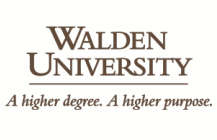

2019

Blood Lead Testing Guideline Development for a Public Health Department

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This is to certify that the doctoral study by

Becky S. Johnson Himes

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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Walden University
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Abstract

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MS, Walden University, 2015

BS, Lake Superior State University, 1992

Project Submitted in Partial Fulfillment

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Abstract

A lack of consistent, evidence-based practices for blood lead testing of children existed in a local public health department (LHD). No known blood lead level is safe, and toxicity can result in behavioral and cognitive impairments. The purpose of this project was to develop and analyze a clinical practice guideline to establish blood lead testing procedures in the LHD to improve testing procedures and enhance future testing within the jurisdiction. The RE-AIM framework was used to address the reach, effectiveness, adoption, implementation, and maintenance of the clinical practice guideline. Five experts evaluated the guideline using the Appraisal of Guidelines for Research and Evaluation instrument. The assessment results indicated 96.4% agreement across all domains. The experts agreed unanimously to recommend adoption of the clinical practice guideline. Implementation of the guideline might advance nursing practice and patient care in the LHD through incorporation of evidence-based practices. Implementation might also lead to early identification of lead-burdened children and may provide the opportunity for treatment to mitigate cognitive and behavioral deficits related to lead toxicity, thereby improving child health and decreasing related health care costs. Engagement of the clinical practice guideline will support positive social change through the empowerment of public health nurses to provide optimal care to a population of children at risk of deleterious and long-term side effects of lead exposure.

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Dedication

This work is dedicated to my daughter, Sydney Himes. You were the inspiration for beginning this journey and continue to inspire me daily. Dreams are attainable with courage, determination, and hard work, so set your sites high. Thank you for supporting my dream. I will always be there to support yours.

Acknowledgments

I would like to thank my husband, Phil, for his endless love and support. Many sacrifices have been made throughout my coursework. Thank you for your patience, persistence, and passion for completing this goal. The culmination of this project represents an accomplishment for our family, not just me. I am proud to share the joy of completion with you. To my parents, thank you for instilling the importance of determination in me; without this, I would have given up long ago. To Dr. Sharon Colley, thank you for being my mentor and encouraging me throughout this journey. A very special thank you to Dr. Marisa Wilson for your steadfast guidance and support in completing this project. Your words were more powerful than you know. Although I cannot name everyone individually, many people have offered unwavering support throughout this process, and I thank each of you from the bottom of my heart.

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Section 1: Nature of the Project

Blood lead testing of children is a procedure that should occur for every child (American Academy of Pediatrics, 2017). Elevated levels of lead in the bloodstream can have detrimental effects on nearly all systems of the body with symptoms that are often unrecognizable (Centers for Disease Control and Prevention [CDC], 2017b). There is no known safe level, and a child's cognitive and behavioral abilities can be impaired with low-level blood lead levels (CDC, 2017b). Studies of the effects of elevated blood levels have resulted in significant changes to the values accepted as normal per CDC guidelines. In 1985, a level of 35 micrograms per deciliter (mcg/dL) or lower was considered acceptable (CDC, 1997); however, with advances in technology and assessment of children, the acceptable level has been lowered multiple times and currently is 5 mcg/dL (CDC, 2017a). Although the reference range for lead toxicity and follow-up evaluations have changed, the education of health care professionals has not always progressed, and testing procedures have remained mostly unchanged (American Academy of Pediatrics, 2013; Choate & Polivka, 2000).

Although federal and state guidelines are in place for health care providers to follow regarding categories of children to be tested, the local strategies, education, and resources necessary to provide the testing and any necessary follow-up activities are not always available. The reporting of elevated blood level is a requirement by state guidelines; however, blood lead collection and the documentation steps associated with the process or case management activities to guide the care of children with identified high-level results are not standardized procedures (Michigan Department of Health &

Human Services, 2109). The purpose of this project was to develop a clinical practice guideline that would produce an effective and efficient blood lead testing procedure for the practice setting. Established procedures for the rural practice setting were evaluated to identify areas for improved efficiency. Also, collaboration with local partners were analyzed to identify needed areas of improved practice. The early identification of children with elevated blood lead levels and the education of staff regarding evidence-based testing guidelines was the intent of this project. Early identification may result in improved cognitive functioning for lead-burdened children, a decrease in health care costs associated with the treatment of lead toxicity, and a decrease in societal burden associated with lead toxicity.

The practice setting for this project was a rural, local public health department (LHD). The LHD is a jurisdictional health department serving six counties with seven clinic locations. Although the administrative staff were consistent throughout the LHD, the clinic staff and office designs were different in each of the offices.

To identify blood lead exposure as early as possible, all children enrolled in Medicaid health coverage are required to receive testing at 12 and 24 months of age (Michigan Department of Health & Human Services [MDHHS], 2017c). Also, Michigan law requires that all children enrolled in the Women, Infant, and Children (WIC) supplemental food program are to receive blood lead testing regardless of Medicaid enrollment status (MDHHS, 2017c). At the time of the DNP project, there were no statewide testing guidelines specific to uninsured or privately insured children in Michigan. In the United States, few states require universal lead testing of children at

ages 1 and 2 years (Raymond, Wheeler, & Brown, 2014) and Michigan is not one of those states. In 2015, 72% of Medicaid-enrolled children in the LHD were tested for blood lead (MDHHS, 2017d). Initially, the rate of testing may appear substantial; however, when children without Medicaid coverage were included in the data, the number of tests completed notably decreased. Lead reporting data for the state of Michigan revealed that within the LHD, only 41.8% of all children 1 and 2 years of age were tested for blood lead in 2015 (MDHHS, 2017d). These data showed a significant gap in testing between children enrolled in Medicaid and those without Medicaid coverage. For the lead-burdened child who does not receive testing and remains undiagnosed, the long-term effects can be devastating (CDC, 2012).

Funding levels for blood lead testing have not maintained the same pace as the changes associated with increased testing recommendations and lowering of the acceptable blood lead level before initiating intensive case management efforts. The State of Michigan (2016) reported that funding necessary to meet the current Michigan requirements of testing Medicaid enrolled children is insufficient. Although there is a state requirement to test all children participating in WIC, the LHD does not currently test WIC-enrolled children who are not enrolled in Medicaid because of a lack of funding. Several private insurance companies have begun reimbursing for blood lead testing, but there are no state or federal requirements to test privately insured children. Children without Medicaid or who privately purchased medical coverage have no paid options for receiving testing. The mission statement of the LHD focused on the promotion of health and well-being through the provision of preventative health care,

education, and environmental safety. A lack of funding has hampered efforts to provide blood lead testing to all children residing within the jurisdiction.

Lead toxicity is a quiet and slowly progressing disease process that many people disregard, and although most children in the state of Michigan are not burdened with lead toxicity, one lead-burdened child is too many. Unlike other services provided within the LHD, blood lead testing is not a service that is included in the Michigan Local Public Health Accreditation Process (Michigan Public Health Institute, 2017) and has not received a great deal of attention within the identified LHD. Other LHD services receive program-designated funding and have staff assigned to specific roles. Blood lead testing has been a low priority; however, with required testing of all children enrolled in Head Start programs, there was a noted need for testing within the LHD. The increased need brought focus on established testing procedures of the LHD. Development of updated, evidence-based procedures was needed to meet the needs of the organization, nursing staff, and children being tested.

Problem Statement

The Doctor of Nursing Practice (DNP) project addressed whether evidence and theory would support the development of a clinical guideline that would be usable and acceptable within the LHD and lead to improved testing within the jurisdiction. Development of a clinical practice guideline was facilitated through the collaborative efforts of a project team lead by me. The project team used a standardized validation tool to conduct a formative review of the developed guideline.

Purpose

The LHD lacked evidence-based practices and comprehensive staff training related to the blood lead testing of children. Guidelines of LHD procedural development were based on the Michigan Medicaid policy requirements and Michigan law, Public Act 286 of 2006, which states that all children participating in WIC supplemental food program are required to receive blood lead testing (MDHHS, 2017c). The developed clinical practice guideline was analyzed to establish blood lead testing procedures within the LHD and identify improved testing procedures to enhance future testing within the jurisdiction.

The developed guideline focused on consistent blood lead collection practices, case management processes for children with identified high levels, increased efficiencies of documentation, incorporation of evidence-based practices, expanding services for those with private insurance or no medical coverage, and collaboration with community partners to secure payment of testing for children without medical coverage. The LHD employed outreach workers dedicated to assisting families with medical coverage enrollment. This project addressed working collaboratively to discover available resources for identified children. Although blood lead testing guidelines were the focus of this project, the establishment of health care coverage for all children to receive medical care is a national priority.

The LHD was approached by a local Head Start agency to work collaboratively toward increasing blood lead testing. Children enrolled in Head Start are required to receive a blood lead test between 36 and 72 months of age if they had not received testing

at 12 and 24 months (U.S. Department of Health & Human Services, 2016b). The Head Start agency is willing to provide funding for the testing of any student not currently enrolled in Medicaid. A partnership between the agencies would promote increased testing of children within the jurisdiction and serve as an additional source of data for updated testing procedures.

Staff education regarding blood lead toxicity is necessary to increase awareness and testing rates. Choate and Polivka (2000) found that health care provider knowledge surrounding established CDC blood lead prevention and testing guidelines was limited and providers were most likely to test children who were perceived to be at high risk or enrolled in Medicaid. It is not possible to determine a child's blood lead level based on a verbal or visual assessment (CDC, 2015). Polivka, Chaudry, and Sharrock (2009) found a 27% increase in testing rates of children ages 12 to 72 months following health care provider training regarding blood lead toxicity prevention and testing. Education is an essential element of advanced nursing practice (American Association of Colleges of Nursing [AACN], 2006) and blood lead education is element that may increase testing rates within the LHD.

The practice-focused question that guided this project was the following: Does evidence support the development of a process and/or guideline that will lead to future consistent blood lead testing procedures within the LHD? Through analysis and investigation, I determined how identified gaps in practice could be alleviated by designing a new model of care for the LHD to improve the consistency of testing within the specified jurisdiction. The evaluation of established procedures used within the LHD

was completed, including identifying aspects of care that were successful and unsuccessful, analyzing barriers to testing, and identifying testing practices involving children who were uninsured or privately insured.

Focused training of the LHD staff regarding blood lead toxicity, collection procedures, and case management strategies would assist in further development of the current LHD program. The education of health care providers on lead poisoning prevention, lead toxicity, blood lead testing, and case management related to lead toxicity has been shown to increase testing rates of children (Polivka et al., 2009). Evidence-based programs designed for the training needs of health care providers regarding blood lead testing are available (Allegheny County Health Department, 2018; CDC, 2004). Through evaluation of the procedures and assessment of staffing needs, the most appropriate clinical practice guidelines were determined.

Nature of the Doctoral Project

Development and planning for quality improvement were accomplished through meeting with the LHD nursing director and nursing staff members, as well as collaborating with partner agencies to improve testing and education efforts. Statistics regarding current levels of testing were retrieved from the LHD, Head Start, and state databases. In addition, the procedures of surrounding health departments were assessed for identification of successful strategies used in lead testing.

Sources of evidence that were necessary to address the practice question included policies, procedures, and data retrieved from the LHD and CDC, data retrieved from the State of Michigan, and information retrieved from agencies collaborating with the LHD

on blood lead testing. Also, peer-reviewed articles relating to blood lead testing, quality improvement efforts, evidence-based models, and change frameworks were included. The creation of evidence-based LHD practice guidelines were achieved through use of identified best practices, promotion of patient-centered care, education of nursing staff, and involvement of LHD staff members in the development of the project guidelines. The purpose of these tasks was to advance staff knowledge, increase testing rates, and ensure early identification of lead toxicity.

Interventions developed to improve projects may not always usable when applied in practice. To increase the success of program design, implementation, and evaluation of intervention steps, the use of a planning and evaluation framework is necessary (White, Dudley-Brown, & Terhaar, 2016). For improvement of the blood lead testing process, the model titled Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) was utilized. Planas (2008) noted that the RE-AIM model can be used to gauge the impact of a public health intervention. The RE-AIM model addresses the dimensions of the project reach, effectiveness, adoption, implementation, and maintenance of an intervention (King, Glasgow, & Leeman-Castillo, 2010).

In the current project, the dimension of reach was associated with the improvement of child health through a change in testing procedures and the frequency of frequency. The dimension of effectiveness was evaluated under the ideal clinic environment and evaluated against the quality control of performed tests, documentation, billing procedures, and patient notification of testing results. The adoption dimension of the model was designed to identify and utilize stakeholders to ensure the project design

fit the needs of the target population (see King et al., 2010). The inclusion of staff members throughout the development of a procedure increases acceptance of the changes (White et al., 2016).

The dimension of implementation employs standards and guidelines to assess if the planned implementation steps were successful and seeks to identify any unanticipated barriers (Planas, 2008). Maintenance of the project will be facilitated through the consistent engagement of LHD staff members for continuity and efficiency, as well as collaboration with the Head Start agency to monitor usage and implications of the procedural implementation.

Significance

Involvement of stakeholders for any project is vital to success. Involvement of crucial participants allows project planners to develop a more comprehensive understanding of the culture, provide insight to potential barriers, and increase program acceptance through a sense of ownership by the stakeholders (Hodges & Videto, 2011). The LHD staff had knowledge and understanding of the organizational circumstances that may not have been readily available to the program planner or evident to LHD administrative staff. Administrative staff members were able to provide insight into the established policy development guidelines, financial status, and collaborative partnership potentials concerning blood lead testing. Representatives from the local Head Start program provided understanding of barriers of testing within their population of students and offered strategies to increase testing in collaboration with the LHD.

Through the development of a clinical practice guideline directed at blood lead testing, multiple areas of health care may be impacted. Identification of lead-burdened children may provide the opportunity for earlier interventions, resulting in improved cognition and behavior functions for the child (see State of Michigan, 2016). Nursing staff within the LHD may become more knowledgeable regarding blood lead testing. Procedures may become more efficient. Successful outcomes may be shared with other public health departments and local provider offices offering similar testing capabilities.

In addition to the positive effects on children, testing and early detection of blood toxicity may also have a positive impact from a societal perspective. The State of Michigan (2016) estimated the 2014 financial impact of lead toxicity to have been approximately $270 million based on the association of decreased earnings, increased cost of health care, special education services, and increased levels of crime. Furthermore, lead exposure has been associated with 10% of juvenile crimes, $1.33 million in annual incarceration fees, and an estimated $64.6 million in costs associated with adult crimes linked to lead exposure in Michigan (Ecology Center, 2016). Improved patient-centered care was the goal of this project, but the potential for significant societal gains was also present.

Summary

There is not an identified level of blood lead that has been deemed safe (American Academy of Pediatrics, 2013). As noted by the CDC (2017a), even a low-level result of lead for children can impact their intelligence quotient, decrease their academic achievements, and reduce their ability to pay attention. The LHD had blood lead testing

procedures in place; however, evidence-based practices were not incorporated into the testing guidelines, testing rates for the jurisdiction remained low, and resources for staff education were limited.

Through improved testing procedures, the goal of improving the health of children may be obtained. Clinical prevention and population health are essential goals of DNP graduates associated with improving overall health status (AACN, 2006). The diffusion of innovations theory of organizational change was used to achieve efficient, positive results.

Section 2: Background and Context

The lack of evidence-based practices (EBP) in established blood lead testing procedures within the local health department (LHD) was the practice problem. Current testing procedures were developed based on requirements from the Michigan Department of Health and Human Services (MDHHS, 2017b) regulations, which state that all children enrolled in the WIC supplemental food program and/or Medicaid health coverage are required to receive testing at 12 and 24 months of age. The CDC and the American Academy of Pediatrics have endorsed universal blood lead testing of all children ages 12-36 months (Council on Environmental Health, 2016). However, funding for universal testing and associated testing procedures does not exist. In this project, I sought to establish clinical practice guidelines for incorporation within the LHD to standardize blood lead testing procedures. The practice-focused question that guided this process was the following: Does evidence support the development of a process and/or guideline that will lead to future consistent blood lead testing procedures within the LHD? Established LHD practices were observed, analyzed, and evaluated. I identified gaps in LHD practices, identified barriers to testing, and identified standards of practice to be used when testing children not enrolled in Medicaid health coverage.

Educational training for the LHD staff related to updated collection procedures may promote increased individual knowledge and the sustainability of EBP integrated procedures. Research has shown an increase in the number of children receiving blood lead testing as a result of education of providers (Polivka et al., 2009). Education related

to the project included information related to lead poisoning prevention, blood lead testing, lead toxicity, and case management of lead-toxic children.

In Section 2, I describe the concepts, models, and theories incorporated in the DNP project. The relevance of blood lead testing to nursing practice is presented, as well as relevance to the LHD and its coverage area. Finally, I describe my role as the DNP student and the DNP project team's role in this project.

Frameworks of Use

The term *diffusion* was defined by Rogers (2003) as the communication of new ideas and interventions through the participants of a specified population. The diffusion of innovations (DOI) theory was used throughout the development of this DNP project. The DOI theory was designed by Rogers to identify and explain how innovations are accepted and used within an identified population (Robinson, 2009). Elements relating to the behavior of the diffusion of information throughout a population include the relative advantage, compatibility, complexity, trialability, and observability of the proposed activity (Sanson-Fisher, 2004). In the current DNP project, the relative advantage was the degree to which LHD staff perceived an EBP testing guideline as better than previously used practices. Compatibility was to the level of compatibility between the beliefs and previous experiences of staff members and the adoption potential of the proposed testing procedure. To have an increased potential for adoption, staff members must address an issue that is perceived as a current problem in practice (Sanson-Fisher, 2004).

The complexity of the project related to the staff members' ability to understand and use the clinical procedure. If the procedure is difficult to understand or implement,

the potential for sustainable use is greatly diminished (Hodges & Videto, 2011). The next element crucial to the DOI theory is the trialability of an innovation. Rogers (2003) described trialability of an innovation as the ability of a new idea to be experimented with on a partial basis. The approach of a partial adoption allows for participants who are uncertain of a complete practice adoption to learn more about the intervention and offer feedback throughout the process. The final characteristic associated with the DOI theory is the observability of the intervention. Observability refers to the degree of visibility of the innovation's results to participants of the population; the higher the observability of the results, the higher the likelihood of innovation adoption (Rogers, 2003).

Because the LHD is a jurisdiction, consistency between the six counties is difficult to achieve. Employing the DOI theory provided me and the DNP project team with a framework to share the project innovations throughout the LHD jurisdiction. I determined that the DOI approach would assist in the identification of change leaders and engagement of staff members who may be reluctant to change. The DOI classifies the speed and order of adopters of innovations into five categories: innovators, early adopters, early majority, late majority, and laggards (Kaminski, 2011). According to Kaminski (2011), innovators require the shortest amount of time and account for 2.5% of adopters of innovation, while early adopters (13.5%) are respected opinion leaders and role models within a population. The early majority (34%) are agreeable to innovations as productivity is enhanced; the late majority (34%) are conservative, cautious, and frequently respond to the pressure of their peers to conform; and the laggards (16%) are reluctant and suspicious of change and prefer to maintain the status quo (Kaminski,

2011). Knowing the different categories of population participants assisted me in streamlining project innovations to meet the needs of staff members within each category.

The RE-AIM (2018) framework can be used to assist in the translation of research into practice and planning of projects to increase the success rate of adoption when placed into practice. There are five steps of translating evidence into action using the RE-AIM approach. The steps include the reach of the population, effectiveness of the project, adoption of the innovation by the target population, implementation, and maintenance of the innovation (RE-AIM, 2018). The RE-AIM framework can be used in both the designing and planning of programs as well as evaluation of the innovations. For the current DNP project, RE-AIM was used throughout the designing and planning process while another tool, the Appraisal of Guidelines for Research and Evaluation II instrument was used for evaluation purposes. While incorporating the steps of the RE-AIM framework, I was guided toward identifying essential project details that would increase the rate of adoption, effectiveness, sustainability, and generalizability of the project.

Concerning the LHD, the reach aspect of the RE-AIM framework included the clinical nursing staff and the procedural steps identified to promote engagement with nursing staff regarding the DNP project. Efficacy was determined through analysis of the innovation outcomes, while adoption addressed those within the LHD participating in the interventions. Implementation of the RE-AIM framework focused on ensuring consistent and proper delivery of program interventions. Finally, maintenance of the program was

determined by the extent to which the innovations were implemented throughout the LHD.

The implementation of a clinical practice guideline may result in a benefit to patient care when quality guidelines are used. It was imperative for me to use a standardized framework of evaluation to determine the quality of innovations. Analysis of the project was completed using the Appraisal of Guidelines for Research and Evaluation (AGREE II) instrument of evaluation. The AGREE II instrument is a 23-item tool that encompasses the analysis of six domains of quality (Brouwers et al., 2010). Each of the six domains includes exclusive quality measures for the developed clinical guideline. The AGREE II instrument provides the guidance necessary to conduct a thorough evaluation of the developed practice guidelines and the quality of reporting that has been identified (Brouwers et al., 2010). Included for use with the AGREE II instrument was a user's manual, which provided guidance to progress through the evaluation process with an improved level of confidence.

Definitions of Terms

Throughout this doctoral project, specific terms were used interchangeably or required a more precise definition. This section includes those definitions.

Blood lead screening: The process of completing a lead hazard questionnaire with a child's guardian (American Academy of Pediatrics, 2017).

Blood lead testing: The obtainment of a capillary or venous blood sample to assess for lead toxicity (American Academy of Pediatrics, 2017).

Parent and guardian: Terms used interchangeably in reference to the adult legally responsible for the medical care of a child (State Bar of Michigan, 2017).

Preschool-aged child: Children 3-5 years of age (CDC, 2017c).

Relevance to Nursing Practice

At the time of the study, no level of blood lead had been determined to be safe (CDC, 2017b). For that reason, children should receive the recommended blood lead testing at 12 and 24 months of age (CDC, 2015). However, more than 500,000 children between 1 and 5 years of age in the United States are living with elevated blood lead levels (Winslow, 2016). Blood lead testing is a clinical practice that needs increased awareness and understanding to combat the potential for damage to the brain and central nervous system of children who have been exposed to lead in their environments (Nicholson & Cleeton, 2016). One LHD nurse I spoke with regarded blood lead testing as an easy process that is postponed to another visit when appointment times are behind or, "if the family is unsure, I just skip it because I don't have time to wait for them to make up their minds" (personal communication, December 6, 2017). Through development of an evidence-based clinical practice guideline, training, and education, the LHD nurses will have the tools necessary to provide optimal preventive care to children in their clinics. An evidence-based guideline may serve children throughout their lives by early identification of lead toxicity.

Unless there is an identified risk for exposure, blood lead testing is a procedure that is most often completed during preventive health care visits (CDC, 2012). It is during these well-child appointments that children also receive immunizations and hemoglobin

testing. Parents may be reluctant to have their child receive an additional test due to the associated pain or may believe that the child previously received blood lead testing when testing did not occur. Polivka, Salesberry, Casavant, Chaudry, and Bush (2006) found that among 532 parents surveyed, 56% reported that their child had received testing, but only 56% of those children could be confirmed as tested through Medicaid billing claims and blood lead laboratory data. This finding demonstrated the lack of understanding on behalf of parents and the lack of testing completed during childhood medical appointments.

Another demonstration of testing need was found in Dignam et al.'s (2004) study of blood lead testing in targeted, high-risk neighborhoods in Chicago. This study revealed that, although the area of testing was deemed as high-risk for lead exposure for children living there, 61% of the 539 children tested had never been previously tested, and 27% of those tested revealed toxic lead levels (Dignam et al., 2004). Choate and Polivka (2000) found that provider knowledge regarding blood lead testing was limited and primarily focused on children with Medicaid coverage or those who were perceived to be at increased risk of lead exposure. Polivka et al. (2009) found a 27% increase in blood lead testing rates among children whose health care provider had received training on blood lead toxicity prevention. The provider education program was the Pediatric Lead Assessment Network Education Training (PLANET), and was a 1-hour, peer-to-peer training that occurred between 2001 and 2006 (Polivka et al., 2009). Awareness and education of parents and healthcare providers regarding blood lead toxiciry are critical factors for increasing the rate of testing and identification of lead-burdened children

(Polivka et al., 2006; Polivka et al., 2009) . Enhanced education on the topic may complement efficient and increased testing within the LHD.

There was limited research available regarding the blood lead testing of children. Multiple searches of scholarly databases revealed limited nursing-specific information from more than 10 years ago and even fewer from the last 10 years. Polivka (2006) sought to identify strategies for use to increase lead-poisoning awareness through public health departments, but since that time, additional research has not been done.

Each U.S. state has specific lead poisoning prevention statutes; however, the statutes are not consistent. The State of Michigan maintains laws regarding lead-based paint, testing of children enrolled in WIC, a lead abatement program, a Childhood Lead Poisoning Prevention Commission, and a Lead in Products Act (Farquhar, 2010). Although these statutes are in place, compliance with the guidelines has been shown to be deficient (Kemper & Clark, 2005). Kemper and Clark (2005) conducted a random survey of primary-care pediatricians in Michigan and found that, although physicians were aware of Medicaid testing requirements, 76% reported not routinely performing blood lead testing. This reflects poor preventive health care practice and indicates an area in which nurses can advocate for more patient testing.

Although the CDC has encouraged the use of standing orders for blood lead testing, implementation is left to the discretion of each state (CDC, 2012). The State of Michigan has standing orders in place for the collection of blood lead specimens. Within the LHD, standing orders for blood lead testing were in place with the expectation that each child 12 to 24 months of age was to receive testing. However, standing orders are

not always updated, included in the care of each child, or performed consistently throughout an organization. For example, the laboratory collection procedures of the State of Michigan are dated as December 2010 and include guidance to conduct a diagnostic venous blood collection for all lead levels ≥ 10 mcg/dL (MDHHS, 2018b). A blood lead level ≥ 5mcg/dL is required to receive a diagnostic venous collection via national standards of practice (CDC, 2017b).

Development of the DNP project provided a clinical practice guideline to offer knowledge and skill training to the nursing staff. Education of nursing staff has been shown to increase the rates of blood lead testing overall and case management services for lead burdened children (Polivka et al., 2009). In addition to promoting improved health for the local community, the project also introduced the incorporation of EBP into an organization that has not historically employed EBP with regard to blood lead testing. Through project analysis and evaluation, barriers and efficiencies were identified to improve patient care within the LHD. The identification of just one child with an elevated blood lead level has potential to advance nursing practice within the organization and bridge a gap in practice.

The organization that participated with the DNP project is a six-county jurisdictional health department. In 2015, the LHD was responsible for a resident population of 188,632; within in the total population, 3,902 were children, aged 12-24 months (Kidscountdata.org, 2018). According to the Kids Count Data Center (2018), 1,608 (41.2%) of the children aged 12-24 months residing within the LHD jurisdiction received a blood lead test in 2015. The mission statement of the LHD refers to the

promotion of health and well-being through the provision of preventative health care, education, and environmental safety. Blood lead testing is an area of service that has not meeting the minimum expectations set forth by national recommendations nor the agency's mission of care.

Role of the DNP Student

As a nurse, I have previously worked within a public health department. I have conducted blood lead testing, follow-up testing, education to families, and case management of lead-burdened children. Each time I was involved in an elevated lead level case, I realized there was a lack of consistency and minimal guidance for providing families with current information. It was not until I began the DNP journey that I understood the lack of EBP utilization within my previous place of public health employment. LHD staffing is limited, and resources are minimal (Citizen's Research Council of Michigan, 2018); the quest to discover new information is often pushed to the bottom of the list of tasks to complete.

In 2010, I worked with the parents of 18 and 36-month old children who were severely lead burdened. The parent's blood test results also revealed elevated lead levels. Both children required inpatient chelation therapy. There was no organizational education or policy in place to guide my care of this family. I sought resources from surrounding LHD's without success. I turned to resources through the State of Michigan and received guidance regarding case management but received limited assistance to identify resources available to abate the lead contamination from the family's dwelling. At the time, I

provided the best care that I was capable of to this family, but I realized more resources needed to be available for use by public health nurses.

Looking back on the developmental delays and behavioral issues displayed by the two lead-burdened children fuels my desire to improve blood testing procedures. At the time of diagnosis, both children were enrolled in Medicaid coverage and attended the WIC clinic within the LHD that I worked for, but neither of them had received blood lead testing. Testing did not occur until the parents enrolled the 36-month old into a Head Start program, where testing is a federal mandate for registration. When the elder child's lead level was determined to be elevated, the younger child was tested with similar results. Tragically, these children are living examples of inconsistently administered preventative care. I intend to decrease this gap in practice. Conducting the DNP project and developing a clinical practice guideline with EBP regarding education and lead testing serves as a starting point toward consistent integration of EBP throughout the LHD.

Role of the Project Team

A project team was established for the development of the DNP project. Involvement of stakeholders is crucial to the success of any program through the establishment of their requirements and expectations during the planning process (White et al., 2016). For this project, the team consisted of two public health nurses, a nurse manager responsible for coordination of the lead testing program within the agency, and me. Team members assisted me in the development of implementation strategies and identification of potential barriers to success. The project team met face-to-face to share

background information and EBP regarding blood lead testing. Each LHD member of the project team had previous experience with blood lead testing and follow-up care associated with elevated results. The project team agreed to collaborate on a bi-weekly basis to discuss program planning, implementation status, and evaluation of the project.

Summary

As the LHD provided preventative care to residents throughout the jurisdiction, the incorporation of education and EBP into blood lead testing procedures were not evident. Of concern related to this DNP project was the inconsistency of procedures used when testing pre-school aged children for blood lead toxicity. The project utilized the diffusion of innovations theory to observe the communication and acceptance process of the project throughout the LHD to combat the noted inconsistencies and inefficiencies. The RE-AIM framework provided guidance to promote the translation of research into practice and the AGREE II instrument was enlisted to evaluate the quality and effectiveness of the implemented strategies. Finally, a project team of seasoned public health nurses was assembled to guide project development and identify barriers that may have had a negative impact on the project outcome. Each of these strategies assisted in decreasing identified gaps in practice.

Section 3: Methodology

A local health department (LHD) that lacked evidence-based practice (EBP) regarding blood lead testing procedures was the site of this project. The LHD had adopted guidelines for testing provided by the Michigan Department of Health and Human Services (MDHHS). The MDHHS (2017b) guidelines require all children enrolled in Medicaid coverage and/or the Women, Infants, and Children (WIC) supplemental food program to be tested at 12 and 24 months of age. Although not all entities support universal lead screening of children, the Centers for Disease Control and Prevention (CDC) and American Academy of Pediatrics have advocated for universal blood lead testing of children (Council on Environmental Health, 2016).

Existing lead testing practices used by the LHD were observed, analyzed, and evaluated to identify potential barriers to testing and deficiencies in LHD practices. The practice-focused question that guided the DNP project was the following: Does evidence support the development of a process and/or guideline that will lead to future consistent blood lead testing procedures within the LHD? I sought to create a clinical practice guideline to be incorporated into the LHD processes and standardize testing procedures. The incorporation of a clinical practice guideline was intended to expand the knowledge base of clinical nursing staff regarding blood lead toxicity, increase the efficiency of testing procedures, and increase the number of children tested for blood lead exposure.

Rogers's diffusion of innovations (DOI) theory was used throughout the project to encourage staff engagement and knowledge of the project status. In addition to the DOI, the RE-AIM framework was incorporated to translate identified research into practice

and planning of project implementation. The inclusion of the DOI and the RE-AIM framework will assist in the successful adoption of interventions (RE-AIM, 2018; Rogers, 2003).

Analysis of the project was completed through the use of the Appraisal of Guidelines for Research and Evaluation (AGREE) instrument. The AGREE II instrument is a 23-item tool used analyze six domains of quality (Brouwers et al., 2010). This tool was of significant value to me as a novice evaluator. Analysis of information gained from the AGREE II instrument was critical to advancing the practices within the LHD and increasing the opportunity for early identification of children living with the burden of lead.

In Section 3, I describe sources of evidence that were used during the development and analysis of the DNP project and steps that were taken to ensure the ethical protection of project participants. Presentation of published findings and conclusions from previous researchers are shared as well as an overview of data that were collected. In addition, I describe the plans for analysis of retrieved information.

Clarification of Operational Definitions

The following section provides guidance and clarification of terms used throughout the project:

Blood lead screening: The process of completing a lead hazard questionnaire with a child's guardian (American Academy of Pediatrics, 2017).

Blood lead testing: Obtainment of a capillary or venous blood sample to assess for lead toxicity (American Academy of Pediatrics, 2017).

Parent and guardian: Terms used interchangeably in reference to the adult legally responsible for the medical care of a child (State Bar of Michigan, 2017).

Preschool-aged child: A child 3-5 years of age (CDC, 2017c).

Sources of Evidence

Nurses cannot provide quality patient care based solely on clinical experience (White et al., 2016). Evidence-based, scholarly resources must be used to ensure that safe, effective, and efficient care is delivered with each patient interaction. In the current project, multiple resources were used to guide the research associated with the practice-focused question. At the site of the project, the electronic database of the LHD provided procedures used and aggregate data specific to services offered within the organization. Patient-specific data were not retrieved.

The CDC, MDHHS, U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality, and the American Public Health Association provided evidence on blood lead testing procedures, hazards associated with not using evidence-based practices, and data necessary to answer the practice-focused question. MDHHS information was specific to Michigan, while the other resources offered information that was applicable on a broader scale. Each of these resources is readily available to the LHD nursing staff; however, at the time of the project, there was no emphasis on EBP inclusion within the LHD.

Assembling material from the sources allowed me to collect evidence to answer the practice-focused question and develop a clinical practice guideline for the LHD. The Institute of Medicine (2011) defined clinical practice guidelines as “statements that

include recommendations intended to optimize patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options" (p. 1). Development of a clinical practice guideline that is efficient and improves patient care requires the review and incorporation of previously established evidence.

Published Outcomes and Research

A systematic review of literature included a comprehensive search of research and critical appraisal of published studies. The strength, consistency, and quality of retrieved literature are identified through critical appraisal (White et al., 2014). I conducted a systematic review of literature to identify evidence to address the project question.

The Walden University library served as the primary source for retrieving scholarly information. Zotero reference management software was employed to maintain an orderly system for document retrieval. Databases and search engines used to identify information essential to determining the outcomes of the practice-focused question included the following:

- Cumulative Index to Nursing & Allied Health Literature (CINAHL)
- Medical Literature Analysis and Retrieval System Online (MEDLINE)
- Ovid Nursing Journal
- Cochrane Database of Systematic Reviews
- ProQuest Nursing & Allied Health Source

The following key words were used in the database searches: *blood lead, blood lead testing, blood lead screening, lead toxicity, blood lead toxicity, blood lead*

guidelines, and *blood lead procedures*. Searches for nursing-specific research on blood lead testing were limited to studies published within the last 10 years. White et al. (2014) noted that clinical implementation of research findings frequently takes up to 17 years or longer. The initial timeframe for research review was 20 years, but given the limited information, the timeframe was expanded to 25 years, including the publication years of 1993 to 2018.

Exhaustive literature reviews are comprehensive and include any topic-related information (Terry, 2015). Multiple databases and search engines were used to retrieve information relevant to the blood lead testing of preschool-aged children. I assumed that all pertinent and available resources were reviewed.

Evidence Generated for the Doctoral Project

After developing the clinical practice guideline, I invited experts in the field of public health nursing and blood lead testing to evaluate the guideline. Ten experts were invited via the letter of participation (see Appendix A) with a goal of recruiting five participants. Prospective participants met the criteria of having (a) worked in the health department for a minimum of 2 years, (b) regularly conducted blood lead testing on children, and (c) had experience in case management processes of elevated blood lead level results. The age range of invited expert panel members was 30 to 65 years. All races and genders were invited to participate. Participants were not members of the DNP project team.

The developed clinical practice guideline was shared with the invited experts. The AGREE II instrument was used to guide evaluations of the clinical practice guideline.

The invited expert panel was provided with a copy of the AGREE II instrument for completion (see Appendix B). A copy of the AGREE II user's manual was also provided to the invited expert panel for reference during the review process. The AGREE II instrument was used to assess the quality of the guideline, ensure that potential biases had been addressed, confirm that recommendations were internally and externally valid, and determine that the guideline was feasible for use in practice (see Brouwers et al., 2010).

Expert comments and timely return of the completed AGREE II instrument tool were requested. Consent was recognized through the contributions received from the invited participants. Five responses to the letter of participation were received. Confidentiality of the expert panelists' identities was always maintained.

Responses received from the expert panel via the AGREE II instrument were analyzed to discern the strengths and weaknesses of the proposed clinical practice guideline. The project team assisted in the appraisal of the responses to increase the reliability of the assessment. Following the analysis process, I incorporated recommended changes identified by the expert panelists to prepare the practice guideline for dissemination to LHD administrators.

Protections

The project team was engaged in the project. In addition, the diffusion of innovation (DOI) theory was used to identify change leaders and staff members who would potentially be reluctant to embrace change. The DOI theory is used to identify how a presented innovation is accepted and applied within an observed population (Robinson, 2009). The people who will be most impacted by a change process must be informed and

included for outcomes to be successful (Hodges & Videto, 2011); in this case, it was necessary for the clinical nursing staff to be aware of the DNP project.

Support from the agency's nursing administration was crucial to the success of the project. To have changes successfully implemented throughout an organization, management must agree with the proposal. Nursing administration received project status updates throughout the process. A member of the project team was also a nurse manager; inclusion of a manager on the team increased transparency of the project.

The names of participants and the LHD were not revealed during the project. Expert panel participants were provided with the Walden University Disclosure To Expert Panelist Form For Anonymous Questionnaires (see Appendix C) before reviewing the developed practice guideline and completing the AGREE II instrument. Expert participants were provided a hard copy of the developed guideline, the AGREE II instrument and user's manual, and a postage-paid envelope to return the completed tool to me anonymously. According to Terry (2015), the Code of Federal Regulations does not require written consent for surveys that are not collecting information that identifies the participant or damages the reputation of a participant.

Prior to initiation of the project, I obtained approval of the Walden University institutional review board (IRB) (IRB approval 10-22-18-0493273). The role of an IRB is to identify the necessary components of a project proposal before approval of the project (O'Sullivan, Rassel, Berner, & Taliaferro, 2017). Elements to be identified by the IRB include the following:

- identified risks to humans as minimal,

- unbiased selection of participants,
- documentation of participants' informed consent,
- appropriate monitoring of collected data for the safety of participants, and
- provision of safeguarding the privacy of participants and the confidentiality of data obtained (O'Sullivan et al., 2017).

Following receipt of IRB approval, I implemented the project.

Analysis of data obtained from the participant evaluation tools is necessary so conclusions regarding content can be derived and project implications for the agency identified (Terry, 2015). Analysis of survey data was facilitated by the project team. The 23 questions of the AGREE II instrument were rated by reviewers on a continuum ranging from *strongly agree* to *strongly disagree* (see White et al., 2016). A numerical score was associated with each answer represented in a range of 1 (strongly disagree) to 7 (strongly agree). Submitted scores were then standardized through comparison of scores obtained against the maximum possible score. The final analysis of submissions was used to formulate a conclusion and incorporate recommendations of the expert panel regarding the guideline's use.

Summary

Blood lead toxicity can lead to long-term, debilitating health effects for children (CDC, 2017b). Early identification of lead toxicity can prevent associated health risks; however, without a valid testing procedure, lead-burdened children may not be identified (CDC, 2017b). The DNP project site did not employ EBP while developing its testing procedures. By examining information retrieved through a review of the literature,

conducting a survey evaluating the beliefs and attitudes of the nursing staff, and analyzing data relevant to the project, I sought to develop a clinical practice guideline that would be implemented in the LHD. Following approval of the Walden University IRB, I developed the clinical practice guideline, facilitated evaluation of the guideline by an expert panel, and prepared the final practice guideline for dissemination to the health department administrative team. Implementation of the developed guideline may facilitate consistent, evidence-based practice in patient care and promote positive social change through early identification of lead-burdened children.

Section 4: Findings and Recommendations

A local health department (LHD) did not consistently incorporate evidence-based practices (EBP) into the organization's procedural guidelines. The LHD lacked EBP in local blood lead testing procedures. The Michigan Department of Health and Human Services (MDHHS) guidelines for age testing categories were incorporated into the LHD procedure; however, consistent implementation of testing throughout the agency was not occurring. Employee interpretation and application of established procedures were not reliable, resulting in the potential for children to not receive appropriate blood lead screening. The practice-focused question guiding the project was the following: Does evidence support the development of a process and/or guideline that will guide future consistent blood lead testing procedures within the LHD? The question guided analysis of existing practices to identify gaps in practice and support the development of a clinical practice guideline aimed at decreasing inconsistency of blood lead testing in the LHD.

Sources of evidence that were used during analysis of established LHD practices included LHD policies and procedures, collaborative meetings with the DNP project team, MDHHS guidelines, and recommendations of the Centers for Disease Control and Prevention (CDC). I conducted in-person meetings and e-mail correspondence with the DNP project team to discuss the evidence and current LHD practices. Blood lead testing evidence retrieved from the U.S. Department of Health and Human Services, the Agency for Healthcare Research and Quality, the American Academy of Pediatrics, and the American Public Health Association was used throughout the analysis process.

Exhaustive literature reviews were conducted to identify information related to the blood lead testing of preschool-aged children. Evidence was appraised in collaboration with the DNP project team incorporating the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system. The GRADE system offers a systematic means of evaluating the quality of retrieved evidence and development of the strength of a recommendation (GRADE Working Group, 2018). The GRADE system facilitated communication between DNP project team members during consideration of the retrieved evidence. The developed clinical practice guideline was evaluated by an expert panel using the AGREE II instrument. The expert panel analysis indicated that the information contained in the clinical practice guideline was thorough, evidence based, and appropriate for the intended audience.

Findings and Implications

The LHD has had a blood lead testing procedure in place for an extended period. However, the policy did not include EBP or receive consistent administration throughout the jurisdiction. I sought to advance established practices of the LHD through the development of a clinical practice guideline (CPG). The CPG offers a comprehensive, systematic, evidence-based approach to blood lead testing to promote patient-centered care. Section 4 includes a discussion of findings revealed during the analysis of evidence.

Michigan offers blood lead information on a state-facilitated website; however, the information is limited. This website had been the primary reference for the LHD. The DNP project team was unaware of the Michigan Childhood Lead Poisoning and Prevention Program website, which offers specific guidelines for the state of Michigan

and case management steps. Discovery of this information was essential to the project development process.

Testing Guidelines

On a national, state, and local level, the recommended age parameters of testing were consistent. Guidelines to test children at 12 and 24 months of age were noted within the LHD procedures and Medicaid guidelines (see Centers for Medicare & Medicaid Services, 2018; MDHHS, 2017a). The guideline of testing a child aged 24 to 72 months who had not been previously tested for blood lead was also consistent throughout all sources.

An area of inconsistency within the testing categories was noted regarding children who are enrolled in Medicaid and those who do not receive Medicaid coverage. Michigan law states that any child participating in the WIC supplemental food program is required to receive lead testing (Michigan Legislature, 2018); however, the law also states that federal funds provided to administer the WIC program are not to be used for blood lead testing. Michigan WIC policy states that children enrolled in the program are to be assessed for a history of blood lead testing and then referred elsewhere for testing as needed (State of Michigan, 2018c). WIC programs are not mandated to perform the blood lead screening within the clinic site.

Although Michigan law requires children enrolled in WIC to be tested for lead, the LHD does not test all children. Any child enrolled in Medicaid is eligible to receive testing at the LHD. Children without Medicaid coverage are tested only if the guardian agrees to pay directly for the service or if private insurance coverage will cover the cost

of the test. Michigan does not require universal testing of children; therefore, the number of private insurance companies that cover costs associated with blood lead testing is not all-inclusive. Children without medical coverage or the ability to pay are referred to identify a private provider willing to conduct the testing.

Risk Assessment Screening

Although it is the current standard of care to perform a risk assessment questionnaire in clinical settings to determine the potential for lead exposure, these questionnaires have been shown to be ineffective at identifying children with a higher risk of lead exposure. France, Glitterman, Melinkovich, and Wright (1996) measured the results of venous blood lead levels against answers received by clinicians on the lead screening questionnaire. Throughout the study, venous level results of < 10 mcg/dL, $\geq$ 10 to < 20 mcg/dL, and $\geq$ 20 mcg/dL had a positive predictive value of the questionnaire of 57%, 51%, and 3% respectively (France et al., 1996). Similarly, a study in Florida indicated that the risk assessment questionnaire had a sensitivity of 26.3% and a specificity of 72.2% in predicting blood lead levels greater than 2 mcg/dL (Nicholson & Cleeton, 2016). Nicholson and Cleeton (2016) concluded that the risk assessment questionnaire is not a useful tool in identifying children at greater risk for lead exposure. A systematic review of lead screening questionnaires by Ossiander (2013) indicated that "lead screening questionnaires showed a wide range of sensitivity and specificity and performed little better than chance at predicting lead poisoning risk among children" (p. e21).

Numerous studies have indicated a lack of reliability in the use of lead screening questionnaires and the ability to predict elevated blood lead levels. The LHD uses a questionnaire fashioned after the Michigan Childhood Lead Poisoning and Prevention Program (CLPPP) questionnaire, but it is not a verbatim copy of the document. The screening questions specific to the MDHSS CLPPP questionnaire are listed in Table 1. An area of concern is the lack of an option for "unsure" on the LHD's questionnaire. Including the option of "unsure" would provide caregivers the opportunity to initiate discussions related to the question. Also, the child's guardian completes the risk assessment on paper without interacting with the nursing staff. Without a verbal completion of the risk assessment, there is no opportunity for the guardian to ask questions or for the caregiver to assess whether the guardian can read and understand the questions.

The Michigan CLPPP includes guidance for the risk assessment questionnaire stating that if all the questions are answered "no," the child is likely not at risk for lead poisoning; if any questions are answered "yes" or "unsure," the caregiver should consider testing (MDHHS, 2017c). As previously noted, the effectiveness of the risk assessment is questionable. Children who have an environmental exposure to lead that is not addressed in the questionnaire are left vulnerable to not being identified as lead burdened. Although research has shown a higher rate of lead toxicity in children living in lower socioeconomic situations, members of minority groups, recent immigrants, or children living in older homes (CDC, 2015), these are not the only situations in which a child could be exposed to lead and that would warrant a screening test.

Table 1

Blood Lead Risk Assessment Questionnaire

Pediatric Screening Questions	Yes	No	Unsure
1. Does the child currently live in a home built before 1950 or have they lived in a home built before 1950 in the recent past? Do they spend time at or often visit a home built before 1950?			
2. Does the child currently live in a home built before 1978 that was recently remodeled? Have they lived in or often visited a home built before 1978 that was recently remodeled?			
3. Does the child have a brother, sister, or playmate with lead poisoning?			
4. Does the child live with an adult whose job or hobby involves lead?			
5. Does the child's caregiver use home remedies that may contain lead?			
6. Is the child included in a special population group such as foreign adoptee, refugee, migrant, or foster child?			

Note. Adapted from Michigan Department of Health & Human Services (2017c).

Area Housing

Guidelines associated with blood lead screening for children are closely tied to the socioeconomic status of the child's family. The screening questionnaire for blood lead testing places emphasis on children living in or frequently visiting houses built before 1978 or those that were recently remodeled (MDHHS, 2017a). Within the LHD jurisdiction, the U.S. Department of Commerce (n.d.) estimated 55.4% of the homes were built prior to 1979 (see Table 2). The state of Michigan has not identified the individual counties of the LHD as being at increased risk of lead exposure based on the percentage of children tested and the number of elevated results; however, it is not clear whether the lack of identification of high-risk counties is related to the number of children residing in

the county who have not been previously tested. As previously noted, 41.8% of children ages 1-2 years living in the LHD were tested for blood lead (MDHHS, 2017c).

Table 2

Housing Units Within the Local Health Department

Age of housing units	Number of units
Units built prior to 1979	64,843
Total number of housing units	117,048
Percent built prior to 1979	55.4%

Note. Adapted from Michigan Department of Health & Human Services (2017b).

Training

Blood lead specimen collection has a high potential for contamination if proper steps are not followed (MDHHS, 2018b). Meticulous cleansing of the collection site and proper technique are essential to avoid potential contamination (MDHHS, 2018b). Both the CDC and MDHHS provide an opportunity for training related to blood lead testing. The MDHHS (2010) has a written collection procedure that is accessible online. The CDC (2004) also provided a thorough training video displaying proper technique; although the video is older, it remains within the current CDC collection of blood lead guidelines. However, this video does not provide specific steps in the use of the point-of-care analyzer; the video is specific to the collection of samples that are transferred to a laboratory for capillary result testing.

Both the CDC and MDHHS refer health care providers using a point-of-care blood analyzer to the manufacturer's website, Magellan Diagnostics, for further instruction. The LHD included the website address to the manufacturer's website in

existing blood lead testing procedures; however, there was no documentation of training recorded for individual nurses and no indication of individualized training.

Magellan Diagnostics offers a free web-based certification course for the point-of-care analyzer used at the LHD. Completion of this course is not required or encouraged through the LHD. The course offers information regarding analyzer setup, completing quality control checks, sample collection, sample preparation, and cleaning procedures related to the analyzer (Meridian Bioscience, 2018).

The American Academy of Pediatrics (AAP, 2013) Principles of Lead Screening do not provide a step-by-step process of correct collection procedures. The AAP does offer guidance that the testing site should be clean and that false positives are common, thereby encouraging an elevated capillary result to be followed with venous testing.

The state of Michigan does not offer training associated with the point-of-care analyzers because this is a Clinical Laboratory Improvement Amendments (CLIA) waived process, and CLIA is a federal program (State of Michigan, 2018b). CLIA-waived tests are laboratory processes that can be performed in sites possessing a valid CLIA certification, that have a history of good laboratory practices, and that are to perform an identified test (i.e. blood lead testing) on clinical specimens in a situation that is reliable, timely, and at low risk of producing inaccurate results (State of Michigan, 2018b).

Level of Results

A consistent result of $\geq$ 5 mcg/dL was noted to be considered an elevated blood lead level within LHD current procedures and governing bodies (CDC, 2018; MDHHS,

2018a). Of significant note, is that the MDHHS Epidemiology and Population Health policy regarding blood lead test results defines an elevated blood lead result as any test result of 4.5 mcg/dL or higher for children under 6 years of age (MDHHS, 2018). The MDHHS (2018) policy discusses a previous database management system that was only able to store blood lead results rounded to the nearest whole number; therefore, test results of 4.5 to 4.9 mcg/dL were rounded to 5 mcg/dL and considered to be elevated. The database within the Michigan Childhood Lead Poisoning and Prevention Program (CLPPP) was updated in 2017 and is now capable of storing unrounded numbers (State of Michigan, 2018a). As a result of this database upgrade, MDHHS CLPPP considers any test result 4.5 mcg/dL or higher to indicate an elevated blood lead level in children under six years of age (MDHHS, 2018).

The rounding of blood lead results was found to be an inconsistency when reporting elevated levels within the LHD. The LHD utilizes a point-of-care testing machine that records results to a tenth of a whole number. The established LHD policies refer to an elevated level as $\geq$ 5 mcg/dL and the policies do not include instructions for nursing staff to round results of 4.5 to 4.9 mcg/dL to 5.0 mcg/dL. An example of potential consequences related to this discrepancy is a result of 4.8 mcg/dL may not be reported as an elevated result, leading to prolonged exposure and noteworthy ramifications. For a child tested at 12 months of age with results recorded as not elevated, the child will not be tested again for a minimum of 12 months. If the child is 24 months of age or older and tested with a non-elevated recorded result, the child may never be tested again, and lead may continue to be a burden until identified.

Confirmatory Testing

The American Academy of Pediatrics notes that lead screening is most often performed by utilizing a capillary specimen (2013). Testing of a capillary sample can be completed with the use of filter paper, at a laboratory using an EDTA (ethylenediamine tetraacetic acid) tube and specimen container, or with a point-of-care lead analyzer. Testing with a capillary specimen increases the risk of environmental contamination; therefore, when a capillary specimen reveals an elevated result, a confirmatory venous sample should be obtained (AAP, 2013) . It is within the retesting guidelines that inconsistencies have been noted between the federal and state guidelines. The LHD uses the guidelines set forth by the Michigan CLPPP.

The differences between the retesting recommendations can be noted in Tables 3 and 4. Considerable differences lie within the retesting of children who have a blood lead level of 10 mcg/dL or higher. As noted in Tables 3 and 4, the CDC (2018) encourages a more rapid than the MDHHS (2017a) response to children with levels at 10-44 mcg/dL and those with a level of $\geq$ 60 mcg/dL. The longer a child is burdened with the lead, the more significant the potential for long-term, damaging effects (CDC, 2017b). Although 48 hours may not appear as a significant difference for retesting, there is no known safe level of lead exposure and time is critical (CDC, 2017b). This is another area of blood lead testing inconsistency to be addressed.

Table 3

CDC Recommendations for Obtaining a Confirmatory Venous Sample

Blood lead level	Time to confirmation testing
< 5-9 mcg/dL	1-3 months
10-44 mcg/dL	1 week-1month*
45-59 mcg/dL	48 hours
60-69 mcg/dL	24 hours
≥70 mcg/dL	Urgently as an emergency test

*The higher the capillary test result, the more urgent the need for confirmatory venous testing.

Note. Adapted from the Centers for Disease Control and Prevention (2018).

Table 4

Michigan CLPPP Recommendations for Obtaining a Confirmatory Venous Sample

Blood lead level	Time to confirmation testing
5-14 mcg/dL	1-3 months
15-44 mcg/dL	Within 4 weeks
45+ mcg/dL	Within 48 hours

Note. Adapted from Michigan Department of Health & Human Services (2017a).

Documentation

Documentation of blood lead testing within the LHD involves multiple processes. Clerical staff collect and complete patient information necessary for admission to the clinic; this is a combination of paper and electronic records. Nursing staff assess the patient record within the Michigan Care Improvement Registry (MCIR), the Michigan statewide health database (MCIR, 2018). The Healthy Homes and Lead Prevention Program Surveillance System (HHLPSS) transfers records of all blood lead results completed in the State of Michigan into the MCIR system for access by medical care providers (MDHHS, 2017b). Once the patient meets with the nurse, a determination of

whether a blood lead test will take place is based upon the patient's age, insurance coverage, prior testing, answers to the screening questionnaire, and consent from the guardian. If a decision to obtain a test is made, the nurse and guardian sign the agency's consent form and the process begins. The LHD utilizes a point-of-care blood lead analyzer for test completion. Once the sample is obtained, the nurse records the patient's information on the clinic testing log to include date, patient name, result of the test, initials of the nurse, and whether the test will be billed to Medicaid or another source. The clinic testing log is faxed daily to an agency clerical staff that collects all testing logs for the jurisdiction and reports testing activity to the HHLPSS system on a weekly basis.

The nurses must also record the patient's name on a separate agency laboratory log and indicate a blood lead test was conducted. For patients enrolled in WIC, the nurse must also record the results within the WIC electronic record. The LHD's electronic medical record is a distinct system from WIC, and therefore requires additional documentation of the patient data to ensure that the agency has a record of the test and Medicaid billing is completed. When a result is determined to be elevated, ongoing documentation associated with case management ensues, which involves the use of an additional agency computerized log and the HHLPSS case management database.

A minimum of three people, three paper records, and four electronic records are enlisted with each blood lead test. The numbers of staff involved increases if a lead result is elevated. The process is labor-intensive and has increased potential for documentation errors. The American Nurses Association (ANA) Principles for Nursing Documentation (2010) recommend that nurses should strive to ensure all necessary patient information is

documented while avoiding duplicative documentation. To enhance documentation procedures, nurses should participate in organizational decisions aimed at facilitating the development of an electronic medical record (EMR) that is compatible with other systems, create user-friendly and efficient means of documentation, and create linkages to evidence-based practice guidelines to promote up-to-date interventions (ANA, 2010).

One of the LHD's remote clinic locations does not have a point-of-care analyzer on-site. Blood lead samples are obtained at the remote site by nurses and registered dieticians who travel to the site for patient appointments. Frequently, the registered dieticians do not return to the main clinic site, and samples are transported the following day by a clerical staff member to the main clinic for analysis to be completed by a nurse. Any nurse available in the main clinic site is tasked with completing the testing process with the point-of-care analyzer and logging the patient information on the clinic testing log; however, this is where documentation of the testing process stopped. Nurses completing the analysis of the sample did not believe it was their responsibility to record the sample results within the agency electronic medical record, complete the billing process, or document the results in the WIC electronic record. Many results were not fully documented related to this gap in care and responsibilities.

Documentation of lead testing within the LHD was an area of concern. Documentation duplication can serve as a source of frustration for nurses and increase data errors (Cowden & Johnson, 2003). The nursing staff has voiced concerns over the documentation processes and acknowledge that errors have been made. "I don't know

how we are supposed to keep up with all of this," (personal communication, November 14, 2018).

Case Management

According to LHD policy and the Michigan CLPPP (MDHHS, 2017b), if a child has an elevated blood lead level of $\geq$ 5 mcg/dL, case management services are to be provided to the child; differing significantly from the MDHHS (2018) laboratory policy that states any result of 4.5 to 4.9 mcg/dL is to be considered an elevated level. Case management activities within the State of Michigan include home visits by public health nursing staff to assess the child's health, nutrition, social patterns, and developmental stage as well as complete a visual inspection of the home for lead hazards and provide education to the family (MDHHS, 2017b). All children, regardless of medical insurance coverage, are eligible to receive one nursing home visit; however, if a child is enrolled in Medicaid, up to a total of six home visits may be provided by a Registered Nurse who is CLPPP trained and the LHD will be reimbursed $201.28 per home visit with funding through Children's Special Health Care Services Medicaid Elevated Blood Lead Case management program (MDHHS, 2017b). The only additional service available for children who are not enrolled in Medicaid is a referral to a primary care provider (MDHHS, 2017b).

Established LHD procedures referred nursing staff to the Michigan CLPPP case management website for guidance, although no direct training is conducted. The LHD procedures also refer to use of the Healthy Housing Lead Poisoning Surveillance System (HHLPSS) upon completion of case management home visits. According to the HHLPSS

website, the intent of the program is to track screening of children for lead toxicity, identify confirmed elevated cases, medical management of case, track non-paint lead hazards, investigate and provide abatement for lead hazards and provide a centralized, state-based repository for information (U.S. Department of Health & Human Services, 2016a). Unfortunately, there was no training process for HHLPSS documented within the LHD and access to the system requires approval from HHLPSS administrators (MDHHS, 2017b). Ensuring that nurses responsible for case management activities receive training and have access to the HHLPSS system may promote consistent documentation practices.

Within the CLPPP case management guidelines, it was noted that the HHLPSS system has a limited ability to export data; therefore, LHD's may need to utilize an electronic medical record to capture key activities for data tracking (MDHHS, 2017b). The LHD did not employ an EMR capable of this process nor did the nursing staff use the agency's EMR for anything related to blood lead other than billing Medicaid for provided services. The LHD lead coordinator was concurrently piloting an organization-specific electronic document to track activities associated with lead follow up and case management activities. A process of multiple systems is cumbersome and increases the risk of documentation errors (Cowden & Johnson, 2003).

Not every child identified with an elevated blood lead level will have received testing from the LHD. Private providers are available throughout the LHD's jurisdiction to provide lead screening to patients. If, however, a private provider detects an elevated level, a referral for follow-up services provided to the LHD (AAP, 2013). The LHD will

conduct case management services for that child as if testing had occurred within the agency.

The LHD does not employ a certified environmental lead inspector on staff; therefore, any environmental investigations are handled by HHLPSS staff MDHHS, 2017b). The HHLPSS environmental inspections occur based on the timeline depicted in Table 5.

Providing training to nurses that conduct elevated blood lead follow up is vital to the provision of efficient and effective patient care (MDHHS, 2017b). Maintaining available resources in one common area is a central need to provide consistent services. Without consistent practices, there is a potential cases may become lost during follow-up procedures.

Table 5

HHLPSS Environmental Investigation Timeline

Blood Lead Result	Inspection Timeframe
< 5 mcg/dL	HHLPPS schedule permitting
5-10 mcg/dL	2 weeks
10- < 45 mcg/dL	1 week
≥ 45 mcg/dL	48 hours

Note. Adapted from Michigan Department of Health & Human Services (2017b).

Limitations to Findings

Several guidelines from state and federal resources were discovered to be inconsistent and out of date. Collection and follow-up guidelines for healthcare providers on the MDHHS website were dated 2010; multiple updates to the collection, testing, and follow-up procedures have occurred since this time (CDC, 2017b; MDHHS, 2017a;

MDHHS, 2017b). Inconsistent guidelines may lead to confusion and misunderstanding of information.

No members of the DNP project team had knowledge of the MDHHS Childhood Lead Poisoning Prevention Program website before beginning the analysis process. This website houses information regarding blood lead activities and case management procedures at the state level (MDHHS, 2017b). Each member of the project team has performed case management for children with elevated blood lead levels, and this website would have been valuable to enhancing care provided to these children.

Implications of Findings

No level of blood lead is known to be safe (CDC, 2017b). Reliable identification of lead-burdened children can be accomplished when evidence-based testing procedures are applied consistently (AAP, 2017). If the results of the DNP project and the CPG are implemented, lead-burdened children within the LHD jurisdiction will have the opportunity to be identified and treated. Cognitive and behavioral impairments resulting from lead toxicity may be circumvented with appropriate testing practices (AAP, 2017). Through focused assessments and education provided by public health nurses, community knowledge regarding blood lead toxicity may be increased (Polivka et al., 2009).

As the CPG is considered, education of the nursing staff has the potential to expand. Offering consistent training practices was found to increase the number of blood lead specimens collected during a research study by Polivka et al. (2009). The possibility

of replicating this increase in testing numbers within the LHD may be achieved with consistent practices.

On an institutional level, the CPG may promote and support the inclusion of evidence-based practices during the development of future LHD procedures. The organization historically utilized a top-down approach to procedural implementation. The DNP project team assisted throughout the project development process and voiced an increased understanding related to evidence-based practices.

Research efforts identified the discrepancy of testing result levels. Existing LHD procedures called for the initiation of follow up procedures for a blood lead result of $\geq$ 5 mcg/dL. Established LHD policies did not reference the process of rounding retrieved results of 4.5 to 4.9 mcg/dL to a value of 5.0 mcg/dL and considering these values to be an elevated result requiring venous blood draw for confirmation. The rounding of results would be a significant change in practice for the LHD.

The medical director of the LHD is also responsible for two other jurisdictions, resulting in a total coverage area of 19 counties. The administrative teams representing the three health jurisdictions meet regularly to discuss procedures that are conducted concurrently under the supervision of the medical director. If acceptable to the LHD, this clinical practice guideline also has the potential to be adopted in other health departments, expanding its potential to display a positive impact on social change.

Recommendations

A clinical practice guideline has been developed with consideration of the presented information. The clinical practice guideline is identified as Appendix D of this

document. The clinical practice guideline strives to incorporate evidence retrieved from the systematic review of evidence and optimize patient care within the LHD. Information regarding a developed clinical practice guideline was collected from five expert panelists using the AGREE II instrument for evaluation purposes. The retrieved information substantiated the validity and intent of the clinical practice guideline as demonstrated in the presented results.

Discussion of Evaluation

Evaluation of the clinical practice guideline was conducted using the AGREE II instrument by blood lead testing experts. Ten local experts were invited to participate in the review process, and five responded with completed AGREE II instruments, indicating their acceptance to participate. All invited and participating evaluators had blood lead testing experience of greater than two years, currently conduct blood lead testing, and have case management experience related to elevated lead levels. The AGREE II instrument uses a seven-point Likert-type scale ranging from a score of 1 (strongly disagree) to 7 (strongly agree). In scoring the appraisal results, a score of four and above indicated agreement with the domain item while a score of three or below indicated disagreement with the domain item. Table 6 represents the summarized data of the AGREE II Instrument results. Detailed results of the AGREE II instrument domains are presented in Appendix E.

Table 6

AGREE II Summarized Data

AGREE II Domain	% of Appraiser agreement
Domain 1: Scope and Purpose	100%
Domain 2: Stakeholder Involvement	96.6%
Domain 3: Rigor and Development	99.2%
Domain 4: Clarity of Presentation	97.8%
Domain 5: Applicability	99.2%
Domain 6: Editorial Independence	100%
Overall Guideline Assessment	96.4%
Recommendation of guidelines for use	100% Yes, without modifications

Domain 1 of the AGREE II instrument focuses on addressing the scope and purpose of the clinical practice guideline (CPG) (Brouwers et al., 2010). Within Domain 1, all appraisers documented full support of the CPG with one appraiser noting that established testing procedures within their agency were not as thorough as the CPG. Domain 2, Stakeholder Involvement, received an overall score of 96.6% with appraiser's remarks being unsure of exactly who was participating on the DNP project team. Comments were also received regarding that although the CPG has a nursing focus, other health care providers could also utilize it.

The rigor of development is assessed in Domain 3 (see Brouwers et al., 2010) and received a score of 99.2%. In this domain, appraisers offered praise for the strength of evidence retrieved within the CPG and noted areas of missing information from established procedures within their place of employment. One appraiser did share a lack of support for testing non-Medicaid enrolled children for blood lead exposure. Domain 4 explored the clarity of presentation (see Brouwers et al., 2010) and scored 97.8% from the appraiser; no comments were provided in this domain.

The topic of CPG applicability was addressed within Domain 5 (see Brouwers et al., 2010). An appraisal score of 99.2% was achieved with one evaluator noting are many barriers to regular use of evidence-based practices within their practicing organization. Editorial independence was presented in Domain 6 (see Brouwers et al., 2010) and attained a 100% score. Item 23 within Domain 6 was deemed to be not applicable (NA) as there were no competing interests noted between the CPG development group members. The final area of the AGREE II instrument is the overall guideline assessment (see Brouwers et al., 2010), where 100% of the appraisers recommended the use of the CPG without modifications.

Contribution of the Doctoral Project Team

The DNP project team consisted of two public health nurses and a nurse manager. The nurse manager was assigned to the coordinator role for blood lead management within the jurisdiction. The team members played an intricate role throughout the development process. The members were eager to provide information regarding current practices, engage in discussions of literature findings, and offer considerations of alternative approaches to processes within the agency. Collaborative work occurred via in-person meetings and email correspondence.

The team members had a demanding schedule with regularly assigned duties and time spent in collaboration with the student was appreciated. The project team was enthusiastic about a consistent approach to lead testing and the potential of LHD procedural development utilizing the clinical practice guideline. “A policy that was

correct and we could follow would be so valuable," (personal communication, November 14, 2018).

The project team offered various scenarios of blood lead testing practices being conducted but not part of a written policy. An example of this included the analyzing of blood samples obtained by a registered dietitian from children in a remote clinic and returned to the primary clinic the following day. One member of the team was completing all documentation related to the testing, while the other member completed the specimen analysis but did not document results in the patient record. Another area involved the reporting of results 4.5 to 4.9 mcg/dL. According to the nurse manager, one LHD clinic is rounding results to 5 mcg/dL but the remaining five sites are not, and the rounding of results is not included in the established LHD policies.

The blood lead coordinator forecasted incorporation of the clinical practice guideline into the health department processes following completion of the DNP project. There is potential to expand incorporation of the clinical practice guideline usage to other surrounding health departments; support from the LHD blood lead coordinator will assist in the potential of this developing. It is the intent of the project to be incorporated within the LHD, thereby supporting the continued use of research and evidence-based practices in future procedural developments.

Strengths and Limitations

Throughout the project, it appeared that some LHD nursing staff value establishing consistent practices through incorporating evidence from scholarly resources whereas other members accept current practices are sufficient. Staff that were not fully

supportive of the project did not belittle the attempts of the DNP team but voiced statements of “that is too much work and what we are doing now is fine,” (personal communication, July 23, 2018). Fortunately, the blood lead coordinator, administrative members, and other nursing staff were supportive of the effort.

A limitation of the project is the lack of uniformity related to blood lead testing on a broad scale; many recommendations exist but identified consistencies were minimal. A noteworthy example of a consistent and effective approach to blood lead testing can be found in Allegheny County, Pennsylvania. Leaders within the community noted that blood lead testing levels were low and action was taken to improve testing rates (Allegheny County Health Department [ACHD], 2018a). Effective January 1, 2018, all children residing within Allegheny County are required to be tested for blood lead at 9-12 and 24 months of age (ACHD, 2018a). Children are required to have lead testing completed prior to kindergarten entry (ACHD, 2018b). The cost of testing for those without health insurance coverage is paid for by the Allegheny County Health Department (ACHD, 2018b). In 2009, 10,838 children less than 72 months of age were screened within Allegheny County; since enacting the testing requirement, the county is on pace to test more than 23,000 unduplicated children in 2018 (ACHD, 2018b). The establishment of a school-entry requirement was a significant achievement toward identification of lead burdened children. Although the LHD did not have a mandatory regulation in place, the example of Allegheny County offers resources and data in support of developing widespread, consistent practices.

Acceptance of the clinical practice guideline for use within the LHD would promote up-to-date and consistent nursing actions in the provision of blood lead testing. Prior to the DNP project, minimal attention had been given to update the testing process and care was provided status quo; however, this project may be a stimulus for moving established practices forward. Enactment of the clinical practice guideline may facilitate advanced nursing care, improve health outcomes of children, and decrease societal burdens related to lead toxicity. If support is received, the clinical practice guideline could be expanded to other health department jurisdictions.

Section 5: Dissemination Plan

Throughout this project, I worked closely with nurses from the project site. According to Melnyk (2013), the DNP scholarly project should focus on translating "research findings into clinical practice or policy to positively influence health care and patient and policy outcomes" (p. 444). The focus of the current scholarly project was to improve the blood lead testing practices in the LHD.

Sharing the developed clinical practice guideline with the organization may increase the likelihood of the LHD adopting evidence-based practices and improved patient care practices regarding the blood lead testing process. Dissemination of the clinical practice guideline will begin with the nursing director and blood lead coordinator. The agency has a history of implementing procedures with a top-down approach; however, staff inclusion throughout the development of the clinical practice guideline may assist in its acceptance within the organization.

The agency supporting the development of the clinical practice guideline is a rural, jurisdictional public health department. The medical director of the LHD has a leadership role in two additional jurisdictional health departments, totaling 19 counties of responsibility. This multiagency relationship may increase the likelihood of adoption of the practice guideline throughout the region. Although the characteristics of the LHD are specific, any health care provider who performs blood lead testing could benefit from the information contained in the practice guideline. Empowering nurses with resources and evidence-based information to support improved patient care practices is appropriate in any situation (White et al., 2016).

I intend to offer the project for review and consideration to the American Public Health Association, *Public Health Nursing* journal, the *Journal of Community & Public Health Nursing*, the *Journal of Environmental and Public Health*, and *BMC Public Health*. If approved for publication, the DNP project would be disseminated to a broad nursing base. In addition, I will develop a poster presentation to share with professional audiences. Potential presentation sites include the Lilly Conference for Evidence-Based Teaching & Learning and the Michigan Chapter of the American Nurses Association Annual Conference. Seeking permission to share the information during Michigan Childhood Lead Poisoning Prevention Program training sessions would also expand the reach of the clinical practice guideline information.

Analysis of Self

The DNP scholarly project has broadened my knowledge base regarding evidence-based practices and the importance of using research to guide policy development. I have worked in public health settings and have witnessed the lack of staff support in the proactive development of organizational procedures. Limited staffing levels and a lack of administrative understanding have resulted in reactionary processes that have been fueled by requirements of regulatory agencies. Engaging LHD members throughout the project development and sharing the process of identifying nursing research expanded not only my knowledge but also the knowledge of DNP project team members. The project team members now have resources available to support future procedural development projects.

The American Association of Colleges of Nursing (AACN, 2006) Essentials of Doctoral Education for Advanced Nursing Practice shares the importance of DNP graduates to be skilled in both providing patient care and understanding the organizational arena in which they are working. The current project provided me the opportunity to identify issues negatively impacting patient care, to create an evidence-based clinical practice guideline that can provide the basis for effective and efficient future testing procedures in the LHD, and to have an impact on patient care resulting in positive social change.

As a nurse, I did not previously seek evidence-based information; however, the DNP project has refocused my practices. I grew in understanding the importance of seeking information rather than accepting the status quo. As a DNP scholar, I have made a personal commitment to lifelong learning and striving to be a change agent for my profession. I am no longer complacent with existing conditions but seek improvements in the nursing practice and patient care.

The employment of principles associated with finance, business, and health policies to implement effective practice initiatives is an essential characteristic of DNP-prepared nurses (AACN, 2006). As a project manager, I have a great deal to learn. My abilities as a practitioner and scholar increased during this project, but I have work to do on my management skills. Having a stronger background in the established practices of the LHD may have assisted in my efforts; however, in the future I will likely face similar circumstances. The knowledge that I have gained throughout this process has provided me with the direction needed to be a competent project manager. Using those skills in

future endeavors will help me hone my project manager abilities. As these skills develop, so will my ability to be a change agent for the nursing profession.

As the DNP project comes to completion, I am excited for what the future holds. I have new confidence in my abilities and hope for improved nursing practices in the LHD. I now understand the commitment it takes to develop a practice guideline in a thorough and supported manner versus responding to a regulatory condition. It has been a long journey with a variety of professional barriers requiring persistence and perseverance. Gaining the trust and respect of members of the LHD was more difficult than anticipated, but through communication, relationships and understanding were achieved. The project has facilitated ongoing relations between the LHD and me, and have opened the door for future collaborations to improving patient care.

Summary

The importance of blood lead testing cannot be underestimated. With no known safe level of blood lead, accurate and consistent testing practices are crucial to the identification of lead-burdened children (CDC, 2017b). The established blood lead testing procedures in the DNP project site lacked evidence-based practices and consistent implementation throughout the jurisdiction. In this project, I sought to develop a clinical practice guideline to be incorporated in the daily operations of the local health department and potentially in other blood lead testing agencies. All relevant information was used in the development of the clinical practice guideline to improve nursing practice related to blood lead testing. One lead-burdened child is too many. The developed guideline has the potential to effect long-term, positive change on children and society.

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Appendix A: Letter of Invitation to Participate in the Review of a Doctoral Project

My name is Becky Johnson-Himes and I am a graduate student in the Doctor of Nursing Practice program at Walden University. I am developing a clinical practice guideline for blood lead testing of preschool aged children in a public health department setting. You have been identified as an expert in the field of blood lead testing based on years of work within a public health setting and history of conducting blood lead testing.

As an expert, your knowledge of blood lead testing will be a valuable resource toward ensuring the clinical practice guideline is evidence-based and peer reviewed. You are being asked to voluntarily review the developed clinical practice guideline, evaluate the guideline using the AGREE II instrument, and provide any comments you deem necessary toward improvement of the process. Once all participants have submitted their review, the information will be analyzed, and results shared with the agencies administrative staff. It is at the discretion of the agencies administrative staff as to whether or not the clinical practice guideline will be implemented within the agency.

At no time will your personal information or responses to the AGREE II instrument be shared with anyone. Please see the enclosed Disclosure to Expert Panelist Form For Anonymous Questionnaires for further information regarding guidelines of this project.

Thank you for your considered participation in the review of a clinical practice guideline that has the potential to improve nursing processes surrounding the blood lead testing of preschool aged children.

Appendix B: AGREE II Instrument

AGREE II INSTRUMENT

DOMAIN 1. SCOPE AND PURPOSE

1. The overall objective(s) of the guideline is (are) specifically described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

2. The health question(s) covered by the guideline is (are) specifically described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 2. STAKEHOLDER INVOLVEMENT

4. The guideline development group includes individuals from all relevant professional groups.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

5. The views and preferences of the target population (patients, public, etc.) have been sought.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

6. The target users of the guideline are clearly defined.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 3. RIGOUR OF DEVELOPMENT

7. Systematic methods were used to search for evidence.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

8. The criteria for selecting the evidence are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

9. The strengths and limitations of the body of evidence are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 3. RIGOUR OF DEVELOPMENT continued

10. The methods for formulating the recommendations are clearly described.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

11. The health benefits, side effects, and risks have been considered in formulating the recommendations.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

12. There is an explicit link between the recommendations and the supporting evidence.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 3. RIGOUR OF DEVELOPMENT continued

13. The guideline has been externally reviewed by experts prior to its publication.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

14. A procedure for updating the guideline is provided.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 4. CLARITY OF PRESENTATION

15. The recommendations are specific and unambiguous.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

16. The different options for management of the condition or health issue are clearly presented.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

17. Key recommendations are easily identifiable.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 5. APPLICABILITY

18. The guideline describes facilitators and barriers to its application.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

19. The guideline provides advice and/or tools on how the recommendations can be put into practice.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

20. The potential resource implications of applying the recommendations have been considered.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 5. APPLICABILITY continued

21. The guideline presents monitoring and/or auditing criteria.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

DOMAIN 6. EDITORIAL INDEPENDENCE

22. The views of the funding body have not influenced the content of the guideline.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

23. Competing interests of guideline development group members have been recorded and addressed.

1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree

Comments

OVERALL GUIDELINE ASSESSMENT

For each question, please choose the response which best characterizes the guideline assessed:

1. Rate the overall quality of this guideline.

1 Lowest possible quality	2	3	4	5	6	7 Highest possible quality

2. I would recommend this guideline for use.

Yes	
Yes, with modifications	
No	

NOTES

(Brouwers et al., 2010)

Appendix C: Disclosure to Expert Panelist Form for Anonymous Questionnaires

To be given to an expert panelist prior to collecting questionnaire responses—note that obtaining a "consent signature" is not appropriate for this type of questionnaire and providing respondents with anonymity is required.

Disclosure to Expert Panelist:

You are invited to take part in an expert panelist questionnaire for the doctoral project that I am conducting.

Questionnaire Procedures:

If you agree to take part, I will be asking you to provide your responses anonymously, to help reduce bias and any sort of pressure to respond a certain way. Panelists' questionnaire responses will be analyzed as part of my doctoral project, along with any archival data, reports, and documents that the organization's leadership deems fit to share. If the revisions from the panelists' feedback are extensive, I might repeat the anonymous questionnaire process with the panel of experts again.

Voluntary Nature of the Project:

This project is voluntary. If you decide to join the project now, you can still change your mind later.

Risks and Benefits of Being in the Project:

Being in this project would not pose any risks beyond those of typical daily professional activities. This project's aim is to provide data and insights to support the organization's success.

Privacy:

I might know that you completed a questionnaire, but I will not know who provided which responses. Any reports, presentations, or publications related to this study will share general patterns from the data, without sharing the identities of individual respondents or partner organization(s). The questionnaire data will be kept for a period of at least 5 years, as required by my university.

Contacts and Questions:

If you want to talk privately about your rights in relation to this project, you can call my university's Advocate via the phone number 612-312-1210. Walden University's ethics approval number for this study is (Student will need to complete Form A in order to obtain an ethics approval number).

Before you start the questionnaire, please share any questions or concerns you might have.

(Walden University, May 2017, pp. 15-16)

Appendix D: Clinical Practice Guideline for Blood Lead Testing Within a Local Health Department

Overview

Obtainment of a blood sample is necessary to identify lead toxicity (American Academy of Pediatrics [AAP], 2013). The local health department utilizes capillary screening and a point-of-care analyzer to assess the blood lead level of children. As one of the few interventions available to screen for lead burden within children, it is imperative that consistent, evidence-based practices are employed during the sampling process (AAP, 2013). Local health department (LHD) procedures must be applied in a reliable manner by appropriately trained staff to be effective and efficient in the testing process. Information obtained from a systematic review of literature, national, state, and local resources was applied in the development of this clinical practice guideline. No funding was received to support the development of this clinical practice guideline.

There is no identified safe level of lead to be housed in the human body (Centers for Disease Control and Prevention [CDC], 2017b). In various amount, lead exposure occurs worldwide (World Health Organization, 2018). On a global level, it is estimated by the World Health Organization (2018) that lead exposure resulted in 540,000 deaths and 13.9 million lost years of healthy life during 2016. It is known that exposed children absorb lead up to 50% more than adults (Michigan Department of Health and Human Services [MDHHS], 2017) and that detrimental effects of lead toxicity impact nearly every system of the body (CDC, 2017b). Effects of lead burden include impairment of the

nervous system, altered cognitive functioning, hypertension, anemia, the toxicity of reproductive organs, and impaired kidney function (World Health Organization, 2018).

Early identification of elevated blood lead levels provides the opportunity for early interventions, resulting in improved cognitive and behavioral functioning (State of Michigan, 2016). Early interventions positively impact child health outcomes and societal considerations. It has been estimated by the State of Michigan (2016) that $270 million in decreased earnings, health care costs, special education services, and increased levels of delinquency were related to lead burden in 2014. Additionally, 10% of juvenile crimes, an annual rate of $1.33 million in incarnation fees, and $64.6 million in costs associated with adult crimes have been linked to lead exposure in Michigan (Ecology Center, 2016).

Children at a higher risk of lead exposure include those living in poverty, members of racial-ethnic minority groups, those living in or visiting older homes, those who have guardians who are exposed to lead at work, and those who are recent immigrants (CDC, 2017). According to the Kids Count Data Center (2018), 14.9% of children under the age of 5 belong to a racial-ethnic minority group, and 25.7% of children are living in poverty in the boundaries of the LHD. Also, within the LHD jurisdiction, 55.4% of the housing units were constructed prior to 1979 (U.S. Department of Commerce, n.d.). For homes that were built before 1978, it is important for families to be aware of the dangers of lead dust and to consider the services of a certified renovator knowledgeable in decreasing the exposure of lead dust during renovations and repairs (Allegheny County Health Department, 2018a).

Current Medicaid regulations require the testing of all enrolled children at 12 and 24 months of age (MDHHS, 2017a). However, only 72% of children 1 or 2 years of age living within the jurisdiction were tested in 2015 (MDHHS, 2017c). To promote effective and consistent blood sample collection that will accurately identify lead toxicity, evidence-based practices must be employed throughout the development and implementation of clinic procedures. An annual review of jurisdictional testing rates and blood lead testing research may promote the continued use of evidence-based practices, thereby supporting safe and effective patient care.

Assessment Practices

Although it is recommended by the American Academy of Pediatrics (2017) and Centers for Disease Control and Prevention (2017a) to conduct screening questionnaires related to blood lead testing, the questionnaires have been shown to lack validity. Verbal interviewing of guardians provides the opportunity to identify circumstances that may place the child at a higher risk of lead exposure. Use of a self-completed questionnaire has been shown to generate different information than what is gathered during a personal interview (Bergmann, Jacobs, Hoffmann, & Boeing, 2004). A 2016 study by Nicholson and Cleeton revealed a risk assessment questionnaire sensitivity of 26.3% and specificity of 72.2% in predicting blood levels greater than 2 mcg/dL. The U.S. Preventive Services Task Force (2006) noted a specificity of blood lead questionnaires as ranging from 32% to 75% in the identification of elevated lead levels. Basing the decision to test a child solely on a screening questionnaire may increase the risk of a lead-burdened child being unidentified. Nurse engagement with guardians is an essential step toward assessing

understanding of lead exposure, associated dangers, and establishing guardian understanding of testing indications.

Testing Guidelines

National, state, and local age recommendations for testing are consistent at 12 and 24 months of age (CDC, 2017a; MDHHS, 2017b). Children enrolled in Medicaid are required to be tested at these ages (MDHHS, 2017b). Children receiving services through the supplemental food program Women, Infants, and Children (WIC) are also mandated under federal guidelines to receive blood lead testing at 12 and 24 months of age, regardless of Medicaid enrollment (State of Michigan, 2018b). A household income of below 185% of the Federal Poverty Guidelines, Medicaid enrolled, or receiving food stamps determine a child's eligibility for the WIC program (State of Michigan, 2018b).

A discrepancy of the location to obtain testing exists for children who are not enrolled in Medicaid. Michigan is not a state that requires private insurance companies to reimburse for blood lead testing, nor is the LHD required to test those children without Medicaid coverage (see State of Michigan, 2018b). When considering the identification of lead-burdened children and the at-risk category of living in poverty (CDC, 2017b), all children receiving services within the WIC program should be tested. Advocating for reimbursement of blood lead testing from private insurance providers may promote further testing of at-risk children, facilitate early intervention services for identified children, and decrease societal costs associated with lead burden.

Allegheny County, Pennsylvania implemented a successful approach to achieving widespread blood lead testing within a community. In response to a 31% testing rate for

children under the age of 72 months, Allegheny County enacted a regulation mandating all children be lead tested at 9-12 and 24 months of age (Allegheny County Health Department, 2018b). The regulation went into effect January 1, 2018, and has yielded an increase from 10,838 children tested in 2009 to an estimated greater than 23,000 that will be tested in 2018 (Allegheny County Health Department, 2018a). Advocacy efforts by healthcare providers and community leaders led to this positive social change.

Collaborating with partner agencies to offset the costs associated with testing may offer an opportunity to increase the number of children tested who are identified as being at-risk but who have private health insurance. Head Start agencies are federally mandated to have enrolled children tested between the ages of 36 and 72 months (U.S. Department of Health & Human Services, 2016b). Head Start is willing to reimburse the LHD for costs associated with blood lead testing for any enrolled child that is not receiving Medicaid coverage (personal communication, May 2, 2018). Community partnerships may have the potential to expand testing services.

Training Opportunity

A training program for nursing staff should be developed and administered within the LHD to promote consistent practices. Capillary blood lead specimen collection has a potential to become contaminated from the environment when proper technique is not followed (AAP, 2013). Although identified resources from the CDC, Michigan Department of Health and Human Services, and Magellan Diagnostics are referenced established LHD policies, there is no record of a consistently implemented training program. Each of the above resources offers specific information valuable to the method

of obtaining a blood lead sample, but none offer the complete process. Documentation and verification of completing a developed training course will promote assurance of testing process being completed appropriately.

Reporting of Results

The Michigan Department of Health and Human Services Childhood Lead Poisoning and Prevention Program (CLPPP) has a policy in place to round blood lead results of 4.5 to 4.9 mcg/dL to 5.0 mcg/dL, which is considered an elevated result (State of Michigan, 2018a). This policy is important to incorporate into the practices of the LHD. A LHD policy statement of $\geq$ 5 mcg/dL being an elevated results does not delineate the rounding of results from 4.5 to 4.9 mcg/dL up to 5 mcg/dL. Without the incorporation of this policy, children with a blood lead level of 4.5 to 4.9 mcg/dL will go without identification and necessary follow up procedures related to an elevated level.

If an elevated level of lead is identified through capillary sampling, confirmatory venous testing should ensue (AAP, 2013). Variation exists in the state and federal recommendations of time to obtain a confirmatory test based on the result level (see CDC, 2018; MDHHS, 2017a). Adoption of a consistent timeframe for completing confirmatory testing within the LHD will aid in the uniformity of testing practices.

Documentation

It is recommended by the American Nurses Association (ANA) Principles of Nursing Documentation (2010) that duplicative documentation should be avoided to minimize the risk of error. A combination of paper and multiple electronic databases increases the risk of documentation error exponentially. The repetition of documentation

is inefficient, a source for staff frustration, and has a great potential to decrease the integrity of the records (Cowden & Johnson, 2006). Through the collaborative efforts of nursing staff, clerical, administrative, billing, and internet technology staff, a process of efficient documentation can occur.

Case Management

For a family receiving notification of a child's elevated blood lead level, the news may be overwhelming. Depending on the result level, follow up procedures may begin immediately or require retesting in three months (see CDC, 2018; MDHHS, 2017a). Regardless of the timeline, a public health nurse knowledgeable in the process is vital to the success of the follow up process. An educated nurse will provide case management efforts offering instruction to the family in an on-going manner. Case management of elevated blood lead cases continues until the child's blood lead level is no longer elevated and education of the family has been completed (MDHHS, 2017b).

Reimbursement of home visits made to Medicaid enrolled children is provided through the Michigan CLPPP (MDHHS, 2018a). Unfortunately, home visit reimbursement is not available for those children not enrolled in Medicaid (see MDHHS, 2018a). Without education of the family and identification of the lead source, the toxicity of the child will continue. Regardless of Medicaid status, community health practices must provide follow-up services to the family.

Documentation of case management services for elevated lead cases is encouraged through the Healthy Housing Lead Poisoning Surveillance System (HHLPSS) (MDHHS, 2017a). The HHLPSS is not a required database for case

management practices; however, it is a statewide database that offers consistency of documentation (MDHHS, 2017a). Incorporating the consistent use of this state-facilitated database would increase the reliability of case management practices.

Interventions

There is no known safe level of lead within the human body (CDC, 2017b). It has been established that screening is recommended for children at 12 and 24 months of age who are identified as being at risk for lead exposure (AAP, 2013); however, a consistent approach to the testing process has not been reliably established within the agency. LHD staff should work collaboratively to identify effective and efficient practices within the organization to promote early identification of lead-burdened children and increase the education of families related to lead toxicity. All children receiving services within the WIC program are at an increased risk of lead exposure based on CDC guidelines (see CDC 2017b) and therefore, should be screened for blood lead levels regardless of Medicaid enrollment status at the time of service versus referring to a different provider. Referring a child to receive testing from another healthcare provider is a lost opportunity for providing care. A lack of direction in practices and complication of documentation has been identified as being frustrating to staff and resulting in some children not being tested. Applying the information of this clinical practice guideline will enhance health department services for lead-burdened children, thereby improving health outcomes for the child and having a positive impact on the community.

Appendix E: AGREE II Detailed Appraisal Item Scores

Domain 1: Scope and Purpose

	Item 1	Item 2	Item 3	Total	% Score
Appraiser 1	7	7	7	21	100%
Appraiser 2	7	7	7	21	100%
Appraiser 3	7	7	7	21	100%
Appraiser 4	7	7	7	21	100%
Appraiser 5	7	7	7	21	100%
Total Domain 1	35	35	35	105	100%

Domain 2: Stakeholder Involvement

	Item 4	Item 5	Item 6	Total	% Score
Appraiser 1	7	7	7	21	100%
Appraiser 2	7	5	7	19	90.5%
Appraiser 3	7	7	7	21	100%
Appraiser 4	7	6	7	20	95.2%
Appraiser 5	7	7	7	21	100%
Total Domain 2	35	33	35	102	96.6%

Domain 3: Rigor of Development

	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Total	% Score
Appraiser 1	7	7	7	7	7	7	7	7	56	100%
Appraiser 2	7	7	6	7	7	7	7	7	55	98.2%
Appraiser 3	7	7	7	7	7	7	7	7	56	100%
Appraiser 4	7	7	7	7	7	7	7	7	56	100%
Appraiser 5	7	7	6	7	7	7	7	7	55	98.2%
Total Domain 3	35	35	33	35	35	35	35	35	278	99.2%

Domain 4: Clarity of Presentation

	Item 15	Item 16	Item 17	Total	% Score
Appraiser 1	7	7	7	21	100%
Appraiser 2	6	7	7	20	95.2%
Appraiser 3	7	7	7	21	100%
Appraiser 4	7	7	7	21	100%
Appraiser 5	7	6	7	20	95.2%
Total Domain 3	34	34	35	103	97.8%

Domain 5: Applicability

	Item 18	Item 19	Item 20	Item 21	Total	% Score
Appraiser 1	7	7	7	7	28	100%
Appraiser 2	6	7	7	7	27	100%
Appraiser 3	7	7	7	7	28	100%
Appraiser 4	7	7	7	7	28	100%
Appraiser 5	7	7	7	7	28	100%
Total Domain 5	34	35	35	35	139	99.2%

Domain 6: Editorial Independence

	Item 22	Item 23	Total	% Score
Appraiser 1	7	NA	7	100%
Appraiser 2	7	NA	7	100%
Appraiser 3	7	NA	7	100%
Appraiser 4	7	NA	7	100%
Appraiser 5	7	NA	7	100%
Total Domain 6	7	NA	7	100%

Overall Guideline Assessment

1. Rate the overall quality of this guideline.				
		Score	Total	% Score
	Appraiser 1	7	7	100%
	Appraiser 2	6	6	85.7%
	Appraiser 3	7	7	100%
	Appraiser 4	7	7	100%
	Appraiser 5	7	7	100%
Total Score for Question 1		34	34	96.4%
2. I would recommend this guideline for use.				
		Yes	Yes, with modifications	No
	Appraiser 1	Yes		
	Appraiser 2	Yes		
	Appraiser 3	Yes		
	Appraiser 4	Yes		
	Appraiser 5	Yes		
Total Number of Recommendations		100%		