Increasing lipid screenings in children 9–11 years old at a federally qualified health center - A quality improvement project

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ABSTRACT

Background: Coronary artery disease (CAD) remains the leading cause of death in the U.S. Atherosclerotic changes leading to CAD begin in early childhood. Universal lipid screenings remain low nationwide despite the 2011 National Heart, Lung, and Blood Institute's (NHLBI) Expert Panel Guidelines.
Local problem: The aim of this quality improvement project was to examine the benefit of an educational intervention on the implementation of universal lipid screening guidelines within a federally qualified health center tasked with providing care to a high-risk population.
Intervention: An educational intervention was offered detailing the 2011 NHLBI guidelines. A total of seven medical providers participated in the intervention.
Method: Following the intervention, a pre- and post- knowledge survey was given to assess improvement in knowledge. A retrospective chart review was performed to evaluate application to practice.
Results: The number of lipid screenings improved from 7.8% ($n = 384$) pre-intervention to 39.2% ($n = 74$) post intervention. There was a statistically significant increase in screenings post-intervention t $(456) = 7.842$, $p = .000$, two-tailed).
Conclusion: More studies are needed to adequately identify the impact of universal screening guidelines on the health of both children and adults alike.
Practice implications: Universal lipid screenings remain promising in early identification of CAD in the pediatric population. Interventions related to expanding the knowledge of healthcare providers, patients, and families are key to decreasing CAD morbidity and mortality.

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Coronary artery disease (CAD) is the leading cause of death of adults in the United States (U.S.) (Benjamin et al., 2018; Kelishadi et al., 2015). Coronary artery disease is a build-up of plaque in the arteries that can lead to hardening and rupturing of the arteries over time (National Heart, Lung, and Blood Institute [NHLBI], 2015). CAD is the precursor to stroke, heart attack, and peripheral arterial disease (NHLBI, 2011). Coronary heart disease accounts for one out of every seven deaths in the U.S. (American Heart Association, 2017). Studies have shown that atherosclerotic changes caused by hyperlipidemia can be seen as early as two years of age (Lozano et al., 2016). Research has clearly demonstrated that pediatric hyperlipidemia increases cardiovascular risk (NHLBI, 2011). The Bogalusa Heart Study evaluated the natural course of cardiovascular disease beginning in childhood over a 37-year period and determined that adolescents with dyslipidemias had significant increases in cardiovascular disease in adulthood (Magnussen et al., 2009).

The pediatric population can be at an increased risk of cardiovascular disease due to traditional risk factors (obesity, family history, diabetes, and hypertension) and high-risk medical conditions (chronic kidney disease, chronic inflammatory disease, childhood cancer, and congenital heart disease) (de Ferranti et al., 2019). The 2011 guidelines recommended universal cholesterol screenings for children 9–11 years of age and again 17–21 years of age to promote early identification of hyperlipidemia and, thereby, offer treatment modalities (NHLBI, 2011).

Review of literature

Early identification of children at risk for cardiovascular disease through population-focused interventions has been suggested throughout the literature. A cross-sectional analysis of 482 children by Sultan et al. (2017) found that hyperlipidemia was more prevalent in children with arterial ischemic stroke and suggested that early identification of risks factors could possibly help reduce ischemic events. Although higher lipid levels were found in overweight and obese children, evidence from a random sample of 802 school- age children in Ghana

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suggested the need for population related interventions to reduce the risk of cardiovascular disease in adulthood (Lartey et al., 2018). Brzeziński et al. (2020) evaluated the frequency of lipid disorders in overweight and obese children and adolescents. In the study, 38.23% of girls and 40.51% of boys were found to have a lipid disorder. This finding provides evidence for the need for population –based effective screening methods. Gourgari et al. (2017) found that children with Type 1 diabetes had subclinical cardiovascular disease with contributing modifiable risk factors such as hyperlipidemia. The study suggested the need for more research on the reduction of modifiable risk factors and the effect of cardiovascular disease.

Literary evidence exists that supports the use of educational interventions along with quality improvement measures to increase lipid screening practices. Wilson et al. (2015) and Kern et al. (2017) evaluated the effectiveness of educational interventions on improving lipid screenings in 9- to 11-year-olds and found that educational interventions increased universal lipid screenings. Although met with barriers related to provider attitudes and behaviors, Wilson et al. (2015) was able to increase screenings from 17.1% to 20.1% by providing an educational program to staff that included the 2011 guidelines, as well as health outcomes associated with hyperlipidemia. Kern et al. (2017) was able to increase screenings by 64.3% by providing education and an electronic health record (EHR) prompt, but their study also reported barriers related to providers' perceptions of cost effectiveness and impact. Like Kern et al. (2017), DeSantes et al. (2017) improved lipid screenings to 50% with EHR modifications and an educational initiative.

In a quasi-experimental pilot study by Gilbertson and Graves (2015), it was determined that health promotion on cardiovascular disease risk which included universal lipid screenings had a 23.08% effect on parents' willingness and desire to implement lifestyle changes. This finding may encourage providers and help eliminate a barrier to universal screenings.

Although there is limited data from randomized controlled trials, findings from many studies support the need for guideline adherence to improve cardiovascular risks while acknowledging the need for further evaluation and evidence from practice (Gilbertson & Graves, 2015; Kelishadi et al., 2015; Kern et al., 2017; Mihalopoulos et al., 2018; Sriram et al., 2017; Wilson et al., 2015).

Another possible reason for poor guideline adherence is related to the controversial stance of the United States Preventive Service Task Force (USPSTF). The U.S. Preventive Services Task Force (2016) issued a Grade I statement and concluded that the current evidence was insufficient to properly evaluate benefits and harms of universal lipid screening. A report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines surmised lipid screenings in children and adolescents with risks factors as a IIa recommendation (reasonable and effective); while screenings in those without cardiovascular risk factors as a IIb recommendation (may be effective/unclear) (Grundy et al., 2019). A systematic review of 21 relevant studies with nine meeting inclusion criteria performed by Smith et al. (2016) concluded that universal lipid screenings may offer positive effects, but the overall impact on health remained understudied. Likewise, Belamarich (2015) argued that the there was no evidence to directly link the presence of pediatric cardiovascular risk factors to adult cardiovascular disease and that guidelines were formed based on a chain of indirect evidence that needed further evaluation with long term studies. Berger et al. (2021) determined low lipid guideline adherence in the presence of high lipid disorders in children and adolescents necessitated further evaluation of obstacles to lipid screenings in children. To increase the evidence base and the strength of the recommendations, more studies are needed that will help resolve controversies and questions.

The lack of guideline implementation with universal lipid screenings increases the likelihood of missed opportunities to implement preventative primary care. Improvement to the current lipid screening rates and guideline usage is needed. To accomplish this task, a quality

initiative to improve guideline adherence utilizing Pettigrew and Whipp's Content Context, and Process Model was implemented. The overarching question that guided this quality improvement project was: Following an educational intervention with the NHLBI guidelines presented to providers, how did the number of lipid screenings and provider adherence to guidelines compare to the number of lipid screenings prior to the intervention.

Background

Although guidelines were introduced in 2011, uptake of the guidelines into practice has been slow (Berger et al., 2021; Mihalopoulos et al., 2018). Healthcare providers' lack of familiarity with the guidelines commonly leads to poor guideline adherence (de Ferranti et al., 2017). Increasing guideline adherence may greatly contribute to better health outcomes associated with CAD (Wilson et al., 2015). Educational interventions related to increasing knowledge of the 2011 NHLBI universal lipid screening guidelines can increase lipid screenings within the pediatric population (de Ferranti et al., 2017).

Elevated lipids in childhood and adolescence lead to poor health outcomes in adulthood (NHLBI, 2011). Family history and obesity alone have shown not to be effective in predicting hyperlipidemia in children (Kelishadi et al., 2015). Universal lipid screenings in children based on the NHLBI guidelines produces a greater yield of identified dyslipidemias (NHLBI, 2011). To promote high- quality patient care and better health outcomes for children and future adults, evidence-based guidelines must be implemented into practice.

Federally Qualified Health Centers (FQHC) have been tasked with providing care to a fast growing low-income, uninsured or Medicaid insured, racial and ethnic minority population living in rural and urban areas (Livernois, 2016). In the southern region, death from coronary artery disease is more prevalent among people living in rural areas as compared to northern regions (Kulshreshtha et al., 2014). This population is at an even greater risk for having hyperlipidemia and comorbidities because obesity, low socioeconomic status, and race have proven to increase cardiovascular risk (Rogers et al., 2015). Another important trend in the patient population of FQHCs is the increase in young patients ages 0 to 19-years-of-age (Livernois, 2016). This quality improvement project's purpose was to evaluate whether an educational intervention provided to clinical staff within a selected health clinic would increase the number of lipid screenings performed and increase provider knowledge of pediatric hyperlipidemia.

Agency internal data

The setting for this QI project was a FQHC located in the southern United States. The demographics of the proposed organization are a mirror of the FQHCs around the country and indicate a great need for early detection and prevention.

Currently, pediatric care at the selected setting is provided by three physicians, six nurse practitioners, and two physician assistants at the organization. These medical providers have an age range of 30–65 years of age. The setting has a patient population that is 25.50% insured by Medicaid and 20.92% uninsured with an ethnic mix of 60.24% African American, 8.14% Hispanic/Latino, and 32.98% Non-Hispanic White. Approximately 4600 children under the age of 18 years of age currently receive care at the facility which accounts for 21.26% of the patient population at the site. Over 98% of the patients are at or below 200% of poverty.

Prior to the initiation of this QI project, a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis needs assessment tool revealed that only 7.8% of children aged 9 to 11-years-old were being screened for hyperlipidemia. Total cholesterol (TC) levels of greater than 200 mg/dL with a range of 200 mg/dL-236 mg/dL were identified on five children between the ages of 9 and 11, and an astounding 40% had some form of dyslipidemia. While most patients identified with

hyperlipidemia had body mass indexes (BMI) of greater than the 95th percentile, 16.7% had normal BMIs ranging between the 5th to 85th percentiles. A TC of 205 mg/dL and a non- HDL of 151 mg/dL was found in an 11-year-old male with a BMI in the 5th to 85th percentile range. Of the eleven medical providers caring for children, only the pediatricians routinely engaged in universal lipid screenings in eleven-year-olds. Lipid screenings were determined to be cost-effective based on 100% insurance reimbursement by both public and private insurance during well-child visits, as well as arrangements with an outside laboratory service provider to provide low to no cost lab services for uninsured patients. Despite the factors, the setting had not systematically implemented the NHLBI 2011 guidelines.

Theoretical framework

To implement the universal lipid screening quality improvement project, Pettigrew and Whipp's Content, Context, and Process Model of strategic change was applied. According to Pettigrew and Whipp (1991), successful change is a constant interaction between the content, the process, and the organizational context. This theoretical framework has been used to analyze and evaluate change in organizations by focusing on the why, what, and how of strategic change (Bohnet-Joschko & Boutsioli, 2014). This change model identifies five factors linked to successful change: environmental assessment, human resources as assets and liabilities, linking strategic and operational change, leading change, and operational coherence (Pettigrew & Whipp, 1991). The objective of the proposed project was to increase the number of children screened for hyperlipidemia between age 9 and 11 by 50% and to increase the knowledge level of physicians, nurse practitioners, and physician assistants on diagnosing and treating hyperlipidemia in children within the selected setting.

Methodology

Project design

Approval from the Institutional Review Board (IRB) of the University of Alabama was obtained prior to the implementation of this project. The FQHC employs 25 medical providers with 11 pre-identified as possible project participants. Participants were recruited via an email invitation if they met the inclusion criteria of providing care to children ages 9 to 11-years-old. The evidence –based protocol approach was utilized to incorporate the evidence-based 2011 NHLBI guidelines into practice via a quality improvement initiative. An author developed PowerPoint presentation detailing the risks associated with cardiovascular disease and the need for universal lipid screenings was given to all providers caring for children 9 to 11-years-old. The PowerPoint presentation also outlined the 2011 NHLBI guidelines and instructed providers on how to apply guidelines in practice. The 2011 NHLBI Dyslipidemia Treatment Algorithm was provided to all participants. Instruction was given to participants to screen 9 to 11-year-old children with a non-fasting and/or fasting lipid panel to include a total cholesterol, LDL, and HDL. Handouts were given to providers to use for reference. These handouts featured the 2011 NHLBI guidelines including the dyslipidemia treatment and management algorithm.

Following a 6-week project implementation period, data collection and chart review was conducted. The number of pre-intervention lipid screenings were compared against the number of post-intervention screenings. Data were collected via a retrospective chart review using computer-generated de-identified reports. Charts meeting the inclusion criteria were assigned a unique project number. A pre- and post- knowledge survey was given to participants to solicit the participants' perceived benefit of the quality improvement project as well as their change in knowledge on the subject (See Appendix). The survey was collected and evaluated using a de-identified unique project participant code using the participant's last two digits of their social security number, the two digits of their birth month (01–12), and their middle initial (if they had one).

Knowledge survey

A modified *Knowledge, Attitudes, and Practices (KAP)* survey was used to assess participant knowledge and attitudes due to the instrument's tested validity and reliability in past studies (World Health Organization, 2008). A 14-item questionnaire was used to assess knowledge prior to the educational intervention and after the educational intervention. The pre-knowledge survey consisted of six multiple choice questions and four true/false questions. All items were closed questions as described in the *KAP* survey. These items were followed by a four item-Likert scale questionnaire assessing confidence and knowledge. The post-knowledge survey was a mirror of the pre-knowledge survey with the addition of a two item Likert-scale questionnaire assessing practice (See Appendix).

Data collection and analysis procedures

Analyzed data provided the net change in lipid screenings using descriptive statistics and *t*-tests. The quantitative pre- and post-knowledge survey were analyzed by converting all non-numerical data into a unique numerical code followed by statistical analysis using the Wilcoxon Signed Rank test and the McNemar's test. The analyses were performed using the SPSS statistical software.

Protection of human rights

All efforts were made to protect human subjects. The Institutional Review Board's (IRB) protocol was followed. The project was a quality improvement measure with data collected from records; there was no investigator access to patients. All participation in the quality improvement project was voluntary and participants were given written informed consent. There was no identifying information on any reports or publications related to this project. De-identified data was stored in a secure locked file cabinet.

Findings

Of the medical providers caring for children 9 to 11 years old, 63.6% ($n = 7$) participated in the project. A Wilcoxon Signed Rank test revealed a statistically significant improvement in knowledge related to the prevalence of hyperlipidemia in children ($z = -2.23, p = .025$), the earliest age of onset of hyperlipidemia ($z = -2.00, p = .046$), recommendations for fasting versus non-fasting lipid panels ($z = -2.00, p = .046$), and when to repeat an abnormal lipid panel ($z = -2.45, p = .014$). The responses to the referenced questions all indicated a large effect size $r = 0.60, 0.53, 0.53,$ and 0.65 respectively. The educational intervention did not yield a statically significant improvement in participants' confidence in ordering a lipid panel on a child, diagnosing hyperlipidemia in children, or educating parents and children on the risks of cardiovascular disease (Fig. 1). However, a Wilcoxon Signed Rank test did reveal a significant improvement in participants' confidence in treating hyperlipidemia in children, $z = -2.33, p = .020$.

Guideline usage prior to the educational intervention was reported by 14% of the participants. Seventy-one percent of participants reported planning to use the 2011 NHLBI treatment algorithm for hyperlipidemia because of the program. The number of lipid screenings performed post intervention was 39.2% ($n = 74$) compared to 7.8% ($n = 384$) pre-intervention (Fig. 2, Fig. 3). An independent -samples *t*-test was conducted to compare the number of lipid screenings pre- intervention and post-intervention. There was a statistically significant increase in screenings post-intervention from pre-intervention screenings ($t (456) = 7.842, p = .000$, two-tailed). The magnitude of the differences in the means (mean difference = 0.314, 95% CI: 0.235 to 0.392)
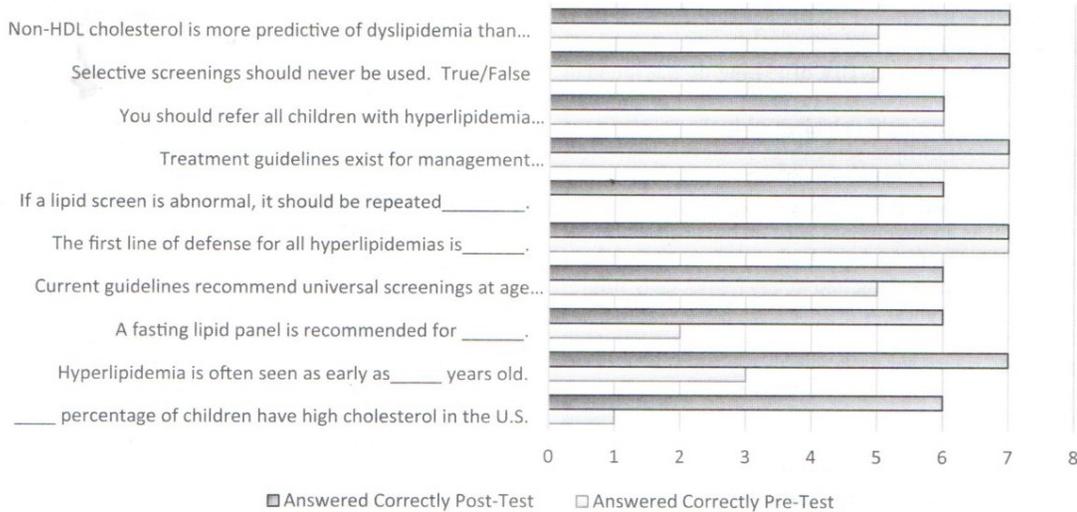
Fig. 1. Testing hyperlipidemia knowledge. This figure illustrates the results from Pre- and Post- Universal Lipid Screening Knowledge Survey.

was a moderate effect (eta squared = 0.12). Of the children with lipid screenings post-intervention, 72.4% ($n = 21$) were 11 years old, 13.8% ($n = 4$) were 10 years old, and 13.8% (n = 4) were 9 years old. However, 77.8% of all children 11 years old, 25% of all children 10 years old, and 12.9% of all children 9 years old presenting for well child exams had lipid panels drawn.

After the educational intervention, 37.9% of lipid panels were performed on obese children and 58.6% were performed on normal weight children. Total cholesterol levels ranged from 112 mg/dL-223 mg/dL in screened individuals. Borderline-high to high total cholesterol was found in 34.5% of those screened for hyperlipidemia. Elevations in non-HDL cholesterol were found in 31% of those screened. There was no statistical difference in the total cholesterol values of overweight versus normal weight children ($p = .35$); however, elevations in triglycerides were statistically higher in overweight children ($p = .04$) (Table 1).

Discussion

Educational interventions to healthcare providers offer a tremendous possibility for increasing guideline adherence for the identified pediatric population who need to be identified and, thereby, provided treatment and follow-up monitoring to reduce this health threat. This educational intervention improved the usage of lipid screening guidelines and promoted provider confidence. However, there continued to be many missed opportunities for screenings, and the concept of

universal screenings was not adopted. All eligible providers did not participate in the project, however, reasons for nonparticipation were not solicited. A change in the administration of the QI project setting around the initiation of the project provided a challenge as well. The new administration was only interested in implementing guidelines recommended by the USPSTF as categories A and/or B.

Practice implications

Research has shown that early identification, management, and treatment of hyperlipidemia can drastically reduce cardiovascular events, co-morbidities, and early deaths (Wilson et al., 2015). Selective, targeted screenings of children with risk factors have been shown to unsuccessfully identify a pediatric population at risk for familial hyperlipidemia and other dyslipidemias (Kelishadi et al., 2015). Universal lipid screenings remain promising, but more studies are needed to affirm the true value on decreasing cardiovascular risks and to assess providers' willingness and/or unwillingness to utilize the 2011 NHLBI guidelines. Interventions related to expanding the knowledge of healthcare providers, patients, and families are key to decreasing CAD morbidity and mortality.
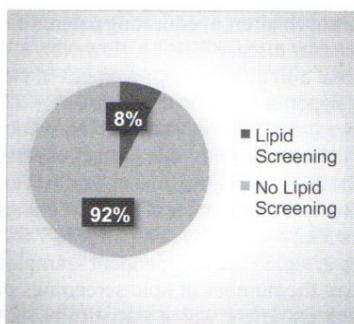

Fig. 2. Pre-intervention lipid screenings. This figure illustrates the results of the number of pre-intervention lipid screenings performed.
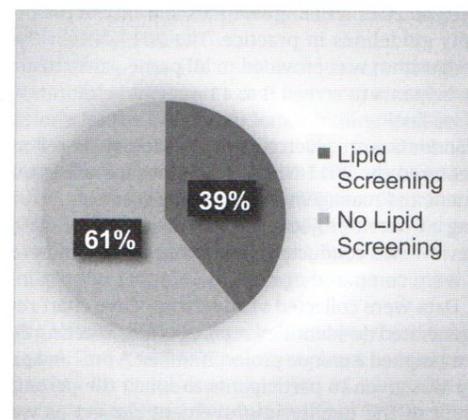

Fig. 3. Post-intervention lipid screenings. This figure illustrates the results of the number of post- intervention lipid screenings performed.

Table 1
Blood lipid levels of children aged 9 to 11 screened after intervention.

Blood lipid indicators	Normal Weight ($n = 17$) Mean $\pm$ SD	Overweight/Obese ($n = 12$) Mean $\pm$ SD	*p*-value
Total Cholesterol	164.1 $\pm$ 34.6	159.8 $\pm$ 21.2	0.35
LDL[1] Cholesterol	89.4 $\pm$ 26.8	91.8 $\pm$ 20.4	0.39
Non- HDL[2] Cholesterol	107.4 $\pm$ 30.1	113.3 $\pm$ 24.6	0.29
HDL[3] Cholesterol	52.8 $\pm$ 13.2	46.4 $\pm$ 10.3	0.09
Triglycerides	82.5 $\pm$ 34.7	112.2 $\pm$ 55.8	0.04

[1] Low-density lipoproteins cholesterol.

[2] Non- high density lipoproteins cholesterol.

[3] High-density lipoproteins cholesterol.

Limitations

One major limitation of this project was a change in the selected setting's administration during the project. The change in administration lead to decreased provider participation due to perceived time constraints. The administration's focus shifted to increasing patient numbers. Many providers felt the added task of implementing the guideline would be too time consuming. Other limitations of the project included a small sample size and a single organization which both limited generalizations.

Conclusion

Many factors play a role in the successful implementation of universal lipid screening guidelines. The willingness of healthcare providers and facilities in the adoption of the guidelines is paramount to realizing the full benefits of universal lipid screenings in children aged 9–11 years old. While this QI project focused on increasing the knowledge of the healthcare provider, it lacked the inclusion of parents and family members. Future QI projects focusing on parental involvement and knowledge expansion related to CAD, especially in children with a family history of CAD, could improve cardiovascular outcomes and decrease health disparities. Preventative health care is key for the underserved, underinsured populations in both rural and urban areas. More studies are needed to adequately identify the impact of universal screening guidelines on the health of both children and adults alike.

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Credit authorship contribution statement

Letisha Scott: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. **Linda Dunn:** Supervision, Writing – review & editing. **JoAnn Oliver:** Writing – review & editing.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pedn.2022.07.007.

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