THE IMPACT OF EARLY INTERVENTION ON BLOOD LEAD LEVELS ≤10 µg/dL AMONG CHILDREN LESS THAN 12 MONTHS OF AGE

INVESTIGATOR
Kimball F. Credle

Committee Chair
Chinaro Kennedy, DrPH, MPH

Field Sponsor
Chicago Department of Public Health

A report submitted to the Career Master of Public Health Program
The Rollins School of Public Health of Emory University in partial fulfillment of the requirements of the degree of Master of Public Health
2014

THE IMPACT OF EARLY INTERVENTION MEASURES ON BLOOD LEAD LEVELS ≤10 µg/dL AMONG ON CHILDREN LESS THAN 12 MONTHS YEARS OF AGE WITH BLOOD LEAD LEVELS LESS THAN THE LEVEL OF CONCERN OF 10 MICROGRAMS PER DECILITER

APPROVED

_____

Chinaro Kennedy, DrPH, MPH Committee Chairperson Date

_____

Emile Jorgensen, Field Advisor Date

_____

Melissa Alperin, MPH, MCHES, Chair, Career MPH Program Date

In presenting this report as a partial fulfillment of the requirements for an advanced degree for Emory University, I agree that the School of Public Health shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to copy from, or to publish this report may be granted by the professor under whose direction it was written, or in his/her absence, by the Chairperson of the Career Master of Public Health, when such copying or publication is solely for scholarly purpose and does not involve potential financial gain. It is understood that any copying from, or publication of this report, which involves potential financial gain will not be allowed without written permission.

_____

Signature of Student **Date**

NOTICE TO BORROWERS

Unpublished papers deposited in the Rollins School of Public Health of Emory University must be used only in accordance with the stipulations prescribed by the author in the preceding statement.

The author of this thesis is:

Kimball Credle
3088 Farmstead Court
Grayson, GA 30017

The Thesis Chairperson of this report is:

Chinaro Kennedy, DrPH, MPH
Adjunct Assistant Professor
Emory University
Maternal and Child Health Epidemiology

Senior Health Scientist
Office of Science
Office of the Director
Office of Non-Communicable Disease and Injury, and Environmental Health
Centers for Disease Control and Prevention
Atlanta, GA 30341

Users of this report are required to attest acceptance of the preceding stipulations by signing below:

Name of User Address Date Type of Use

VITA

FULL NAME: KIMBALL FRED CREDLE
3088 Farmstead Court
Grayson, GA. 30017

EDUCATION: BA, COMMUNICATION, NORTH CAROLINA A&T STATE UNIVERSITY, GREENSBORO, N.C., 27411

GRADUATE COURSEWORK: EMORY UNIVERSITY- Present (Career MPH Program), Completed the Emory University, Rollins School of Public Health, Graduate Certificate Program (GCP**)**

EXPERIENCE: PUBLIC HEALTH ADVISOR - CENTERS FOR DISEASE CONTROL & PREVENTION

JULY 1990 – PRESENT

Public Health Advisor/Project Officer (GS 685 – 13): May/2006 – Present

Public Health Advisor/Intervention Specialist (GS 685 – 9/11): 11/98 – 5/2006

Clinic Manager (GS 685 – 11): 11/97 -- 11/98

Gonorrhea Screening Coordinator: 3/97 -- 11/97

Training and Education Coordinator: 12/95 -- 2/97

Disease Intervention Specialist: 7/90 -- 12/95

COMMISSIONED OFFICER -- UNITED STATES ARMY, FT. HOOD, TX

1/86 -- 2/89 (ACTIVE DUTY)
9/92 – 6/01 (ACTIVE RESERVES - District of Columbia Army National Guard)

PROFESSIONAL ORGANIZATIONS:

1997 – PRESENT Watsonian Society

Acknowledgements

I would like to take this opportunity to acknowledge my wife, Marcia, for the encouragement and support she has given me in my efforts to complete this project. I also want to thank Dr. Mary Jean Brown for her timely encouragement, and unwavering commitment to supporting me. With sincere appreciation and gratitude, I thank my Chairperson, Dr. Chinaro Kennedy, and Field Advisor, Emile Jorgensen.

Table of Contents

List of Tables

Abstract

Background: The Chicago Lead Poisoning and Prevention Program (CLPPP) implemented an early intervention program for infants between the age of 6 to 12 months with blood lead levels between 5 and 9 µg/dl. Infants that receive the same environmental and case management services as children with blood lead levels ≥ 10µg/dl is a powerful method of addressing childhood lead poisoning.

Purpose: The Chicago CLPPP has a primary objective to reduce the number of infants who progress to have blood lead levels ≥ 10µg/dl by 12 months of age by ensuring environmental and case management services are delivered. However, there has been no comparative assessment of this approach, either in terms of affecting case reduction, or in terms of effectiveness of the intervention.

Method: A comparative analysis was made on two different lead data groups reported to and recorded by the Chicago Department of Public Health, Lead Poisoning Prevention Program and the Center for Disease Control and Prevention, Healthy Homes and Lead Poisoning Prevention Program. This comparison was performed with strict attention to childhood blood lead level data and case and environment management measures performed. To help with comparability between the two datasets, the determination as to level of follow-up versus no follow-up was established as the standard used for measure within this study design.

Results: Blood lead test data of children with blood lead levels of 5 to 9 µg/dl were assessed, analyzing the results of those that saw an increase in there BLL, compared to those that saw a decrease based on an early intervention approach of including an environmental assessment apart of the initial case management visit. It is believed that the intervention would reduce the number of cases of lead poisoning, as well as reduce the number of children's blood lead levels from rising to the now removed level of concern of ≥ 10µg/dl.

Conclusion: The analysis indicated that blood lead test data of children with BLL of 5 to 9 µg/dl saw a significant reduction in their blood lead levels after receiving an environment home assessment along with initial case management visit.

CHAPTER I

INTRODUCTION

Childhood lead poisoning is a preventable environmental health condition. It is now known that in children blood lead levels of 10 microgram per deciliter (10µg/dl) or lower is associated with learning and physical disabilities, and behavioral problems (CDC, Atlanta 1997). It can be argued that by taking preventative action, such as providing an environmental assessment, in conjunction with proper case management and hazard control or elimination, the number of new cases, as well as, those newly exposed to lead may be reduced. Children under the age of 6 years are known to be more vulnerable to lead exposure and poisoning, and are more likely to succumb to the disabling effects of lead poisoning. (CDC, 1997). Such disabilities include hyperactivity, decreased appetite, fatigue, headaches, vomiting, and weight loss (CDC, 1997). Evidence suggests long-term exposure to lead causes adverse effects on a child's central nervous system, which may lead to cognitive deficits (ATSDR, 1990; Dietrich, et. al. 1991). Given the frequent hand to mouth behavior of young children, exposure to lead usually occurs from consumption of lead-based paint and contaminated dust. Additionally, exposure is known to occur through contaminated soil, water, toys, ceramic ware, and traditional remedies (ATSDR, 1990; Dietrich, et. al. 1991).

In late 2010, the Centers for Disease Control and Prevention's (CDC) Advisory Committee for Childhood Lead Poisoning Prevention (ACCLPP) formed a workgroup to evaluate new approaches, terminology, and strategies for defining elevated blood-lead levels (BLLs) among children (CDC, 2012). From this action, it was recommended that the elimination of the use of the term "blood lead level of concern." The Advisory

Committee on Childhood Lead Poisoning Prevention has recommended changing from using a level of concern value of 10µg/dl or greater to a reference interval value defined as the 97.5 percentile of BLLs in U.S. children aged 1-5 years from two consecutive cycles of the National Health and Nutrition Examination Survey (NHANES) (MMWR, 2012). The calculation of 97.5th percentile of the distribution of the combined 2007-2008 and 2009-2010 NHANES cycles is ≥5 µg/dl. Therefore, ≥5 µg/dl is now defined as a high blood lead level.

It is known that approximately 450,000 children in the U.S. have BLLs higher than the noted reference value (MMWR, 2012). It was also recommended that more research on developing and evaluating interventions that effectively minimizes any effects of BLLs below the reference value.

Low-income families are disproportionately at risk, as these families tend to live in older, poorly maintained housing which may contain lead-based paint or lead plumbing (CDC, 1997). Because of this some states adopted universal blood lead screening requirements, and some adopted targeted screening requirements (CDC, 2005). Universal screening requirements consist of ensuring the blood lead testing of all children in a given area or population, between the age of 6 month to 6 years of age. Targeted screening focuses on identifying and testing those children that live in certain areas where homes are older or children who are identified as high-risk groups often defined as low-income, and minorities. The difference is that local factor(s) may drive the basis for screening all or some children, for example: program capacity, number of old homes, economic status, or legislation.

Current trends show children with elevated blood lead levels have been on a dramatic decline since the 1970s (CDC, 2012). Still, there are over half a million children with an elevated blood lead level due to exposure (MMWR, 2013). New lead screening guidance was recently introduced in the United States (MMWR, 2009). Blood lead screening of children is the preferred method of detection and prevention.

Through screening, the goal is to identify children who are, and have been exposed to reduce their chances of having an elevated blood lead level. Blood screenings occur at public and private healthcare centers and providers within the community. Current guidance is centered on helping health professionals to examine those conditions that contribute to lead hazards still at ≥10µg/dl. No new CDC guidance or recommendations for case management have been introduced addressing any child with blood lead levels at the new ACCLPP recommendation.

Given limited funding and resources, state and local programs are challenged to implement activities to address the new reference value. This means case management of children that have a blood lead level between 5 and 9µg/dl often goes without immediate services. The current case management recommendations per the CDC, involves coordinating, providing, and follow-up services required to reduce the blood lead level to less than 10µg/dl (CDC, 2002). This publication also acknowledges that a child is not officially a case until the blood lead level is determined to be 15 µg/dl or greater.

The Chicago Department of Health, Childhood Lead Poisoning Prevention Program instituted an early intervention program for older infants, 6 to 12 months, with blood lead levels between 6 and 9 µg/dl in 2003. During an official site-visit by the CDC assigned Project Officer, it was noted that this intervention approach was being

implemented. Within this program, infants would receive the same environmental and case management services a child with a blood lead level of 10µg/dl or greater. The primary objective is to reduce the number of older infants who progress to have blood lead levels 10 µg/dl by 24 months of age.

Although trends suggest lead poisoning cases are on the decline over the past 5 years, the City of Chicago currently ranks among cities with the highest rates of childhood lead exposure and poisoning (CDC, 2012). The goal of the Chicago CLPPP is to eliminate childhood lead poisoning as a public health problem within the city. Approximately 100,000 children in the city are screened for elevated blood lead levels and more than 1,000 receive medical and environmental services after being identified as having an elevated blood lead level of 10 µg/dl or higher.

The Chicago CLPPP screening and testing guidelines, recommend that the first blood test occur at 6 to 9 months of age. In mid-2003, the Chicago CLPPP began recommending and offering environmental and case management for older infants at high risk of having elevated blood lead level.

High-risk is defined as children between 6 and 24 months living in housing built before 1950, and of a lower social-economic status. In Chicago, most cases of children with an elevated blood lead level of ≥ 10µ/dl were from minority communities. Although one may surmise both case management and environmental assessment among children very concomitantly act to decrease subsequent blood lead poisoning and exposures, no formal evaluation have been conducted. This inquiry is to therefore to examine the effectiveness of reducing blood lead levels, as well as, the impact on preventing blood lead levels from increasing among those with blood levels between 5 to 9 µg/dl.

Purpose Statement:

The purpose of this study is to assess the efficacy of the early intervention approach of implementing case management, environment assessments and lead hazard control for children ages 6 to 12 months with a blood lead level of 5 to 9 µg/dl. To address the question of efficacy with this approach, data was obtained from program data management and surveillance sources, as well as the identification of social status of participants and their geographic locations. The approach is not necessarily new, however no evidence exists that it is effective in reducing blood lead levels. Additionally, other health delivery methods as they relate to the Chicago CLPPP will be identified and evaluated. For children with blood lead levels ≥ 10µ/dl data support the null hypothesis that this intervention is not effective. The alternative hypothesis is that the intervention does statistically confirm and show a significant impact in the reducing the number of children from reaching the lead level of concern (10µ/dl) and from becoming a case.

For this to be achieved, each process measure for the purpose of efficacy and effectiveness was assessed. The base-line screening data determined the before and after effects of intervention activities. If it is established that the preventive measure show the desired affects, then the conclusion will be worthwhile in promoting guidance and recommendations that play a major role in the prevention of childhood lead poisoning. It will also have an economic impact due to the implementation of recommendations as to how it they will help reduce healthcare visits and cost.

The objective was to assess and confirm an approach that can be nationally promoted as a workable intervention measure. The intended audiences are public and private healthcare administrators and providers on the federal, state and local levels. The

expectation is that decision-makers within the levels of government will have increased knowledge and insight as to best practice measures in trying to meet the CDC objective of eliminating childhood lead poison by reducing exposure and increase screening. Those who review this project will receive background information on challenges and barriers encountered.

This analysis will also determine the strengths and weaknesses of the approach from an intervention stand point. The initial data does not appear to indicate a significant difference. However, this can be attributed to how the interventions are being implemented and measured. Behavioral factors must be ruled out that may distort the activities of identifying the source of the exposure and minimizing future contact. If it is determined that environmental inspections of high-risk children below the level of concern specifically have an impact on case reduction of childhood lead poisoning, then it is necessary to determine the best promotion method needed. This could be crucial in determining efficacy and program impact.

Definition of Terms

Screening – Blood lead testing and laboratory analysis using capillary blood sampling on to filter paper or electronic analyzer devices) to identify asymptomatic children that have been exposed.

Efficacy – Quantifying whether the proposed intervention is successful in reducing blood lead levels in target children..

Exposure – Being subject to or put at risk of hazardous conditions.

Level of Concern – Measurement of blood lead test at a given time that requires the implementation of preventive measures.

Primary Prevention – Preventing a problem or exposure from happening before it occurs.

Preventive Measure – Prevention activity used to intervene in the development of a problem.

Environmental Investigation – Assessment of lead hazards by trained personnel in the homes of targeted children.

Case Management – The ongoing communication with the caregivers and other service providers, home visits to provide education to parents and other care givers, and a cooperative approach to solving any problems that may arise during efforts to decrease the child's BLL and eliminate lead hazards in the child's environment.

CHAPTER II

LITERATURE REVIEW

A call for an all-out effort to eliminate childhood lead poisoning in 20 years was released in 1991 by the U.S. Public Health Service (PHS) (CDC, 2012). A 1994 national survey showed that about 24% of young children had been screened (MMWR, 2013). Many children now, especially those who live in older homes and poor, are still subject to lead poisoning. The 1991 edition of Preventing Lead Poisoning in Young Children, a publication by CDC, called for universal screening of children between 12 and 72 months of age (CDC, 1991). The Chicago Lead Poisoning Prevention Program like other programs instituted various outreach and follow-up measures to address the need to increase screening rates and prevent childhood lead poisoning throughout the city. The effectiveness of the approach will be the focus of the literature presented for review in this chapter.

Childhood lead poisoning screening, case management, environmental investigation and lead hazard control are important aspect of a comprehensive lead poisoning prevention program. The goal of the three measures is to identify those children who are in need of screening, raise awareness about lead poisoning, and reduce the number children with an elevated blood lead level. The need is to demonstrate the effectiveness of the approach and provide future guidance as related to increasing screening rates and eliminating childhood lead poisoning.

The CDC Advisory Committee on Childhood Lead Poisoning Prevention (2012) recommended more effort be placed on primary prevention methods (CDC, 2012). The focus is to assess and modify current recommended measures and best practice activities

such as environmental investigations to prevent the development of new childhood lead poisoning cases. It has also been recommended as an efficient way of identifying and screening children that are high-risk. It is also now known that other local and state programs seek to incorporate measures that will not allow children to be used as subjects to detect lead hazards in homes.

Why environmental investigations for high-risk children with blood lead levels of 5-9 µg/dl?

There are several factors that drive this effort. The CDC Advisory Committee on Childhood Lead Poisoning now supports local programs decisions to incorporate appropriate methods of blood lead screening approaches (CDC, 2012). This is based on local data that drives the needs of established programs. Many local CLPPP focus their efforts on the identification and case management of individual children with an elevated blood level (i.e., secondary prevention) which has limited effects on reducing the number of cases. Recent studies suggest that children with blood lead levels less than 10µg/dl have shown adverse effects. A 2003 study supported by the National Institute of Health Sciences found that blood concentrations lower than 10µg/dl can impair a child's ability to learn and result in lower IQ scores (CDC, 2005).

Research findings also indicate that primary prevention efforts would benefit all children at high risk because communities with the largest percentages of children with blood lead levels >20 µg/dl also have the largest percentage of children with blood lead levels that are lower but still above the national average of approximately 2 µg/dl (CDC, 2012). These data underscore the importance of targeting efforts to communities where risk for exposure is highest and provide a strong rationale for continued primary

prevention activities. Most CLPPPs emphasize secondary prevention of lead poisoning (i.e., blood lead screening of children to identify and provide follow-up care for those that have an elevated blood lead level). As stated previously, this has limited benefits for children living in housing that poses an increased risk.

However, primary prevention measures have succeeded (CDC, 2012). CLPPPs have introduced prevention techniques associated with behavior change for example, encouraging families to increase hand washing, mopping, cleaning, and increase iron and calcium intake. However, these educational approaches alone do not reduce exposures significantly, since they offer little sustainable protection to children of high risk exposure.

It can also be said that when you identify and reduce the exposure of a child to lead hazards, you reduce their chances of developing an elevated blood lead level. The approach can be associated with the approach used in exposure to a communicable disease. If someone is exposed to Syphilis by having sex with an infected person that someone is still receives prophylactic treatment. This is to stop the manifestation of the Syphilis bacteria from progressing. It seems the same methodology is being applied by the Chicago program.

Why Targeted Screening, and not Universal?

CDC recommends routine blood lead screening (MMWR, 2009). Universal screening is recommended if the risk of lead exposure is widespread, such as all homes in a given area of were built before 1960 (MMWR, 2009). Targeted screening is recommended if the risk is more confined to a specific area, or to a certain sub-population. In a Utah study, conducted in 1995, seven WIC clinics dispersed throughout

the County of Salt Lake were targeted to provide lead screening (MMWR, 1997). Data from WIC Prevalence Survey showed that of the 5350 children aged 12 to 36 months enrolled in the WIC clinics, 5168 (96%) parents or guardians provided written consent for lead screening. Of the number screened, 93 (1.8%) had elevated blood lead levels (MMWR, 1997).

The prevalence of EBL (10µg/dl or higher) levels among the participants varied from 0-6% by zip code area, which is among the 25 (of 34) local zip codes. These areas represent 50 children that participated in the survey. Based on local census data, the targeted area had a higher prevalence of houses built before 1950 than the remainder of the county. Two out of the seven WIC clinics were located with the targeted area. Among the WIC participants screened that were 12 to 36 months of age and had elevated blood levels of 10 or higher, the prevalence was greater for those in the target area than outside (MMWR, 1997).

Numerous programs from across the country, including the cities of Chicago, Indianapolis, Philadelphia and Cincinnati, have reported an increase in screening of children within high risk communities. Because of the partnerships with local community based organizations and other government entities, programs have been able to identify children that are most at risk in their communities, and have seen a reduction of the number of children exposed to lead. Some state and local programs have also experienced a reduction in the number of children with an elevated blood lead level. Still screening rates of these programs are relatively low. It has not been determined if the increase in screening rates are a contributing factor to the reduction of the number of elevated blood lead levels.

How do we Measure Effectiveness?

Effectiveness is the extent to which an activity achieves its long-term goals and objectives. The goal for this project is to not only determine the effectiveness of home investigation during initial visit of children with blood lead levels between 5-9 10µg/dl, but also establish guidelines that will drive future efforts of this kind. For a particular activity such as this, effectiveness relates to how the outcomes support the broader goals. Essentially, calculating the number of children with blood lead levels below the level of concern within a given time period and comparing it to another can give an estimate of improvement. However, this is not very effective if children being identified are not within the 12 to 24 month age group, nor if they are not from high risk communities as recommended by CDC. The practice of comparing screening data only determines increases within certain periods of time; however impact can be evaluated if also assessing methods, behaviors, and demographics of children that received environmental investigations during the process.

Access to data is a key component when conducting an evaluation. For the past seven years, the Chicago CLPPP has been collecting data as it relates to the project. Preliminary reports from the Chicago CLPPP to CDC indicate there may be a significant impact based on preliminary comparisons. The only way to be sure, is to identify and thoroughly evaluate key components and factors that drive the motive of implementation the measure. Although some indicators give an initial measuring of the screening occurring, past and present, it can also give more if a comparison of the results is conducted. If children between the ages of 0 to 24 months are assessed with an initial

blood lead level of 5 to 9 then a comparison with children that may have identical living conditions that did not receive an environmental investigation should be conducted. A significant difference based on the required follow-up test results may be seen. The comparison group can be identified or comprised of children from the same age group and living in areas around Chicago and the state of Illinois.

It is also important to know the demographics and make-up for those targeted areas. Having access to census data, age of children, social economic status, race, and age of housing will help determine effectiveness when comparing data. In measuring effectiveness, the extent to which shifts have taken place that supports the goals must be assessed. The weighing of evidence of both quantitative and qualitative data is essential. For examplereviewing medical records for confirmation of lead hazard being identified and assessing the number of children screened out of all identified children that meets the criteria for that high risk area. Being able to conduct follow up assessments that may include a new or different approach to identifying hazards and screening children is essential. The measurement of changes in values, attitudes, skills and behavior relies on comparisons and the ability to recognize and describe when change has taken place. It is known that change has occurred based on the number screened. The challenge is to assess the awareness as it relates to future behaviors, and attitudes.

CHAPTER III

METHODOLOGY

The method of evaluation for this project will center on data analysis of one group during one period of time using a before and after design. It is desired in the near future a comparison group will be available based on an earlier time period when the intervention was not in place. The children in the comparison group will be identical to those in the intervention group in terms of age, social condition, environment, initial screening and blood lead level (5 to 9 µg/dl). They will be different due to receiving and not receiving case management and environmental inspection of their homes. The assessment of the data surrounding these specified time periods is crucial in determining the level of impact and effectiveness. The measure was implemented in 2003.

The baseline data for the analysis will be screening and environmental investigation data collected until December 2010. The comparison data will be screening/ environmental investigation data collected by the end of the fiscal year 2010. Initial analysis of the data confirmed differences in the number of children with an increase of the blood lead levels in those targeted areas of the city. The benefit of this approach is that better representation of the general population will be obtained, and it will provide a current indication of health screening rates and reduction in the number of children reaching the level of concern or becoming a case at the specified time. When accessing effectiveness of an intervention process it is extremely important that all variables and process measures are identified during the period of analysis. Knowing and understanding all variables and measures can be used for educational purposes and assist in identifying strengths and weaknesses of the overall approach.

As previously stated, it is known that when an increase in screening occurs, a reduction in the number of cases also occurred for the Chicago CLPPP. However, it is not known if the preventive measure of providing case management and an environmental investigation actually made children safer from lead hazards or exposure to lead hazards. The challenge is to determine if the efforts within this intervention caused specific behaviors of parents and children to be altered to the point where a more preventive approach is taken toward lead poisoning. And, with the adoption of this preventive outlook, the community impact should show an increase in the number of children in a high risk areas screened. If this is proven then the Chicago CLPPP has confirmed its efforts in a manner that is favorable, and now should adopt and promote the practice of environmental investigations beyond the selected age group established for this project. It should also promote partnerships being established between the Illinois CLPPP and other screening sites throughout the state.

Study Population

This analysis will focus on children less than 12 months of age screened throughout targeted areas of the City of Chicago from 2003 to 2010 that received blood lead testing, a result of 5 to 9 µg/dl, and case management services and an environmental investigation (risk assessment). The assessment and analysis will address those children that were screened between 6 and 12 months. The total number of children screened with the above results and follow-up in the targeted areas will provide the dominator in determining screening percentage, blood lead levels, and level of concern/case rates. It is very important to note that the focus on those children with initial blood lead testing with in the recommended age group also received follow-up testing within the recommended

guidance from CDC. The geographic location of the screening will also be reviewed. A future comparison of children receiving environmental investigations is critical as it is determined if location plays a significant role in community impact and effectiveness. Also, a determination of healthcare status, insured or un-insured, is needed to assess the effectiveness of this approach as a community intervention.

Research Design

A cross-sectional study was conducted to measure and assess the intervention that is centered on the need for case management and environmental investigations for children that have a blood lead level between 5 and 9µg/dl that are between the ages of 6 and 12 months. The Chicago CLPPP allowed access to medical and environmental records. A data analysis was done to determine effectiveness of intervention in reducing the number of children exposed to lead hazards. For this project, data was provided from the Chicago CLPPP surveillance database called Systematic Tracking of Elevated Lead Levels & Remediation (STELLAR). Also used was data from a locally created excel database that all blood lead testing data is stored that did not reach the level of concern of 10 mµ/dl, but did receive case management and an environmental investigation in accordance with CDC recommendations.

Procedures

The collected results were analyzed for initial and follow-up testing, result response, appropriate case management and environmental assessment. Based on the established criteria by the local program for this initiative, a determination was made on which children fell into the prescribed categories. To initially qualify, the age of the child must be 6 to 12 months. The next determination made was blood lead testing and results.

A minimum of three or more follow-up results was used to establish a significant validation of the intervention. This provided an indication of services being offered and rendered, and if they were in accordance with CDC recommendations.

The next step determined whether blood lead results incurred a reduction within acceptable period of time. Last, a confirmation that medical case management was received, as well as, an environmental assessment. What was demonstrated is a comparison between children age 6 to 12 months with blood lead levels between 6 and 9, follow-up testing confirming a lower level incurrence with case management and an environmental assessment and children of the same age, blood lead test results between 6 and 9, no reduction in follow-up test, and with case management and environmental assessment.

The blood lead data obtained from the local program was summarized in a table format to best illustrate the comparability of blood lead results, determinations found from the case management and home assessments, and environmental inspections. Some of the primary elements of the study were described in a standardized format so that the best possible comparison can be determined. It is important to acknowledge that a significant amount of the results were analyzed within a short period of time. This lead to the determination of some test being identified as screening test with a confirmatory test following.

Instruments

The Chicago Department of Public Health, Childhood Lead Poisoning Prevention, surveillance data collection and monitoring system, STELLAR, which is a database used by the local program to collect and maintain blood lead data. The program also used a

local database to maintain all blood lead results and housing data. Both systems were used for search purposes in assessing the quality of information and ensuring identified results meet the criteria for inclusion.

Data Collection

Secondary data was used to examine the association between environmental assessment and BLL among children with initial BLL between 5-9 µ/dl. The Chicago Department of Public Health, Childhood Lead Poisoning Prevention Program provided data for children aged 6-12 months of age who had an initial BLL between 5-9 µ/dl. Children having BLL at this level were entered into the case management system, which included an ordered environmental assessment of their primary dwelling.

The collection and review of data was centered on a fixed time period. The period was identified based on the initiation and conclusion of the prevention measure. In the future, a comparison group will be derived from laboratory and case management data from previous decade. Articles relating to lead testing and primary prevention in CLPPP will serve as examples for comparison purposes. For example, the data findings and conclusions as they relate to a similar population (children 24 months or younger) will establish a generalization of screening practices. CDC annual reports will be reviewed to identify those programs that have taken on the challenge of screening and providing best practice measures addressing children with blood lead levels below the level of concern. A data comparison will be conducted through the usage of local screening data reported to the Chicago Department of Public Health, Childhood Lead Poisoning Prevention Program and the CDC, Healthy Homes and Lead Poisoning Prevention Program.

Data Analysis

Study Research Question

Does the inclusion of an environmental home assessment reduce the risk of a child aged 6 to 12 months with a BLL between 5-9µg/dl from becoming a diagnosed case (≥10 µg/dl) of lead poisoning after the initial follow-up?

Study Hypotheses

***Null Hypothesis**: Inclusion of an environmental home assessment is not associated with the risk of a child aged 6 to 12 months with an initial BLL between 5-9 µg/dl developing a BLL ≥10 µg/dl after the initial follow-up.*

***Alternative Hypothesis**: Inclusion of an environmental home assessment is associated with the risk of a child aged 6 to 12 months with an initial BLL between 5-9 µg/dl developing a BLL ≥10 µg/dl after the initial follow-up.*

Descriptive statistics using means, frequencies and percentages were used to describe the demographic characteristics of children in the Chicago CLPPP aged 6-12 months old with BLL 5-9 µg/dl, who would have been recommended to receive an environmental assessment during their initial case management visit. Due to privacy regulations from the Chicago CLPPP, the demographic characteristics presented represents a global examination of children aged 6-12 months of old with BLL 5-9 µg/dl who would have been eligible for enhance case management, based on data reported to the National Lead Poisoning and Prevention Database.

Assumptions

It is assumed that the demographic information of children for who received case management and laboratory information are similar to the demographic information of

children whose laboratory information is reported to the National Lead Poisoning and Prevention Database.

Limitations

There were several limitations that had to be recognized with respect to the study that was conducted. First, the data collected only provided age, type of test, blood lead test results, follow-up blood test results, and case management and environmental assessment data. Data not available were race, gender, address, and zip codes. Activities related to how the home was maintained were not on-hand for analysis due to not being collected. Ideally, the setting would be to obtain all of this information to thoroughly determine if there are any behavioral correlations between the children, their homes, or the area of which they live. This is because studies of behavior and interventions are typically unique in design and therefore can be challenging to compare. The City of Chicago, Department of Public Health incorporated data sharing restrictions on specific characteristics of data to eliminate chances of liability issues relating to the release of medical information. However, as time progress and the volume of data increased, it was possible to conduct a study that allowed for goals to be achieved and determinations made.

Another limitation is that the assessment of the data only allowed for a snap shot measurement. Due to so many of the children that were tested, had results of their test, but did not receive follow-up testing due to reasons such as parents moving from one location to another, non-compliance of parents or guardians, failure of medical personnel reviewing records appropriately and not testing the child, dropping out of system, or access to the medical facility, they did not meet the requirements for this study. Some

children's results did not qualify because of the time factor involved in the study, even though they may have received care or housing attention months later.

Advantages

There are several advantages to this study design as it has been developed. The main advantage in performing this study/analysis is that it was relatively simple and inexpensive to retrieve and analyze the data as it was already collected and properly stored. However, the ideal situation would have been to have complete access to the data sets generated from the local public health office. This would have allowed for a more precise analysis. Unfortunately, since most of the information falls within the local medical information restriction ordinance, it would be unrealistic to expect access to more information.

Another advantage in performing this study was the volume of data available for analysis. The volume of blood lead data allowed for reliability and validity to the findings and outcomes of the study. The information meets the criteria established by the local program, and it seems to give legitimacy to the approach and theory that supports the concept of addressing the health concern.

CHAPTER IV

RESULTS

The objective of this assessment was to focus on a particular early intervention program and quantitatively observe its effectiveness. For seven years, 2003 to 2010, the Chicago Department of Public Health, Childhood Lead Poisoning Prevention Program has been conducting follow-up activities among children ages of 0 to 12 months with blood lead levels of 5-9 µg/dl. Even though, the CDC recommendation for case management and follow-up procedures begin at 10µg/dl, the Chicago CLPPP believed it would be more advantageous for them to prevent exposure from continuing at the earliest point. This would reduce the chance children of that age from being put at risk of developing complications.

Demographic Information

Table 1: Demographic Characteristics of Children aged 0-12 Months of age with BLL 5-9 µg/dl who would have been eligible for enhanced case management in the Chicago CLPPP (2,213 labs)

Variable	Percentage with characteristic
Age	
0-3 Months old	124/6%
4-6 months old	200/9%
7-9 months old	1189/54%
8-12 months old	700/32%
Gender	
Male	1113/50%
Female	1043/47%
Unknown	57/3%
Race/Ethnicity (Estimate- zip code)	
Black (Non-Hispanic)	39%
White (Non-Hispanic)	8%
Hispanic	53%

Reported to the National Childhood Lead Poisoning Prevention Data Base 2003-2010

Laboratory Information of Selected Children form the Chicago CLPPP who received enhanced case management

Preliminary results of the early intervention program assessment are highlighted as follows. Of the 1773 study population of children enrolled in the Chicago program between the years of 2003 to 2010, 1578 had BLLs from 5 to 9µg/dl with follow-up screening following and an environmental assessment during within a week of the initiation home visit. Of the number of enrolled children, 50% were retested within 6 months of their initial test. 75% were retested within 9 months of their initial test; and 90% were retested within 12 months. Based on initial analysis of BLL results from the retesting, a significant reduction in BLLs from a mean of ≥7 µg/dl to 5µg/dl was observed amongst the children enrolled. And what is to be the most significant finding is that of the 1578 children with a retest after the home visit occurred, only 80 (5%) had blood lead levels ≥ 10 µg/dl during follow-up testing.

Table 2: Breakdown of the participants with follow-up blood testing by month	
Months	**Percentage based on mean (1578)**
Follow-up testing within 3 months	**15/1578 (1%)**
Follow-up testing within 6 months	**789/1578 (50%) Median**
Follow-up testing within 9 months	**1183/1578 (75%)**
Follow-up testing within 12 months	**1420/1578 (90%)**

Table 3: Breakdown of children with initial blood lead test results of 6-9 μg/dl	
Children with a 5-9 μg/dl and received follow-up and testing	1578/1173 = 89%
Percent of children responded to intervention with a reduction in blood lead level from 7 to 5 μg/dl	1499/1578 = 95%
Percent of children had their first BLL ≥5 μg/dl reduce on a subsequent test (but never go to or higher than 10)	238/1499= 15%
Percent of children with initial BLL between 5-9μg/dl increased above the level of concern of ≥ 10μg/dl	80/1578 = 5%

Table 4: Breakdown of percentage duration of the 80 children that blood lead levels increased to above the former level of concern of ≥10μg/dl	
Less than 3 months of follow-up testing	**14(18%)**
3 to 6 months of follow-up testing	**17(21%)**
6 to 9 months of follow-up testing	**21(26%)**
Greater than 12 months of follow-up testing	**28(35%)**

Findings

The findings of the early intervention program assessment demonstrate that programs with the capacity to immediately conduct home visits will have a significant impact on reducing the number of childhood blood lead cases. It will also have a significant impact in identifying and reducing the number of home with lead and other home hazards. The findings also provide some measurement and assessment of current program effectiveness, as well as effectiveness of current adherence to the Chicago

Department of Health, Childhood Lead Poisoning Prevention Program case management protocol.

CHAPTER V

CONCLUSION

It should be noted that not many programs across the country have implemented measures of this degree to identify and reduce exposure and the number of cases of childhood lead poisoning. One helpful aspect of this type of study is that because of the collected data, it has made it inexpensive and simple to perform, and can be repeated by other programs, if they choose to implement the intervention.

Current data reveals that the City of Chicago is in the top five of cities with children being diagnosed with lead poisoning for the past 15 years. In 2003, the city lead program enacted a proactive early intervention initiative to reduce incidence of blood lead levels equal to or greater than 10µg/dl in children between ages of 6 to 12 months. Screenings occurred at several local public/community health facilities and private providers. For this research project, The Chicago Department of Health, Childhood Lead Poisoning Prevention Program was able to provide data associated with this intervention since its origination. Based on the data provided, 1773 children were identified between the ages of 0 to12 months. Of the 1773 children identified, case management efforts were initiated within 10 days. These efforts included a home visit which was to achieve major objectives: (1) conduct a visual assessment to control or eliminate lead paint hazards; (2) evaluate other sources of lead, including water, soil, imported products and take-home exposures; and (3) make referrals to the Women, Infants and Children Program and follow-up blood lead testing.

The screening protocol included recommended follow-up blood lead testing at 6 or 9 months of age, approximately every 6 months until the child reached 3 years of age,

and annually until the child reached 6 years of age. Again, the screening protocol exceeded CDC's current requirements and recommendations.

Introduction

The objectives of the early intervention home assessment were three-fold. To measure efficacy and effectiveness of instituting a home visit upon notification of a child blood lead level between 5-9 μg/dl. Measure the possible reduction the number of high-risk children 6-12 months of age who's BLLs potentially could increase to ≥10 μg/dl. Lastly, to reduce the number of lead and other home hazards identified during the home assessment of a lead case. The analysis of the data has clearly shown that all three areas were significantly impacted by the intervention approach taken. The most significant finding was that of the 1578 children with a retest after the home visit occurred, only 79 (5%) had blood lead levels ≥ 10 μg/dl at follow-up.

Summary of Analysis

The uniqueness about this research analysis is that the intervention is an approach that is used in STD/communicable disease cases such as Syphilis and Gonorrhea. Meaning, when exposure occurs, the client or patient is treated, and partners are notified and treated presumptively to eliminate the source of the infection or exposure. The former program manager of the Chicago CLPPP and I worked together in the Chicago STD program in 1997. So, when assigned as the project officer to Chicago CLPPP and learned of this approach being implemented by a former colleague who was the former program manager, I assumed it was due to their HIV/STD background.

The research found no other specific data or studies of this nature to have occurred or is occurring. Through interactions with other programs, it was determined that most were found to operate in accordance with CDC guidelines where neither the steps nor the activities in this approach by the Chicago CLPPP are recommended.

As the three areas were reviewed, it can be noted that by initiating a home visit to conduct a home assessment, identifying the lead hazard, within a reasonable a reasonable time limit of 10 days is effective in reducing exposure to lead. The methodology used was to look at data identifying those children that had a blood lead level of 5 to 9 µg/dl and received case management and an environmental assessment within a reasonable allotted time period. Based on the recommendations, all intervention steps should occur within 90 days, including follow-up blood testing after the environmental assessment. The objective was to brake-down the data by making sure children selected were between 6 and 12 months of age, race and sex was not used as variable. Blood lead levels between 5 and 9 µg/dl of the children was the next variable to be identified. The objective was to also look for all children within the age range with a blood lead test result 5-9 µg/dl, a home visit and environmental assessment, and a follow-up blood lead test.

In total, 1773 children met the criteria between the years 2003 to 2010. The results of the analysis showed that the intervention itself has had a positive effect on the overall practice measures of outreach and case management protocols of the program. Children initially exposed to lead, confirmed by a blood test with the results being between 5-9 µg/dl, and received home visits within in timely manner reduced the chances of becoming a case tremendously. In fact, a significant reduction in the BLL by an average of two micro grams per deciliter points was noted. Because of the approach,

program staff was able to identify lead hazards and introduce property owners to services that allowed for intermediate controls and other remediation techniques to be applied. These steps were instrumental in reducing exposure because families were now aware and educated on how to address lead hazards. This is quite interesting since current recommendations require home visits at a BLL of ≥10 µg/dl.

Conclusion

The objective was to measure the effect of an intervention that was implemented with the purpose to reduce the number cases of children being lead poisoned in the City of Chicago. The question that drove this analysis was can requiring lead risk assessments for children with blood lead levels between 5 - 9µg/dl reduce the number of children from increasing to the level of concern of ≥10 µg/dl and reduce the number of confirmed cases. The City of Chicago, Department of Health, Childhood Lead Poisoning Prevention Program choose to implement a strategy of applying CDC recommended case management and environment assessment protocols towards children with blood lead levels between 5-9 µg/dl. The intent it to identify, address, and reduce the exposure of the lead hazards with the objective of preventing the child's level from rising above the level of concern, which was 10 µg/dl, and becoming a confirmed case. It is not clear if any analysis of this nature, with such specific data has occurred previously. What is known is that the analysis of the data has clearly proven that the intervention has had a significant effect on reducing the number of cases, and raising awareness of complications associated with lead exposure and other home health hazards. When a proactive approach of allowing health and housing practitioners to sit down with parents, occupants, and

property owners, as well as other health practitioners and explain the importance of preventive steps being taken to reduce exposure, the prevention of cases are occurring.

Implication

It can be assumed that this approach can be beneficial in preventing other home related health complications. For example, home visits and environmental assessments to those diagnosed with Asthma or severe allergens, and seniors that are prone to injury. Preventative visits with the purpose of educating and assessing the home for hazards that may cause attacks or injury can prevent emergency room visits and possibly reduce unnecessary healthcare cost. This is confirmed based on the intervention approach itself already being used to intervene and prevent communicable diseases.

Recommendation

Overall, to make a true determination of the effects of this intervention, it is important to consider a cohort study design that factors in population demographics, and economic status. As mentioned above, it is the desire of the Healthy Homes and Lead Poisoning Prevention Branch to continue to work with the Chicago CLPPP in retrieving data results from previous years, before this intervention was implemented. As a program consultant responsible for the continued follow-up of this study, the decision as to how the approach moving forward will definitely include the findings from this analysis. For example, it can only be advantageous and possibly cost effective to compare a group that benefited from the current intervention to a group that may not have benefited from the same. The comparison would validate what has been initially analyzed and provides a conclusion that also validates the implication stated above as to usage of the intervention to prevent other home associated health complications. This intervention by itself, in no

way will be as effective without other resources being implemented and utilized to address those identified hazards in the home. The reduction in the significant amount of blood lead levels by children can be attributed to necessary changes in maintaining and monitoring the home by family members. It should also be considered that the Chicago, CLPPP was also awarded Housing and Urban Development (HUD) funding to address lead hazards specifically. These additional resources played a major role in the results and impact of this intervention approach. It is the intent of the researcher to ensure these factors are also included in the next phase of this study.

References

ATSDR. 1990. Case studies in environmental medicine: Lead toxicity. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.atsdr.cdc.gov/toxprofiles

Centers for Disease Control and Prevention (CDC). (2012). CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in "Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention." Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/ACCLPP/acclpp_main.htm

Centers for Disease Control and Prevention (CDC). (2012). Advisory Committee on Childhood Lead Poisoning Prevention. Low level lead exposure harms children: a renewed call for primary prevention. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf

Centers for Disease Control and Prevention (CDC).(2013). Blood Lead Levels in Children Aged 1-5 Years – United States, 1999 to 2010. MMWR 62: 245-48.

Centers for Disease Control and Prevention (CDC). (2012). National Surveillance Data (1997-2012). Atlanta, GA: U.S. Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/national.htm

Centers for Disease Control and Prevention (CDC). (1997). Targeted Screening for Childhood Lead Exposure in a Low Prevalence Area Salt Lake County, Utah, 1995 1996. MMWR 46(10); 213-217.

Centers for Disease Control and Prevention (CDC). (2009). Recommendations for Blood Lead Screening of Medicaid-Eligible Children Aged 1-5 Years: an Updated Approach to Targeting a Group of High Risk. MMWR 58: 1-13.

Centers for Disease Control and Prevention (CDC). (1991). Preventing Lead Poisoning in Young Children. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/publications/books/plpyc/contents.htm

Centers for Disease Control and Prevention (CDC). (2005). Building Blocks for Primary Prevention: Protecting Children from Lead-Based Paint Hazards. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/publications/Building_Blocks_for_Primary_Prevention.htm

Centers for Disease Control and Prevention (CDC). (2002). Managing Elevated Blood Lead Levels Among Young Children: Recommendation for the Advisory Committee on Childhood Lead Poisoning Prevention. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/CaseManagement/caseManage_main.htm

Centers for Disease Control and Prevention (CDC). (1997). Screening Young Children for Lead Poisoning: Guidance for State and Local Public Health Officials. Atlanta, GA: US Department of Health and Human Services, CDC. Available at www.cdc.gov/nceh/lead/publications/screening.htm

Dietrich, K.N., Succop, P.A., Berger, Ol, Hammond, P., Bornschein, R. L. 1991. Lead exposure and cognitive development of urban preschool children: the Cincinnati lead study cohort at age 4 years. Neurotoxicology and Teratology 13: 203-11.