore, while mailers to homeowners were customized with their names, those sent to tenants were addressed to “The Resident”. All mailers had a return sticker label addressed to the lead researcher. In September 2020, the first wave of mailers was packed into envelopes, addressed and sent out – the treatment assignment to each census tract is shown in Fig. 1. Wave 2 mailers were sent out in November 2020 to homes where wave 1 delivery had been successful, however, the Census tracts were randomized to receive different treatments (see Fig. 1). Each home received both English and Spanish versions of the materials.

## 2.3. Measures

The primary outcomes for this study were i) the event rate defined as the number of phone call inquiries received by the CoL, and ii) the number of applications received between September 2020 and December 2020. The CoL collected the following data from individuals who inquired about the LHC funds i) the address of caller, and ii) how the caller had learned of the funding, and subsequently iii) completed application forms.

## 2.4. Data analysis

Because the exact denominator - total number of homes in each census tract that are eligible to receive the LHC funds - is unknown, a true response rate could not be calculated. However, the event rate defined as the number of calls received divided by the total number of successfully delivered mailers was calculated and expressed as a percentage. Event rates were calculated both per treatment and for the

**Table 1**  
Profile summaries for LHC program-eligible census tracts in Lancaster, PA.

|                                      | Census Tract 9 | Census Tract 10 | Census Tract 14 | Census Tract 147 |
|--------------------------------------|----------------|-----------------|-----------------|------------------|
| <b>Population characteristics</b>    |                |                 |                 |                  |
| Population                           | 3496           | 3782            | 5100            | 4558             |
| Median age                           | 28.9           | 30.2            | 26.8            | 25.9             |
| • Under 18                           | 30%            | 24%             | 35%             | 39%              |
| • 18-64                              | 59%            | 68%             | 60%             | 54%              |
| • 65 and over                        | 11%            | 7%              | 6%              | 7%               |
| Female                               | 50%            | 52%             | 51%             | 51%              |
| White                                | 13%            | 25%             | 24%             | 11%              |
| Black                                | 22%            | 22%             | 13%             | 15%              |
| Hispanic                             | 62%            | 47%             | 54%             | 73%              |
| Other                                | 3%             | 6%              | 9%              | 1%               |
| <b>Social characteristics</b>        |                |                 |                 |                  |
| High school grad or higher           | 65.40%         | 72.40%          | 74.90%          | 64.70%           |
| Language spoken at home by adults    |                |                 |                 |                  |
| • English only                       | 42%            | 65%             | 52%             | 28%              |
| • Spanish                            | 51%            | 33%             | 46%             | 69%              |
| • Other                              | 7%             | 2%              | 2%              | 3%               |
| <b>Economic characteristics</b>      |                |                 |                 |                  |
| Per capita income per year           | \$13,976       | \$17,103        | \$14,170        | \$14,533         |
| Median household income              | \$24,275       | \$40,764        | \$36,773        | \$45,750         |
| • Under 50 K                         | 78%            | 65%             | 62%             | 52%              |
| • 50 K and over                      | 22%            | 35%             | 38%             | 48%              |
| Population below the poverty line    | 47%            | 26%             | 33%             | 39%              |
| <b>Housing characteristics</b>       |                |                 |                 |                  |
| Occupied properties                  | 93%            | 92%             | 89%             | 95%              |
| Vacant properties                    | 7%             | 8%              | 11%             | 5%               |
| Renter occupied                      | 77%            | 64%             | 56%             | 51%              |
| Owner occupied properties            | 23%            | 36%             | 44%             | 49%              |
| Median value of owner-occupied homes | \$85,600       | \$79,400        | \$84,300        | \$88,600         |
| Lived in the same house last year    | 77%            | 73%             | 83%             | 80%              |

entire mailing. Only callers who provided their address and housing status were included in the analyses. These analyses assume that the proportion of families who met the LHC program eligibility criteria was the same across the census tracts, and that any previous mass media campaigns were equally experienced in all the census tracts. The Chi-square test of goodness of fit, conducted in Stata version 14,[32] was used to compare event rates in each of the treatments (BF, IF, AFF) relative to the control (F) group where applicable. A chi-square test was used to compare total event rates between owner-occupied homes and renter-occupied homes.

A cost-effectiveness analysis was performed by determining i) the cost per call received and ii) the cost per completed application form for all the mailers.

### 3. Results

Overall, 5103 mailers were sent to renter- and owner-occupied homes in four census tracts in Lancaster. Two months later, 4312 booster mailers were sent to homes.

In Wave 1, of the 3165 mailers mailed out to renter-occupied homes, 76.8% were successfully delivered. Specifically, 84.3%, 91.2%, 81.2% and 58.3% were successfully delivered to the addresses in the F, BF, IF, AFF groups, respectively. Of the mailers sent to owner-occupied households, 97.1% of the mailers were successfully delivered; 99.7%,

97.6%, 98.8% and 93.5% delivery was completed for the F, BF, IF, AFF groups, respectively. The delivery success rate in each of the groups was higher for owner-occupied homes than it was for renter-occupied homes. Unsuccessful delivery was due to “vacant homes”, “unknown address/insufficient address”, “resident refused to accept mail”.

After the first wave of mailers, a total of 24 calls were received: 4 were from tenants, 17 were from homeowners, and 3 were from callers who left voice messages. Efforts to connect with the callers were unsuccessful. All analyses exclude the three callers because their housing status and addresses were unknown. Therefore, the overall event rate after wave 1 was 0.49%; the event rate of the renter-occupied homes was 0.16%, and that of the owner-occupied homes was 0.90%.

None of the tenants in the Flyer only group called about the LHC funds, however, an event rate of 0.35%, 0.12% and 0.18% were attained for the BF, IF, and AFF groups, respectively. Of the callers, one tenant in the AFF group applied for the LHC grant funds. Among the homeowners, calls were received from individuals from each of the groups. Specifically, the event rate was 0.93%, 0.45%, 0.86% and 1.32% in the F, BF, IF and AFF groups, respectively. From the calls made by the homeowners, 6 applications for the LHC funds were received; 1 from the BF group, 2 from the IF group, and 3 from the AFF group.

No treatment was identified to be superior; none of the treatment groups had an event rate that was significantly different from the event rate of the control group (F). There was no association between the event rates and the groups when comparing each of the groups to the flyer group; the p-values for the respective comparisons were 0.42, 0.91 and 0.61 for the BF, IF and AFF groups. However, the event rate of the owner-occupied homes was significantly different from that of renter-occupied homes (p-value = 0.001).

For Wave 1, 57% of the events occurred within the first week of sending the mailers and the remaining events occurred within 6 weeks.

Following the Wave 2 mailers; an event rate of 0.28% was attained. All of the calls were from individuals in the BF group and resulted in one application; this group had received the IF treatment in Wave 1. Events following the booster mailers occurred within 2 weeks, 80% occurred with the first week.

#### 3.1. Cost-effectiveness

The cost of printing and mailing mailers for wave 1 was \$11,133 (\$1.20 per household). Of those mailers that were successfully delivered the cost per call was \$292 and the cost per completed application form was \$833. For wave 2, the total cost was \$5302; \$1060 per call and \$5302 per completed application form. Wave 1 was more cost effective than wave 2.

### 4. Discussion

We hypothesized that the provision of detailed information prepared in preferred languages and at the recommended 7th grade reading to families would motivate the application of funds for RLR. However, our findings suggest that the provision of application forms and a brief flyer with information about funding availability, eligibility criteria, and funding administrator contact information to owner-occupied homes may be more effective.

Regardless of the type of messaging, more inquiries and applications were received from owner-owner occupied homes in comparison to renter-occupied homes. Housing tenure has been identified as a risk factor for lead poisoning [12], and the low event rate observed among tenants in this study suggests children in rental homes continue to be at risk of lead exposure. Previous studies in Lancaster have identified tenants' lack of autonomy and low interest to improve temporary housing as factors limiting the enrollment into programs that would mitigate exposure to household lead hazards [17,33]. Children of individuals who rent homes are 3.2 times more likely to have blood lead levels  $\geq 10$   $\mu\text{g}/\text{dL}$  [34]. Therefore, efforts to engage landlords to apply

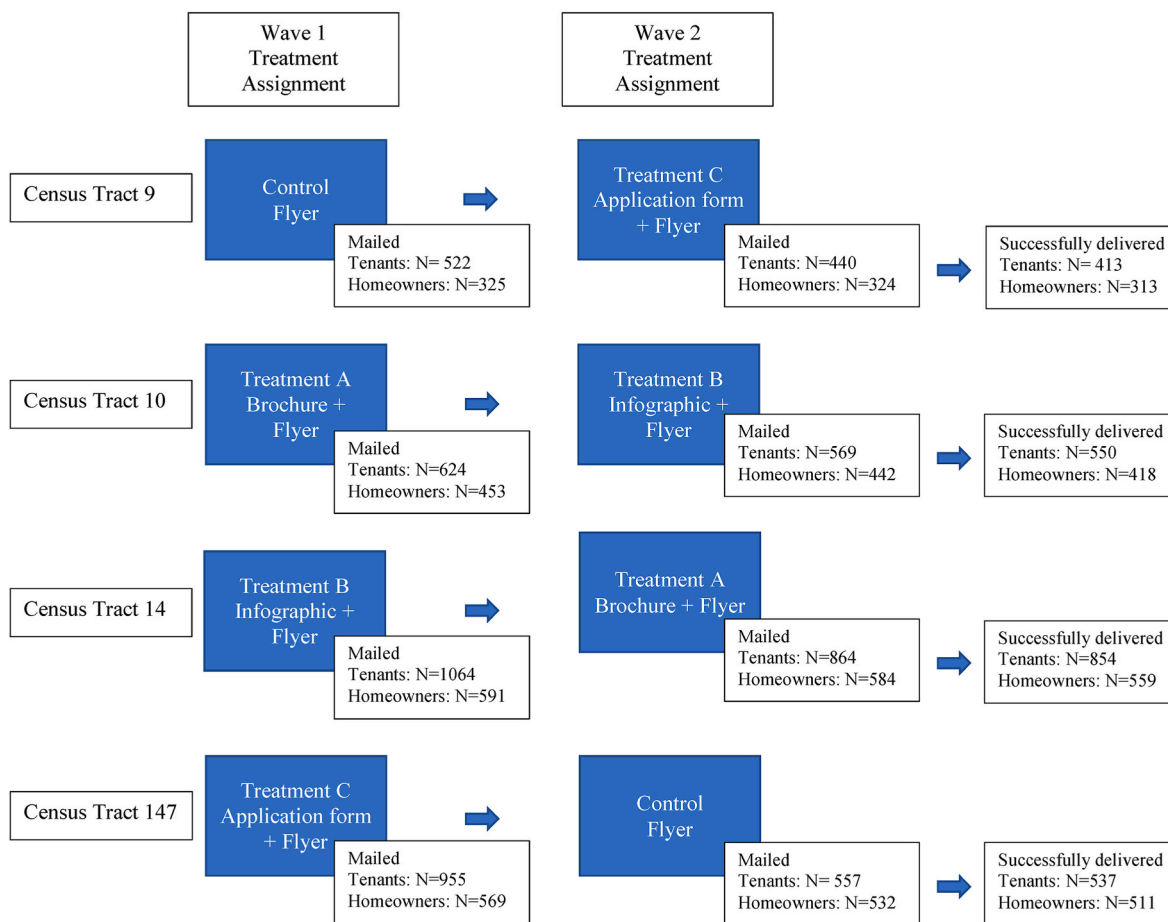


Fig. 1. Treatment assignment for each of the Census tracts in Waves 1 and 2. The number of successfully delivered mailers in Wave 1 is the number of mailers mailed in Wave 2.

for LHC funds would likely yield additional tenant applications, however, it should be noted that landlords are required to make a modest financial contribution.

This experiment yielded a similar number of applications as the pre-experiment era (7 in 5 months vs 10 in 7 months). Therefore, direct mailing proved to be a feasible, cost-effective and safe approach to inform eligible residents about the LHC grant, eligibility criteria and to motivate application for these funds during the pandemic. Direct mailing has been used to engage, interact with, and communicate public health information to assess public health information and/or encourage behavior change because of its relative ease, reach and equity [35–38].

Direct mailing efforts have generated a wide range of responses rates: 1.6% and 4.5% in a study to promote organ donor registration [39]; 3.7% for smokers to call a quit line [36]; 5.6%–7.7% in a study to promote deceased organ registration [40]; and 3.6% in a study to increase mammography use [41]. In this study, the event rate yielded from the direct mailing ranged between 0.12% and 1.32% for the different treatment groups. The comparatively lower event rate attained in this study may be a result of two factors; using a non-descript “the resident” in the address line of the mailers sent to renter-occupied homes; and sending mailers to the total population in each census tracts rather than sending mailers only to the homes that met the LHC program eligibility criteria. Future studies should utilize current mailing lists with complete names and addresses as individuals are likely to ignore mail that is not personalized [42]. Mailing only to the LHC-eligible homes would further improve the cost effectiveness of direct mailing.

Among homeowners, the group that received the Application form and the flyer, were more likely to turn in a completed application. This is consistent with literature that shows that health campaigns that include

a free or reduced price products such as condoms, child car seats and over the counter nicotine therapy are more successful [43]. The application form may have been viewed by recipients as a direct link to the product – the LHC funds, whereas all other treatments involved at least two steps – a call and accessing the application form. Outreach campaigns e.g door to door outreach, or community events should make application forms available to potential beneficiaries.

Unfortunately, the expected booster effect of wave 2 mailing was not observed. Similar to the study by Paquin et al. [37], sending booster mailers was ineffective. However, the cost-effectiveness analysis should be interpreted with caution since the mailers were not exclusively sent to eligible households. Furthermore, future studies should calculate and interpret the cost of engaging community members to apply for RLR funds in context of the social and economic benefits of remediation. A study by Gould estimates that for every dollar invested in lead hazard control results in \$17 - \$221 in return over the life course [4].

This study is not without limitations. It is likely that some of the homes that received the mailings could not read either Spanish or English and this might have hindered their ability to make an inquiry or to apply for these funds. Because this study was conducted during the pandemic when public health messages promoted social distancing, individuals might have made the decision not to call the CoL to avoid having lead contractors and risk assessors in their homes. However, there is no reason to expect that the rate of avoidance in one treatment group would have been greater in any one of the other groups. Finally, mailers did not provide contact options for those with vision or hearing impairment, and also assumed everyone would have access to a phone to contact the LHC remediation fund administrators.

The strengths of this study include the investigation of a large

population in a collaborative approach through the partnership between a local governing agency and an academic institution. This study adds to the outreach toolkit on potential approaches to increase RLR funds uptake; there are very few studies on this topic. A co-benefit of this study is the distribution of lead and lead poisoning prevention materials prepared at appropriate literacy levels to almost all the homes in the census tracts eligible for the LHC funds.

## 5. Conclusion

We demonstrated the feasibility of using direct mailing to promote the uptake of funds for RLR during the COVID-19 pandemic. Although statistically, none of the treatments (brochure, health infographic, and application form) outperformed the control group, it is likely that the use of direct mailing increases the levels of awareness and knowledge about lead poisoning regardless of the type of messaging. This is particularly important because the prevalence of lead poisoning is higher among low-income communities who might have limited access to social and mass media avenues frequently used in public health campaigns. Homeowners were more responsive than tenants suggesting that different approaches may be suitable for tenants. Since direct mailing yielded a low response rate, more effective outreach methods based on the geographic and cultural context of the population of interest should be explored. However, during pandemics and lock downs, when direct mailing might be the only feasible approach, efforts should be directed at only eligible families. Targeted outreach would likely increase the awareness of lead poisoning, and increase the uptake of RLR funds in a more cost-effective manner.

## Ethical approval

This study was approved by the Franklin and Marshall Institutional Review Board and assigned the following number R\_1gilUsMyrWXBBDB.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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