Developing a Protocol and Educational Program for Pediatric Lead Screening in a Small Rural Vermont Family Medicine Facility

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Abstract

The Vermont Department of Health (VDH) mandates that all children be tested for lead at 12 months, 24 months, and between three to six years of age, if testing has not been done previously. This quality improvement project was designed to increase lead screening rates at a Small Rural Vermont Family Medicine Facility to meet the state mandate. Barriers included the absence of a formal protocol for preparing for and ordering lead screening, a tool for ordering within the practice's electronic health record, and formal training for all staff on lead screening.

The primary intervention involved a protocol change by adding a visual cue in the clinic's electronic health record in the form of a checkbox to prompt lead screening ordering during well-child visits. The secondary intervention focused on enhancing staff knowledge, confidence, and awareness about lead screening guidelines through an education session, assessed via a pre-and post-education survey.

Throughout the study period, the checkbox was utilized, achieving a 58.33% usage rate, an improvement from pre-intervention. Additionally, there was a marked increase in awareness of Vermont's legal requirements and VDH standards for lead screening in the post education sessions. Post-implementation surveys revealed a significant increase in provider confidence regarding lead screening, with all providers feeling confident or very confident. All staff found the educational session valuable and reported it enhanced their knowledge and confidence.

This project demonstrated the potential for a protocol change with electronic health record integration and staff education sessions to improve lead screening adherence and foster improved health equity.

Key Words: Lead Screening, Electronic Health Record, Education, Provider Confidence, Quality Improvement

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Introduction

Elevated lead levels, detected from measuring capillary or venous blood, in children under 6 years old is a significant public health concern. Early exposure in childhood, during critical times for neurocognitive development, leaves children vulnerable to lead poisoning, which negatively affects their mental and physical development (Davidson et al., 2021). Studies of children with higher blood lead levels have consistently demonstrated lower IQ scores, increased language difficulties, learning disorders, attention problems, and behavioral issues (Hauptman et al., 2017).

The level of lead exposure is a critical factor in determining its potential harm. While elevated levels pose significant risks, even low levels of exposure have been shown to cause serious health issues. Evidence shows that blood lead levels below 10 micrograms per deciliter are associated with adverse effects in children such as impaired neurobehavioral development (World Health Organization: WHO, 2024). Vermont has lowered its definition of elevated blood lead results from five micrograms per deciliter to any reported level as research highlights that there are no safe levels of lead (*Lead Poisoning Prevention Guidance for Health Care Providers*, 2023). An estimated two and a half percent of children in the United States under six years old have blood lead levels greater than five micrograms per deciliter (Hauptman et al., 2017). Lead screening is critical to identify children at risk for high levels of lead and provide timely treatment.

Children are at risk of exposure to lead through many different interactions with common products. Lead is a naturally occurring substance found in the earth's crust but can also be found at elevated levels in paint, soil, air, water, food, cosmetics, medicines, toys, and consumer products (Preventing Lead Exposure in Children, 2023). Children are at risk of lead

exposure from lead-based paint. Although lead was banned in house paint in 1978, sixty-six percent of homes in Vermont were built before then. Additionally, eighty percent of rental units in Vermont were constructed prior to 1978 and are likely to contain lead-based paint (*Lead*, n.d.). Children are often exposed to lead through putting contaminated objects in their mouths or exposed to dust containing lead. Children absorb lead more efficiently than adults from the gastrointestinal tract. About 40% of lead ingested is absorbed in children, whereas only 5-15% is absorbed in adults. Along with their efficient gastrointestinal tracts, their blood-brain barrier, and liver detoxification systems are biologically immature, contributing to higher levels of lead accumulating in their systems (Abelsohn & Sanborn, 2010). Prevention of exposure to lead in children is important, as there are no immediate symptoms when a child is exposed (Hauptman et al., 2017). Lead is not easily visually identified and is non-odorous; therefore, detection occurs through capillary blood tests or a venous blood draw. Each lead-exposed child costs an estimated $5,600 in medical and special education services, making lead exposure a costly expense to society (Hauptman et al., 2017). The Vermont Department of Health recommends, and state law requires that all children be tested for lead at 12 and 24 months. If a child is not tested at these ages, testing must be done between the ages of three and six years old (Lead Poisoning Prevention Guidance for Health Care Providers, 2023). Universal screening is not only mandated by the Vermont Department of Health, but is also essential for identifying children at risk, detecting lead exposure early, targeting at-risk populations, preventing long-term health effects, allocating resources effectively, and addressing health disparities. Furthermore, Vermont state law requires healthcare professionals to provide a copy of "What Your Child’s Lead Test Means" to all parents or caregivers of children being tested for lead, regardless of the test results. This is to ensure families are educated about lead screening and have a better understanding of the

impact of lead screening (Lead Poisoning Prevention Guidance for Health Care Providers, 2024c).

Problem Statement

Vermont state law requires universal screening, however, lead screening rates at the project site highlight a gap in best practice. As of January 16, 2024, at the Small Rural Vermont Family Medicine Facility, 80% of eligible 12-month-olds have been screened for lead, 16% of eligible 24-month-olds have been screened for lead, and 47% of eligible children aged three to six years old's have received no screening on or after 11 months of age.

Lead screening rates need to be improved for children at ages 12 months and 24 months, ensuring that by the time a child turns three, they have either been screened at 12 months and 24 months, or are scheduled to be screened. This will help the Small Rural Vermont Family Medicine Facility better comply with the Vermont Department of Health guidelines and Vermont state law.

Purpose Statement

The purpose of this project is to improve compliance at the Small Rural Vermont Family Medicine Facility, pertaining to the Vermont Department of Health's lead screening guidelines through two main objectives, by establishing a protocol change in the form of a check box to prompt providers to order lead screening and an educational session reviewing current lead screening guidelines.

Rationale

Improving lead screening rates at this Small Rural Vermont Family Medicine Facility will benefit the community by identifying children at risk, detecting lead exposure early, and

targeting at-risk populations by identifying areas of higher concentrations of lead exposure. This proactive approach will help prevent long-term health effects, allocate resources effectively, and address health disparities.

This quality improvement project aims to create a formal protocol for staff to follow and implement education sessions to improve lead screening rates within the practice. The quality improvement project sought to establish a protocol by adding a lead screening checkbox in patient records to serve as a prompt for lead screening consideration and provide an educational session for staff on the topic of lead screening.

As a private practice, the Small Rural Vermont Family Medicine Facility holds Patient Care Medical Home (PCMH) accreditation from the Joint Commission to attract patients and show that they achieve a high standard of patient care. This accreditation represents that this facility focuses on care coordination, access to care, and highlights that the primary care provider and the patient work in a partnership. Improvements in lead screening practices are necessary for this Small Rural Vermont Family Medicine Facility to continue to be accredited by the Joint Commission. The PCMH team is comprised of providers, office staff, and nurses. The PCMH team tasked the project leader with this project to improve lead screening practice and its quality measures.

Project Aims

The primary aim was to implement a visual cue for clinicians through a workflow protocol change to indicate when lead screening was due to prompt the provider to order lead screening. The second aim of this quality improvement project was to increase provider confidence in ordering lead screenings and enhance overall awareness and knowledge of lead

screening practices within the entire practice. The global of this project was to increase lead screening rates at the Small Rural Vermont Family Medicine Facility.

Conceptual Framework

Conceptual framework that embodies this Doctor of Nursing Practice quality improvement project includes Mark Salmon White's Construct for Public Health Nursing. Mark Solomon White describes public health nursing as a focus of achieving and maintaining public health (*Theories Applied in Community Health Nursing*, n.d.). Lead exposure is a public health issue, with the Centers for Disease Control and Prevention estimating that 500,000 children in the United States have blood levels higher than the blood level recommended value (*Overview of Childhood Lead Poisoning Prevention | LEAD |*, n.d.). Mark Solomon White gave 3 practice priorities, prevention of disease and poor health, protection against disease, and external agents and promotion of health with 3 intervention categories as follows:

1. Education directed toward voluntary change in the attitude and behavior of the subjects.
2. Engineering directed at managing risk related variables.
3. Enforcement directed at mandatory regulation to achieve better health.

To address Mark Salomon White's first practice priority, this project will use education of the staff to encourage a voluntary change in the attitude and behaviors towards pediatric lead screening. Education provided by healthcare providers to parents of children is intended to encourage voluntary changes that encourage lead screening during office visits. Registered Nurses and Medical Assistants will also receive this education, equipping them with the latest guidelines and recommendations to help educate patients effectively.

For Mark Salomon White's second practice priority that uses engineering, such as a protocol change, will be implemented by adding an additional checkbox to the well-child check template

for specific age groups. This will serve as a reminder for providers to order lead screening during well-child visits.

To address Mark Salomon White's third practice priority, there is currently mandatory screening guidance in place from the Vermont Department of Health for every child to be screened at the ages of 12 and 24 months in the state of Vermont. Lead screening is enforced though a combination of public health policies, medical guidelines, and educational outreach to primary care offices to improve lead screening rates for pediatric children by organizations like Vermont Child Health Improvement Program (VCHIP).

Critical Appraisal of the Literature

Multiple studies consistently showed in the literature that there were no safe lead levels for children and that children experienced the most profound effects from exposure, with risks to their internal organs (Kamai et al., 2022; Beidinger-Burnett et al., 2018; Davidson et al., 2021c). Robust evidence also showed that screening children was vital to identifying exposures and expediting treatment (Kamai et al., 2022; Davidson et al., 2021c).

Lead screening rates themselves are low in some areas of the United States, where lead screenings were not being performed at the level recommended, including at the Small Rural Vermont Family Medicine Facility that was studied for this Doctor of Nursing Practice quality improvement project (Beidinger-Burnett et al., 2018; Davidson et al., 2021c). In 2022, 72.5% of one-year-olds and 64.1% of two-year-olds in Vermont were screened for lead (Weiss-Tisman, 2023). According to Medicaid, all children enrolled in Medicaid, regardless of whether coverage was funded through Title XIX or XXI, were required to receive blood lead screening tests at ages 12 months and 24 months (Medicaid, n.d.). There were social determinants that put children at risk of not being screened for lead, such as having a young mother, being Hispanic, Black,

American Indian, or being on Medicaid services (Kamai et al., 2022). Lead screening should be conducted at a 100% rate to reduce health disparities and ensure all children receive equal care for all children.

There are several ways to reduce lead exposure and improve lead screening in healthcare practices, including the implementation of policies and the effective use of electronic health records. Policies have been put into place to lessen a child's exposure, such as banning lead in gasoline or lead in paint (Zahran et al., 2021). There are also policies in place, such as the Vermont state law, which requires that all children be tested for lead at 12 months and 24 months.

Electronic health care records have been used as a tool to aid in patient's care. Studies have looked at the utilization of electronic health records to significantly increase the percentage of children screened for lead toxicity or to identify patients who were due for screening or interventions, resulting in improved care and better patient outcomes (Davidson et al., 2021c). These studies highlighted that this quality improvement project, with a global goal to increase lead screening rates, could be beneficial for the Small Rural Vermont Family Medicine Facility project site. One study, for example, targeted a community health network with low screening rates. The aim was to improve universal screening at 12 months of age, increasing the rate from 71% to 95%, and to increase the screening rate for 24-month-olds from 41% to 70%. This study employed dynamic order sets in the electronic health record that generated a pre-checked lead screening order based on the patient's age, prior screening results, and risk factors. The results were notable, screening rates for 12-month-olds increased from 71% to 96%, and for 2-year-olds, from 41% to 74% (Davidson et al., 2021). This study found that utilizing clinical decision support tools within the electronic health record significantly increased the percentage of

children screened for lead toxicity. Protocol changes within the health records could help identify patients who are due for other types of screenings or interventions, leading to improved care, and patient outcomes.

Education sessions for healthcare providers in medical facilities have improved lead screening rates. One study looked at how the Centers for Disease Control and Prevention, launched the Increasing Capacity for Blood Lead Testing Extension for Community Healthcare Outcomes (ECHO) project. Its goal was to educate healthcare workers about the importance of testing children for lead exposure and access practice behavior change. It was found that two weeks to one month after facilities received training, 80% of participants reported increased lead testing resulted in practice changes (Calabrese et al., 2022). This study shows that education sessions can be effective at increasing provider knowledge of lead screening and ultimately increase lead screening rates. Based on the appraisal of the literature, this Small Rural Vermont Family Medicine Facility and its pediatric patients would benefit greatly from improving their lead screening practices though the use of protocol changes within their electronic health record and education sessions.

Interventions

Intervention #1 Workflow Protocol Change

The first intervention included a daily workflow protocol change to the well child check template for providers, adding a checkbox to indicate that lead screening had been completed or was due for the following age groups:

- 12 months
- 18 months
- 24 months
- 30 months
- Three years old

Having the checkbox at these age groups was meant to ensure that lead screening was performed for 12-month and 24-month visits, with safeguards at 18 months and 30 months in case it was overlooked or unable to be performed for various reasons. The three-year-old age group served as a “catch-all” to determine whether lead screening had been performed or if it still needed to be completed.

A protocol change for preparation of the well child check visit requires a Registered Nurse or Medical Assistant to access to the Vermont Lead Registry from the Vermont Department of Health. This state registry documents the dates and results of lead screenings, as required by Vermont law. At the start of the project, only one Registered Nurse at the site had access to this database. To ensure broader access, all Registered Nurses and Medical Assistants were given the necessary paperwork to obtain access to the registry and view patient screening statuses. This access form was also incorporated into the new employee onboarding paperwork, ensuring that all appropriate staff members could access the registry moving forward.

A new protocol was created for pre-visit planning for the Registered Nurses or Medical Assistants, where lead screening status of a pediatric patient was updated the health maintenance section of the chart by reviewing the Vermont Lead Registry database. If lead screening was due at the appointment, this was communicated in the appointment notes for the provider to review and subsequently order. The goal was to make this information readily available to the provider during the visit, allowing them to offer the most up to date recommendations for lead screening based on the patient's screening status, with relevant past screening information readily available for reference. During a well-child check, the provider will see a final checkbox labeled “Is lead screening due?” This gives the provider an opportunity to review the necessary information and determine if the child needs to undergo lead screening.

A further protocol was introduced to the front desk staff. The front desk attached the lead screening PDF, "What Your Child's Lead Test Means," to each 12-month and 24-month visit packet to provide this information to the families and to comply with the Vermont Department of Health guidelines to include this information each time lead screening is performed. "What Your Childs Lead Test Means" was also included in each patient room and added to the room stocking protocols to ensure ease of distribution at each applicable visit.

At the time of this quality improvement project, there was no established protocol for chart prepping, inclusion of "What Your Child's Lead Test Means" information to parents at each lead screening visit, nor was there a reminder checkbox for lead screening, or lead screening health information to be prepped and relayed in the health maintenance section of the chart.

Intervention #2 Education Session

Multiple synchronous lead screening education sessions were offered over one week to all staff for one hour during lunch times throughout the week of September 23rd, 2024. Employees did not need to clock out for these training sessions, in effort to attract employees. These full staff meetings served as a refresher on the importance of lead testing for the community. They also informed the team about the protocol changes, including the addition of a checkbox in the well-child check template. New protocols for front desk staff, chart preparation, and the checkbox were introduced across the entire practice. Each attendee was provided a packet that contained pre and post education session surveys, copies of the slides reviewed during the presentation, an example of Vermont state lead testing results, a copy of Pediatric Blood Lead Testing Guidelines from the Centers for Disease Control, and a copy of "What Your Childs Lead Test Means" to review. Hard copies were meant to serve as a resource for future use

or for refresher purposes. This education session covered several lead screening topics, including Vermont laws, the definition of normal lead levels, what lead is, and more (see conclusive list of topics in Appendix B). Participants filled out pre-and post-education surveys to provide insight of the effectiveness of the education sessions.

Methods

A root cause analysis was conducted using a quality improvement framework to address low lead screening rates at the Small Rural Vermont Family Medicine Facility. This methodology was selected because it focused on identifying underlying causes of lead screening challenges and developing targeted solutions to improve lead screening practice outcomes. The Small Rural Vermont Family Medicine Facility was an ideal setting for this initiative, given its size, the strong motivation of stakeholders, and the demonstrated need to increase lead screening rates through root cause analysis. The primary and secondary aims, if implemented as designed, had the overall goal of increasing lead screening rates at the Small Rural Vermont Family Medicine Facility. The project's interventions were tailored to and developed by feedback and suggestions from a multidisciplinary team, which included Physicians, Nurse Practitioners, Registered Nurses, Medical Assistants, administrative personnel, and the PCMH team.

Baseline data on practice-wide lead screening rates were collected from the clinic's electronic health records. In addition, an assessment of current practices was conducted following informal meetings with providers. These meetings provided insights into potential barriers to lead screening and helped identify several root causes. These included the lack of a reminder system, inadequate provider and patient education, underuse of the health maintenance section within the electronic health record, difficulty identifying children who required

screenings, and insufficient engagement from the broader practice team in ensuring consistent screening.

The analysis revealed two primary factors contributing to low lead screening rates: insufficient ordering of lead screening tests by healthcare providers and patient refusal to have their children screened for lead exposure. This highlighted the need to identify a formal protocol to implement a reminder system for providers and improve patient education. Based on these findings, two targeted interventions were developed to address the identified barriers.

The primary intervention involved the integration of a visual cue in the form of a checkbox within the clinic's electronic health record, Medent, to prompt clinicians to order lead screening during well-child visits. The use of this cue was tracked through the electronic health record's checkbox functionality, allowing for a quantifiable measure of its implementation. A retrospective chart review was conducted to assess the impact of this intervention on lead screening rates before and after its implementation. Lead screening rates were measured for children at the following ages: 12 months, 24 months, and 3–6 years. Lead screening rates were defined as the percentage of children who visited the clinic for well-child checks at the specified ages (12 months, 18 months, 24 months, 30 months, and three to six years). Screening rates practice-wide for each age group were tracked using the Vermont Department of Health Lead Registry database, which required the reporting of all lead screening results.

The secondary intervention focused on improving provider and healthcare worker awareness, knowledge, and confidence regarding lead screening. This was measured using a pre- and post-education surveys, consisting of 10 questions assessing knowledge, confidence, and awareness. Nine questions used a Likert scale ranging from one (strongly unaware) to five (strongly aware), while one question used a yes/neutral/no format. The survey was administered

to providers and healthcare workers before and after the educational session (see Appendix A). To encourage participation, a sticky note was provided as a raffle ticket, allowing those who completed both the pre-and post-education surveys to enter a drawing for a five-dollar gift card to a local bakery. Each participant in the education session received a copy of a 17-slide PowerPoint presentation that was reviewed during the practice-wide education session, allowing employees to refer to it later. The session also included an example of a state lead result to review as a group, to help identify lead screening values, and a copy of the "Pediatric Blood Lead Testing Guidelines" from the Vermont Department of Health. This comprehensive document outlined criteria for testing asymptomatic children during well-child visits, indications for lead testing, guidelines for confirming capillary blood lead tests, follow-up procedures for venous retests, and clinical treatment guidelines for confirmed blood lead levels. Additionally, the educational packet included a document titled "What Your Child's Lead Test Means," which is a state requirement to provide each time lead screening is performed. During the week of September 23rd, 2024, multiple one-hour sessions were offered to accommodate varying employee schedules. Before-and-after surveys were collected at each session, along with the five-dollar raffle entry to be randomized.

Ethical Concerns

For the first aim, during retrospective chart review, only the minimum amount of data necessary to answer the specific aims of the project was collected. No data beyond checkbox usage was obtained from patients. Patient identities and personal health details were not required for this project. The project leader adhered to the Health Insurance Portability and Accountability Act regulations, which mandate strict guidelines for protecting patient privacy and managing health information. A waiver of informed consent was not necessary, as this quality

improvement project involved the use of data already collected as part of routine clinical care. All data collected was stored securely on a password-protected computer. Selection bias was minimized, as every eligible well-child check visit was accounted for during the study period.

For the second aim, data collected from the surveys were securely stored, with no names or personal identifying information collected to maintain participant anonymity. Participants were fully informed about the purpose of the study, the types of questions asked, and how their data would be used. Voluntary participation was emphasized, and participants were made aware that they could withdraw from the education session at any time. Data from the project were stored in a password-protected, secure location, and all responses were protected in the same manner. Reidentification of the raw data was not possible once analyzed by Excel. An incentive, an entry into a five-dollar bakery gift card drawing, was offered for completing the survey. Participants were informed upfront how the gift card would be distributed, and it was made clear that the gift card was not contingent upon specific answers. The survey was written in clear, simple language. All data collected from the surveys were used for this project.

The project leader was an employee at the Small Rural Vermont Family Medicine Facility where this project took place, and all data were observed objectively. This quality improvement project does not require Institutional Review Board review because it does not meet the definition of a research activity under the regulatory definition. This project did not involve traditional statistical testing; therefore, it was classified as a quality improvement project and not considered human subject research.

Data Collection

For the primary aim, a retrospective chart review though Medent, the electronic health record, was evaluated to see if clinicians were using the well-child check checkbox within the

well-child check template. Since the usage of the checkbox was being tracked, both checked and unchecked boxes were counted as "usage." Both responses were acceptable, as parents could decline testing, it might have already been done, or the test could be due. Usage was compared to the total number of eligible well-child checks, and data were collected for analysis.

For the secondary aim, pre-and post-education surveys were provided to each employee who participated in the lead screening education sessions (See Appendix A). 22 packets were handed out to each staff member, with eight participants being providers. Pre-and post-education surveys were collected and evaluated to determine whether healthcare provider awareness, confidence, and knowledge were enhanced by the sessions. The surveys were collected anonymously in an envelope before and after each session, along with the raffle entry.

Preliminary data were collected on September 12, 2024, from the Department of Health Lead Screening Registry, this data served as baseline information for lead screening rates performed at the Small Rural Vermont Family Medicine Facility. Final data were collected on October 26, 2024, from the same registry to determine if the primary and secondary aims were successful in increasing lead screening rates at the facility post implementation.

Measures

This study used a retrospective chart review and pre-and post-education surveys to assess the impact of the interventions' primary and secondary aims. The primary intervention involved updating the well-child check template in Medent to include a checkbox that prompted providers to order lead screening during well-child visits. The prompt read, "Is lead screening due?" The checkbox had two options: "Yes" or "No," indicating whether a lead screening was ordered for a child during the visit. In certain cases, either response was considered appropriate, depending on the child’s age, parental refusal, and screening history. The use of the checkbox as a reminder

tool was tracked by counting how often providers selected it during well-child check appointments. Both "Yes" and "No" responses were recorded and analyzed. Data was collected retrospectively through the electronic health system, offering insight into how often the reminder tool was used to prompt lead screening orders. The frequency of checkbox usage was compared to the number of eligible visits during the study period. Screening rates were defined as the percentage of children who received a lead screening during their scheduled well-child visits at the clinic compared to the eligible children requiring lead screening. These rates were tracked through the Vermont Department of Health Lead Registry database, which records reported lead screenings conducted statewide. Pre- and post-intervention data was analyzed to determine if the interventions improved lead screening rates at the Small Rural Vermont Family Medicine Facility.

The secondary aim assessed the impact of the education session on provider and healthcare worker knowledge, confidence, and awareness of lead screening laws and procedures was assessed using pre-and post-education surveys. The surveys consisted of 10 questions designed to assess participants' knowledge, awareness, and confidence regarding lead screening guidelines and protocols. Nine of the questions used a Likert scale ranging from one strongly unaware to five, strongly aware. One question used a yes/neutral/no format to assess awareness of specific lead screening laws. The pre-and post-education surveys allowed for a direct comparison of changes in knowledge, confidence, and awareness following the educational intervention.

Data Analysis

The analytic strategy for this project aimed to evaluate both the primary and secondary aims through a combination of data tracking and a comparison of pre- and post-intervention

outcomes. For the primary aim, the use of the designated checkbox for lead screening was tracked to evaluate whether its increased utilization would correlate with higher lead screening rates. The project designer hypothesized that a higher frequency of checkbox usage would lead to increased completion of lead screenings within the clinic. By analyzing the frequency of checkbox use compared to the total number of well-child check visits for eligible children, the goal was to establish a direct relationship between checkbox implementation and lead screening rates.

For the secondary aim, pre-and post-education surveys were developed to assess healthcare providers' and staff's confidence, awareness, and knowledge of lead screening practices. The surveys, which included a five-point Likert scale to measure these factors, were offered to all attendees of the educational session, and both complete and incomplete surveys were included in the analysis. The quantitative data collected from the surveys were analyzed using Microsoft Excel. The results from the Likert scale questions were presented in bar graphs to show the average responses, while the “Yes” and “No” question responses were summarized by percentages to illustrate changes before and after the intervention.

Finally, to assess the overall impact of the project on lead screening rates at the Small Rural Vermont Family Medicine Practice, lead screening data from the Vermont Department of Health were analyzed. Baseline lead screening rates, collected prior to the interventions, were compared to final data to evaluate whether the interventions led to a significant increase in lead screening rates, or if they had no noticeable impact on the practice’s screening rates.

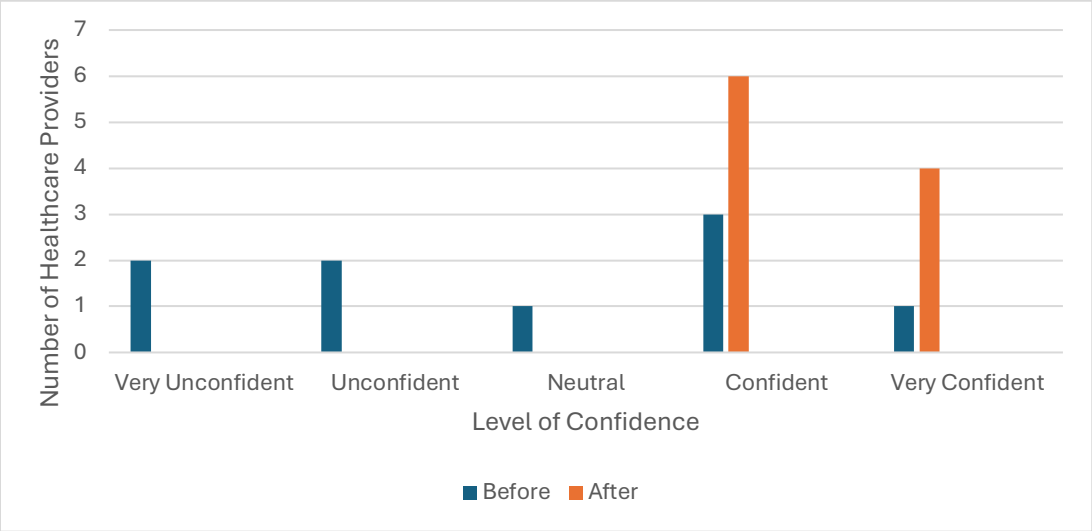
Results

For the primary aim of this study, data was collected during the survey period from September 23, 2024, to October 26, 2024. During this time, there were 12 opportunities to utilize

the check box feature. The check box was used seven times, resulting in a utilization rate of 58.33%, an increase from zero percent. Upon review, it was noted that there were two instances where the check box was not utilized, yet a lead screening was still ordered. No-show visits and acute visits were excluded from this analysis, only well child check visits were considered.

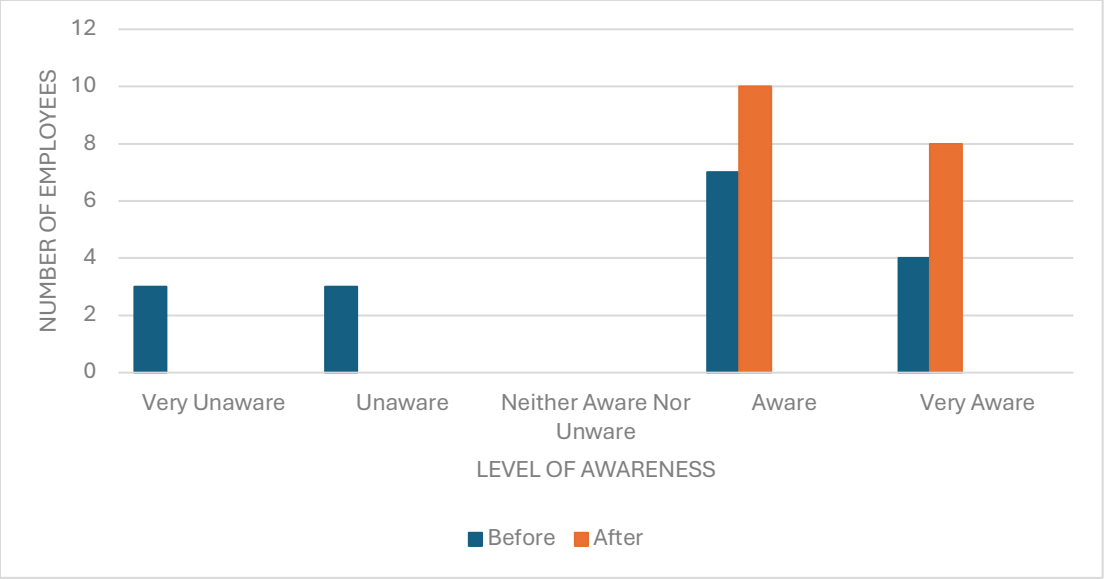
For the secondary aim, a comprehensive practice wide education session was conducted during the week of September 26, 2024. The outcome of this education session was positive. Notably, there was a significant increase in provider confidence with ordering lead screening for children, with most respondents in the confident and very confident range after this education session (Figure 1). Additionally, there was a significant increase in awareness of the Vermont state law mandating that lead screening be performed on 12-month-olds and 24-month-olds (Figure 2). 100% of the after surveys responded with a "Yes," indicating that this education session was helpful in the post-education surveys.

Figure 1
Provider Confidence with Ordering Lead Screening



Note. Number of health care providers who rated their confidence with ordering lead screenings for patients.

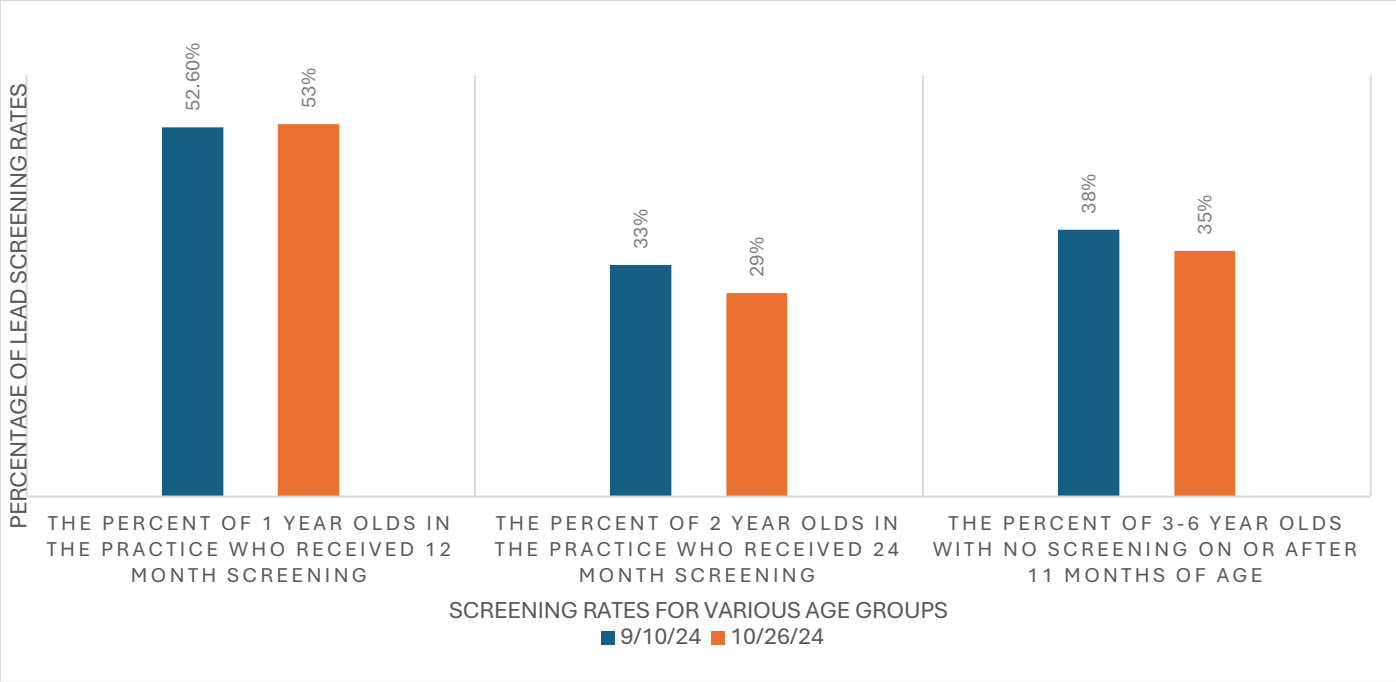
Figure 2
Practice Wide awareness of Vermont State Laws Requiring Lead Screening



Note. Number of employees who rated their awareness of Vermont state laws that require lead screening

This project did not result in an increase in lead screening rates within the practice (Figure 3). Lead screening rates remain below the 100% target recommended by the Vermont Department of Health. The data indicates no significant improvement in screening rates following the implementation of the two interventions, a check box addition and an education session.

Figure 3
Comparison of Practice Lead Screening Rates on September 10th, 2024, and October 26th, 2024



Note. Comparison of lead screening rates for specific age groups before and after the implementation of the project.

Discussion

Challenges Encountered and Actions to Address Challenges

Challenges encountered during the project included inconsistencies in pre-visit planning to prepare for the use of the checkbox. To address these challenges, meetings were held with Registered Nurses and Medical Assistants to review pre-visit planning procedures to make ease of use of the check box for providers more streamlined during pediatric visits. The implementation of the check box was introduced at each education session and at each practice wide morning meeting. New protocols were implemented in the chart preparation reference to include updating lead screening status for appropriate age groups with a guide of where to obtain this information.

Another challenge during the project was tracking the checkbox usage within the electronic health record. After multiple discussions with administrators, it was determined that

the checkbox could not be tracked directly, necessitating a chart review to gather data on its usage. If the practice wishes to continue using the checkbox, further discussions with the information technology department would have been required to assess whether its functionality could be adapted for future use. As a result, no measurable outcomes were identified during the project from adding the checkbox to the medical record template without incorporating additional steps, such as retroactive chart review, which can be time consuming.

Employee participation in the education sessions was another challenge. The before-and-after education session surveys indicated that the education session was effective, based on the responses collected. Participation was encouraged through a raffle entry, with reminders sent via email, and discussed at full staff morning meetings. However, of the 22 employees targeted for this quality improvement project, 18 participated in various educational sessions held throughout the week. Full employee participation could have promoted more lead screening engagement.

Evaluation of Observed Outcomes and Unintended Consequences of Intervention Implementation

No unintended consequences were discovered from the implementation of the primary and secondary interventions.

Project Impact

The practice was able to implement a new protocol to encourage lead screening using the checkbox with the primary aim. While there is room for growth, this tool has the potential to be effective if used as intended. The outcome of this intervention showed a utilization rate of the checkbox within the well child check template of 58.33%. With a 58.33% utilization rate, the practice continued to underachieve in screening children for lead, as higher rates of lead

screening were not demonstrated. This usage rate indicated that there was room for improvement in the use of the checkbox that was implemented for this quality improvement project.

The intervention of the second aim, which involved implementing a practice-wide education session on the importance of lead testing and the relevant laws, was successful as a training session. All participants reported feeling aware or very aware of Vermont state laws requiring lead screening for 12-month-olds and 24-month-olds after the session. Additionally, the education session helped increase providers' confidence in ordering lead screenings. The project did have a positive impact on provider confidence, knowledge, and awareness of lead screening. With increased knowledge, Physicians, Nurse Practitioners, Registered Nurses, and Medical Assistants were better equipped to educate patients moving forward. There are resources provided at the education sessions were intended to look back on to aid in patient education.

The project had moderate impact on the community of patients at this Small Rural Vermont Family Medicine Facility. Notably, the practice continued to fall short of the Vermont Department of Health's recommendation to test all children and remained below the Vermont state average for lead screening rates.

Comparison of Outcomes with Existing Literature and Quality Improvement Projects

For the primary aim, the intervention focused on modifying the electronic health record system to support providers in ordering lead screenings, with the overarching goal of increasing lead screening rates at the practice. The results of this project did not show the same level of improvement as seen in previous studies.

For the secondary aim, studies have shown that providing lead education to health care workers can increase lead testing rates. This quality improvement project did demonstrate that

education sessions was affective at increasing provider knowledge, however, did not lead to an increase in lead screening rates as demonstrated in prior studies.

Analysis of Factors Contributing to Differences Between Observed and Anticipated Outcomes

While this project did not achieve a significant increase in lead screening rates for 12-month-olds and 24-month-olds, it did lay the groundwork for using the electronic health record as a tool to improve lead screening practices. One limitation of the intervention was that pre-charting, an essential step for the checkbox process to be effective, required active completion by employees. This process might be more effective if further automated with lead screening completion dates, expanded use of the health maintenance section in the electronic health record, and reminders within the Medent system to reduce the burden on staff.

Possible reasons for the difference between observed and anticipated outcomes include the inconsistent use of the checkbox across patient appointment type. The checkbox was only utilized during well child check visits. Given the relatively low population of pediatric patients compared to adults at the project site, it may be beneficial to expand the lead screening check box to include acute visits, outside of the well child check appointments to capture more children for lead screening. It may also be easier to train staff to prepare charts for all child visits instead of certain well child check visits for consistency purposes.

The success of the project also depended on employee buy-in for both interventions. Not all staff members were equally engaged with the changes, which led to inconsistent implementation. Some employees may not have received adequate training on how to use the checkbox or may have missed the education session. Without full participation and proper training, the project's potential impact was diminished.

Furthermore, families of children who provide consent for screening played a critical role in the success of increasing lead screening rates. The education sessions were designed to improve awareness and give ideas for healthcare workers to provide education for families. The sessions provided ways to interact with patient refusal and provide education of the importance of lead screening.

Finally, there may have been inaccuracies or inconsistencies in data collection. For example, there were two instances where lead screening was ordered, but the checkbox was not utilized by the provider. Addressing these challenges in future implementations will be important to achieving more consistent results.

Limitations

Factors That Influenced Project Evaluation of Outcomes

Overall, challenges to performing lead testing at this Small Rural Vermont Family Medicine Facility were multifactorial. These challenges may have included the difficulty of completion of lead testing (i.e. preforming venous draw or fingerstick on young children), high turnover of employees, onboarding of new staff, lingering impacts of COVID-19, and the education of families who declined testing. The practice was not immune to staff turnover during the implementation of this project, meaning that employees were at varying levels of training at any given time. Combined with short staffing, this likely affected employee satisfaction and patient care, potentially contributing to the lower lead screening rates observed.

The ongoing Covid-19 pandemic could be affecting lead screening rates. A particularly striking statistic from the data collection phase of this quality improvement project was that 20 out of the 57 total children aged 36 to 72 months in the practice had not received lead screening

after 11 months of age. In the state of Vermont, between 2019 and 2021, the proportion of two-year-olds receiving blood tests dropped by more than 10 percentage points, and the testing rate for one-year-olds fell by about six percentage points (Weiss-Tisman, 2023). While blood lead testing rates in Vermont have slowly increased since the pandemic, they have remained below pre-pandemic levels (Weiss-Tisman, 2023). The ongoing Covid-19 pandemic could be a contributor to why lead screening rates continue to be low.

Parents declining lead screening may have influenced lead screening outcomes of this project. Although providers at this practice understood the importance of lead screening and recognized it as state-mandated post education session, the low screening rates persisted. This may have been due, in part, to patient refusal, which highlights the ongoing need for more targeted education for families eligible for lead screening.

Lead screening rates may have been influenced by the need for hemoglobin screening at the 12-month visit. Hemoglobin screening is a blood test that measures the level of hemoglobin in a child's blood, primarily to detect iron deficiency anemia. Screening for iron deficiency anemia is recommended in all young children at nine and 12 months of age. Children of this age group are likely to primarily breast feed and are at highest risk of iron deficiency anemia (*UpToDate*, n.d.). This may have contributed to higher screening rates for 12-month visits in comparison to 24-month visits, both at the state level and within the Small Vermont Family Medicine Facility, as one sample of blood is able to be used for both tests. However, because the practice did not have point-of-care testing for lead or hemoglobin, blood draws, typically venous, were required to capture both the hemoglobin and lead levels. This presented a challenge, as only two staff members were trained to draw blood on pediatric patients, limiting the capacity to perform these tests. State testing with capillary draws started August 28th, 2024, at the project

site, involving a finger stick to complete the testing. This allowed more employees to be able to complete lead screening during patient visits as opposed to a venous draw.

Efforts to Minimize and Adjust for Limitations

Tracking patient refusals could provide valuable insight into why lead screening rates are low at this practice. It could show if lead screening was offered but declined or if lead screening was overlooked. Analyzing patient panels per provider could reveal if certain providers were more likely to have low screening rates, enabling more tailored education for providers with lower adherence to the Vermont Department of Health recommendations.

One suggestion was to designate nurse "lead champions" within the practice to follow up with families, call patients who were due for screening, perform pre-visit planning, and track those eligible for testing. Managing the pediatric patient population for lead screening could also have been more effective if a designated nurse tracked which children were due for screening, provided education, and made follow-up calls to parents to schedule appointments. Pediatric patients could be managed more efficiently, particularly if the nurse could coordinate and track these patients' appointments.

An additional strategy would be to review patient panels and determine if children listed as eligible for screening were still active patients of the practice. Some children may have moved away with their families but remained on the Vermont Department of Health records, which could have skewed the data and impacted screening rates. With a relatively low population of pediatric patients, having patient results that are not truly apart of the practice anymore can skew lead screening rates.

In future efforts, these proposed solutions could help address the underlying challenges and improve lead screening rates at the practice, ensuring that more children are tested in

accordance with state guidelines. Actionable future efforts could include tracking patient refusals, provider specific analysis and tailored education, designating nurse "Lead Champions," pre-visit planning and tracking for pediatric patients, verifying active patient status, and staff training and capacity building.

Conclusions

For the primary aim, the introduction of the check box feature in the electronic health record indicates that the intervention was successfully implemented, although the utilization rate remained lower than expected, suggesting that there is room for improvement in using this tool in routine practice.

This project highlighted the importance of a collaborative, interdisciplinary approach in achieving improvements in care. The project underscores the critical role of Registered Nurses and Medical Assistants, in implementing and supporting improvement initiatives. These roles were directly involved with pre-visit planning using the state record and education sessions. Registered Nurses can serve as champions for lead screening by supporting providers in utilizing the electronic health record effectively, educating families, and ensuring follow up care. Future implications suggest that nursing teams should be trained not only in the technical aspects of lead screening but also in motivating patients and families to participate in screenings, especially when faced with parental reluctance. For sustainability of this project, its crucial to ensure that the use of the electronic health record checkbox feature becomes fully integrated into the clinic's workflow. Future interventions include training for staff, including new hires, and regular reinforcement of the importance of using the checkbox.

For the secondary aim, the education session was conducted practice wide, was well received, and had a significant positive impact. All participants reported that this education

session was helpful, underscoring the sessions value in enhancing staff knowledge and confidence regarding lead screening practices. The education sessions not only increased provider confidence but also raised awareness across the entire practice about the importance of lead screening, potentially leading to better patient outcomes. For families, having a healthcare provider equipped with knowledge and confidence about lead screening can help build trust and encourage compliance of lead screening recommendations from the Vermont Department of Health.

The overall results of this project indicate a positive, but moderate impact on the practice's lead screening efforts and highlights areas for further improvement. This project lays the groundwork for future projects to improve lead screening rates in pediatric populations. For replicability of this project, key components like provider education, the use of the electronic health record for lead screening reminders, and ongoing staff engagement could be adapted for other healthcare settings facing similar deficits. Addressing the root causes of patient refusals and increasing family education could promote higher participation rates.

The project's outcomes have the potential to positively impact care, particularly among vulnerable pediatric populations who are at risk of lead poisoning. As lead exposure is preventable, improving lead screening rates directly benefits children by identifying those at risk early and allowing for timely intervention. Improving screening rates could have a broader population level impacts by reducing the incidence of lead poisoning, especially in at-risk groups such as children from low-income households, minority communities, or those enrolled in Medicaid. Overall, while the project demonstrated positive outcomes, such as improved provider confidence, and a moderate increase in electronic health record check box utilization, further

efforts will be needed to fully integrate these practices into routine workflow and to ensure more consistent application across the practice.

On a larger scale, these improvements in lead screening can contribute to better health equity by ensuring that all children, are given the same opportunities for early identification and intervention for lead exposure. Continued focus on education, process improvement, and system integration will be crucial to sustaining and expanding the impact of this work at the Small Rural Vermont Family Medicine Facility for the future.

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Appendix A

Survey Questions

Questions for this survey were the same for pre-and post-session.

Confidence Assessment (5-point Likert Scale)

- Options: Very Confident, Confident, Neutral, Unconfident, Very Unconfident
    - How confident are you with ordering lead screening?
    - How confident are you with providing education to a patient on the topic of lead screening?
    - How would you rate your confidence on the topic of lead screening?

Awareness/Knowledge Assessment (5-point Likert Scale)

- Options: Very Unaware, Unaware, Neither Aware nor Unaware, Aware, Very Aware
    - How would you rate your awareness of the following aspects of lead screening?
        - Vermont state laws requiring lead screening for 12-month-olds and 24-month-olds.
        - Knowledge about studies showing there are no safe levels of lead in children.
        - Guidelines for lead screening and handling results by the Vermont Department of Health.
        - The Vermont Department of Health's "What Your Child's Lead Test Means" handout and the state law to provide this to parents.
        - Importance and significance of lead screening in children under six.

Learning Feedback

- Options: Yes, neutral, no
    - Do you feel this learning on lead screening was helpful?

Appendix B

Lead Education Power Point Topics

Presentation objectives include:

- Why is there a need for this
  - Review Vermont laws
  - Definition of "normal lead levels."
  - Current practice statistics
- Introduce evidenced based practice
- Introduce DNP project
- Introduce PCMH projects
- Introduce lead
  - What is lead?
  - Why are children more at risk?
- Patient education
  - Who are children exposed to lead?
  - Ways to reduce lead exposure
- Case study
- Indications for lead testing per Vermont Department of Health
- Why do we care?
  - Vermont law
  - Health consequences
  - State tracking
- How is lead testing performed?
- What do you do with a high lead reading?
- How is everyone involved with increasing lead screening rates at this Small Rural Vermont Family Medicine Facility?
- Guidelines

Appendix C

What Your Child's Lead Test Means

VERMONT
DEPARTMENT OF HEALTH

What Your Child's Lead Test Means

July 2022

State law requires that all Vermont children are tested for lead at age 1 and again at age 2

There is no safe level of lead in the body. A child can be hurt by lead and still look healthy. Lead can harm a child's growth, behavior, and ability to learn. The only way to find out if your child has been exposed to lead is with a blood test.

Children are usually first tested with a capillary test – a small amount of blood taken from a finger, heel or toe – at their 1- and 2-year-old well child visits.

If lead is detected in your child's blood, they may need to be monitored or the result may need to be checked again with a venous test. This test uses blood from a vein (often in the arm). The venous test result is more accurate.

What can you do?

- Getting your child tested for lead is the first step. You did this!
- Schedule a venous test if your child's level is 3.5 µg/dL (micrograms per deciliter) or higher.
- No matter what your child's blood lead level is, learn how to protect your child from being exposed to lead. Visit healthvermont.gov/lead or call the Healthy Homes Lead Poisoning Prevention Program at 802-863-7220 or 800-439-8550.

Capillary Blood Lead Result	When to confirm with a venous blood test	
No detected lead (DL)	**No Confirmation needed.** There is no detected lead in your child's blood.	
DL – 3.4 µg/dL	**Monitor over the next 6 months with another test.** There is very little lead in your child's blood. Review sources of lead to keep your child's lead level from rising.	
3.5 – 9 µg/dL	**1 month to 3 months.** If confirmed, your child has more lead than most children. Take steps to reduce sources of lead. The Health Department will contact you to help you find sources of lead.	
10 – 44 µg/dL	**2 weeks to 1 month.** If confirmed, your child's lead level is high. You and your doctor should act quickly to reduce sources of lead and discuss your child's diet, growth and development. The Health Department can visit your home to help you find where lead may be coming from.	
45 – 59 µg/dL	48 hours	If confirmed, your child will need medical treatment right away. Consult with your doctor and reduce lead sources immediately. The Health Department can visit your home to help you find where lead may be coming from.
60+ µg/dL	Immediately	
The higher the capillary test result, the more urgent the need to confirm with a venous test.		
Your child's test result _____ µg /dL Date _____		

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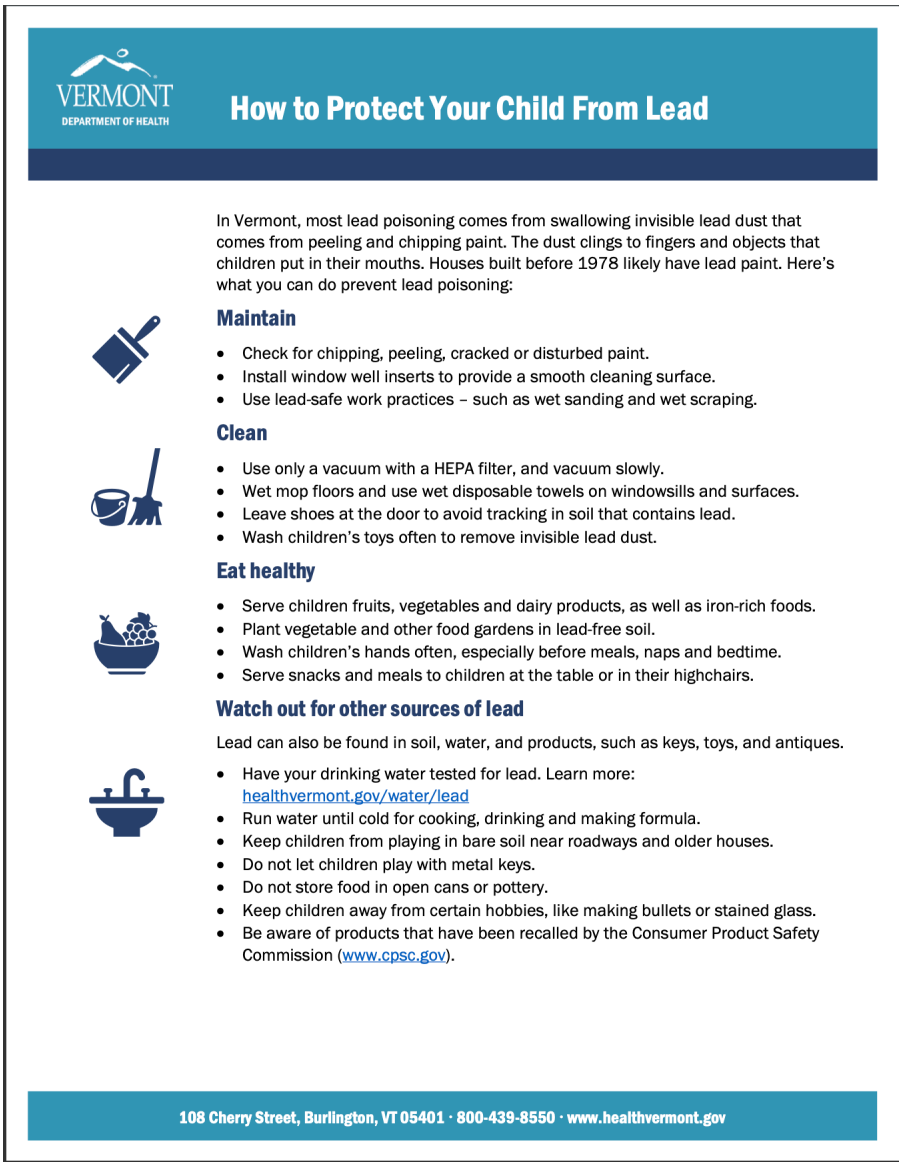

VERMONT
DEPARTMENT OF HEALTH

How to Protect Your Child From Lead

In Vermont, most lead poisoning comes from swallowing invisible lead dust that comes from peeling and chipping paint. The dust clings to fingers and objects that children put in their mouths. Houses built before 1978 likely have lead paint. Here's what you can do prevent lead poisoning:

Maintain

- Check for chipping, peeling, cracked or disturbed paint.
- Install window well inserts to provide a smooth cleaning surface.
- Use lead-safe work practices – such as wet sanding and wet scraping.

Clean

- Use only a vacuum with a HEPA filter, and vacuum slowly.
- Wet mop floors and use wet disposable towels on windowsills and surfaces.
- Leave shoes at the door to avoid tracking in soil that contains lead.
- Wash children's toys often to remove invisible lead dust.

Eat healthy

- Serve children fruits, vegetables and dairy products, as well as iron-rich foods.
- Plant vegetable and other food gardens in lead-free soil.
- Wash children's hands often, especially before meals, naps and bedtime.
- Serve snacks and meals to children at the table or in their highchairs.

Watch out for other sources of lead

Lead can also be found in soil, water, and products, such as keys, toys, and antiques.

- Have your drinking water tested for lead. Learn more: healthvermont.gov/water/lead
- Run water until cold for cooking, drinking and making formula.
- Keep children from playing in bare soil near roadways and older houses.
- Do not let children play with metal keys.
- Do not store food in open cans or pottery.
- Keep children away from certain hobbies, like making bullets or stained glass.
- Be aware of products that have been recalled by the Consumer Product Safety Commission (www.cpsc.gov).

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(HealthVermont.gov, 2022)

Appendix D

CERTIFICATION

TO: Karly Fischer

DATE OF CERTIFICATION: Wednesday, May 1, 2024 - 09:39

SUBJECT: Establishing a Protocol and Providing Education for lead screening at a Rural Family Medicine Facility for Children

Based upon answers to the self-determination tool, this project does not require IRB review because it does not meet the definition of a "research" activity under the regulatory definition. According to 45 CFR 46.102(d), the definition of "research" is "a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge."

Projects that are not a systematic study or are not intended to contribute to generalizable knowledge, e.g. quality assurance, quality improvement, program evaluation, or public health practice, do not require IRB review.

This certification can be provided as documentation that this project does not meet the definition of research. Public presentations, academic curriculum vitae, publications, etc., with a planned statement similar to *"According to the policy defining activities which constitute research at the University of Vermont/University of Vermont Medical Center, this work met criteria for operational improvement activities exempt from ethics review."*