

Childhood Obesity: Implementing a Provider Alert System

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Author Note

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She has no known conflict of interest to disclose.

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Abstract

Childhood obesity is on the rise, leading to the development of comorbid diseases. New guidelines from the American Academy of Pediatrics (AAP) stress the importance of screening for and treating childhood obesity; however, with increased patient volumes and decreased patient interaction time, pediatric primary care providers are having difficulty addressing this issue. This project aims to increase provider awareness and responsiveness to the current AAP guidelines for child and adolescent obesity. Applying concepts acquired from the Health Belief Model (Rosenstock, 1974), the development of an alert system for providers when a child over the age of 10 has a body mass index (BMI) greater than the 85th percentile was created at a primary care office in the Southwestern United States. Chart reviews were completed for 1-month before the intervention and for 1-month during the intervention to assess if providers were more likely to follow the current AAP guidelines. Additionally, a pre and post-test was provided to the providers to evaluate their knowledge and confidence in the management of overweight and obese children and adolescents. A statistically significant number of increased ICD-10 codes were used ($p = .036$), and an increased number of laboratory studies were ordered when the alert system was used ($p = .004$). Additionally, providers also reported increased confidence in the utilization of the current AAP guidelines for child and adolescent obesity. An alert system targeting childhood obesity is an effective way to encourage providers to take steps to diagnose and treat this pressing problem.

Keywords: childhood obesity, overweight, BMI, pediatric primary care, alert system

Addressing Childhood Obesity: Implementing a Provider Alert System

Childhood obesity remains a significant medical condition affecting millions of children worldwide. Multifactorial approaches and screening tools in pediatric primary care clinics are inconsistent and ineffective in challenging the outcomes of these children. Without proper diagnosis, intervention, and follow-up, these children are plagued with complex and chronic medical conditions that compromise their health in the future (Centers for Disease Control and Prevention [CDC], 2022a).

Problem Statement

Childhood obesity is a pressing problem in the United States, with 19.7% of children and adolescents between 2-19 years of age considered obese (CDC, 2022a). Obesity in children and adolescents is defined as a body mass index (BMI) greater than or equal to the 95th percentile of the child or adolescent's sex and age (Sanyaolu et al., 2019). To calculate a person's BMI, their weight in kilograms is divided by their square height in meters (CDC, 2022b). According to the American Academy of Pediatrics, childhood obesity is a chronic disease with a multifactorial etiology that requires ongoing medical attention (Hampl et al., 2023). Some of the physical and psychological conditions related to obesity include high blood pressure, high cholesterol, type 2 diabetes, asthma, sleep apnea, joint problems, depression, and anxiety. With pediatric primary care providers at the first line of defense in both recognizing and intervening with childhood obesity, interventions are needed to improve and quicken their response.

Purpose and Rationale

With rates of childhood obesity increasing every year, interventions aimed at both screening for obesity and educating on healthy nutrition and physical activity at primary care visits are pivotal to ensure children are set up to have a healthy future. Obesity is a multifactorial

disease that affects the long-term health of millions of children and adolescents, and interventions are needed to help overcome and negate adverse health outcomes. A myriad of behaviors, including a Western diet, increased screen time, and altered sleep patterns, have been found to contribute to the problem of childhood obesity (Smith et al., 2020). Interventions aimed at decreasing the rates of childhood obesity warrant a multifactorial approach of physical activity, nutrition changes, and family involvement. This project seeks to explore childhood obesity, the available interventions, and how the pediatric primary care provider can do more to decrease the number of children affected.

Background and Significance

In reviewing current literature, childhood obesity remains a prevalent problem that needs to be addressed in the primary care clinic setting. Because of the relevance of this problem, Healthy People 2030, which is a national initiative that aims to improve health and well-being, has created an objective that seeks to reduce the proportion of children and adolescents with obesity through intensive behavioral programs and policy and school curriculum changes (Office of Disease Prevention and Health Promotion [ODPHP], n.d.). While multiple interventions are available to combat this multifactorial condition, getting children access to these interventions can be better facilitated. Obesity is difficult to study and treat because it is considered chronic and is not defined by any one lifestyle pattern.

Obese/Overweight Children

Childhood and adolescent obesity have reached epidemic levels, contributing to morbid outcomes, and further solidifying it as a public health crisis (Sanyaolu et al., 2019). Children are disproportionately affected by obesity based on factors like race, gender, and socioeconomic status. Isong et al. (2018) found that Hispanic, African American, and American Indian children

were most at risk for obesity, relating to a higher percentage of children living in food-insecure households or unsafe neighborhoods. Additionally, according to Williams et al. (2018), the etiology of childhood obesity can include modifiable risk factors such as decreased physical activity rates, increased time playing video games/watching television, being put to bed with a bottle, parental smoking, and not eating meals as a family. Furthermore, the coronavirus (COVID) pandemic has been shown to negatively impact the weight and health of children from all racial and socioeconomic backgrounds. Children who were overweight or obese before the pandemic saw more significant weight gain because of decreased physical activity after the pandemic (Trivedi et al., 2021). Understanding risk factors can be beneficial to not only treating childhood obesity but also preventing it.

Interventions

An intervention aimed at reducing childhood obesity can be multifactorial and will generally involve parental guidance. Behavioral modifications are showing promising effects when used in combination with both diet and exercise. Motivational interviewing (MI) and specific, measurable, attainable, realistic, and timely (SMART) goals are two options that have been observed to be beneficial when looking into lifestyle modifications. MI remains a crucial intervention that focuses on four critical components, including engaging, focusing, evoking, and planning, which can be reviewed and evaluated by primary care providers during well-child visits (Hampl et al., 2023). SMART goals are another promising intervention for children ages 6-12. Weight maintenance or reduction is significantly seen when children target these goals toward eating and activity behaviors (Dislippe et al., 2023). Diet and exercise modifications used in conjunction with MI and SMART goals have been studied and are most effective. MI and

SMART goals are great options to help educate regarding healthy lifestyles from a dietician or behavioral health specialist.

When lifestyle modifications fail to improve outcomes, anti-obesity pharmacotherapy and bariatric surgery are options offered to the patient. Two of the most widely used medications for pediatric obesity approved by the Food and Drug Administration (FDA) are Phentermine and Orlistat; however, other options that are used off-label also exist (Singhal et al., 2021). While pharmacotherapy has promising effects, it has several unpleasant side effects, and the lack of long-term data makes it especially undesired (Singhal et al., 2021). These unpleasant side effects can include abdominal pain, fecal urgency/incontinence, irritability, dry mouth, tremor, cognitive dysfunction, paresthesia, and more, depending on the medication taken (Singhal et al., 2021). An alternative to pharmacotherapy that is considered is bariatric surgery. The three types of surgeries that are performed are gastric bypass, vertical sleeve gastrectomy, and laparoscopic adjustable gastric band (Armstrong et al., 2019). Bariatric surgery can be highly efficacious; however, it is only reserved for pediatric patients who meet strict and specific criteria because of its invasiveness.

Current Practice

Current guidelines outlined by the American Academy of Pediatrics (AAP) for children and adolescents with obesity suggest that diagnosing overweight and obesity should be followed by prompt laboratory evaluation and comprehensive treatment strategies (Hampel et al., 2023). Specific guidelines are determined by the patient's age and BMI percentile, which decide what evaluation studies are ordered and the associated treatment options. Components of the evaluation studies include physical examination, blood pressure, fasting lipid panel, blood glucose levels, and liver enzymes. Treatment options encompass motivational interviewing,

intensive health behavior and lifestyle treatment, pharmacotherapy, and referral to comprehensive pediatric metabolic and bariatric surgery programs when necessary. However, at the practice and provider level, there are many barriers to implementation, including lack of time, resources, knowledge, awareness, self-efficacy, and outcome expectancy (Hampel et al., 2023).

Pediatric primary care providers need to spend more time screening for, discussing, and knowing where to refer overweight and obese patients. Loth et al. (2021) delved further into the issue of why pediatric primary care providers are not diagnosing obesity as often as they should. According to their research, 4 sub-themes of risks associated with talking about weight included lowering patients' self-esteem, increasing weight-related stigma and adverse outcomes, negatively impacting patient-provider relationships, and promoting the development of eating disorders (Loth et al., 2021). Providers seem to be putting their fears ahead of best practices in certain instances. To lower childhood obesity rates, pediatric primary care providers need to find comfort and confidence in screening, educating, diagnosing, and referring their patients when necessary.

Desired Outcomes

As previously mentioned, childhood obesity is linked to several devastating chronic diseases, and pediatric primary care providers must do more to combat this problem. The current AAP guidelines suggest that children and adolescents who suffer from obesity will benefit from health behavior and lifestyle treatment, which involves a coordinated care approach with other pediatric healthcare providers, including dietitians (Hampl et al., 2023). When children who are overweight or obese are successfully evaluated and treated, they will have the opportunity to develop better futures with less disease and better quality of life.

Common Themes

A review of the most current literature reveals a gap in what is known to be true about screening, evaluating, and treating childhood obesity and how pediatric primary care providers choose to approach this significant and urgent problem. Interventions aimed at educating children and their parents on healthy lifestyles have proven effective; however, getting to that point requires a level of alertness and confidence by the providers to evaluate obesity during well-child examinations. Until pediatric primary care clinics establish a consistent protocol, with referral or educational opportunities for patients and their parents, the problem of childhood obesity will persist.

Internal Data

The organization being observed was a pediatric primary care office in the southwestern United States, with a primarily middle-class population. The providers have noticed that they spend minimal time discussing, evaluating, or referring children who are overweight or obese. This is consistent with the current literature from Imoisili et al. (2019) and Loth et al. (2019), who found a gap in provider engagement in childhood obesity in the primary care office. One key factor that the providers of this primary care office addressed was the lack of time to educate on topics such as nutrition or physical activity due to the high demand to see upwards of forty patients daily. The critical stakeholder at this office is one of the owners, who is also one of the clinic providers. This problem was discovered over several months at the clinic observing patient and provider encounters. As childhood obesity increases, there is a growing need to intervene, and pediatric well-child visits provide an optimal opportunity to address this issue. If unaddressed, these children can end up with future chronic health issues that affect their overall quality of life and lead to higher healthcare costs.

PICOT Question

A review of the literature led to the clinically relevant PICOT question: “In pediatric patients with obesity, how does nutrition guidance in the primary care setting, compared to no guidance on nutrition in the primary care setting, improve healthy weight management?” and led to the following exhaustive search.

Search Strategy

An extensive search was conducted in the electronic databases of the Cumulative Index of Nursing and Allied Health Literature (CINAHL), PsycINFO, and PubMed. These databases were selected because of their application to the PICOT question, medical relevance, peer review, and research base. Articles with only the highest level of evidence, including Levels I and II, were strategically selected to solidify the evidence further and answer the PICOT question. Combinations of keywords about the question were used repeatedly to narrow down articles to best fit the search.

Keyword Selection

The searches of the databases included key terms and combinations of these key terms that addressed numerous aspects of the PICOT question. They included: *childhood obesity*, *nutrition interventions*, and *quality of life*. To gather further research, variations of the words were used and included *nutrition education*, *nutrition teaching*, *child obesity*, *obese children*, and *overweight children*. The environment and location of terms were specified using the word *primary care*, and the terms *randomized controlled trials (RCT)* and *systematic review* were used to narrow the level of evidence. Additionally, relevant research was facilitated by applying a filter that included publication dates from 2018-2023. With the current epidemic of childhood obesity, significant and relevant research was found.

Initial and Final Search Yields

The initial search of *childhood obesity* AND *nutrition* AND *randomized controlled trials* yielded 244 results in CINAHL. Specifying the term *nutrition* to *nutrition education* narrowed the results to 94 articles, and including the term *primary care* narrowed it further to 46 articles. Exchanging the term *randomized controlled trials* with *systematic reviews* gave an even smaller result of 12. An initial search of PsychINFO included the key terms *childhood obesity* and *nutrition education*, resulting in 1,643 articles. To narrow down this search, the key term *primary care* was added, resulting in 42 articles. By changing the term *nutrition education* to *nutrition education*, the search was further narrowed to 26 articles. Lastly, the initial search of PubMed using the terms *childhood obesity* and *nutrition education* resulted in 2,079 articles. To generate a smaller result, the terms *primary care* and *primary research* were included, narrowing the result to 380 articles. Only relevant studies with strong evidence were selected when reviewing the titles and abstracts of the articles generated by the searches on these three research databases.

Limitations, Inclusion, and Exclusion Criteria

Inclusion criteria included only interventions that involved nutrition; however, nutrition education could be aimed at a caregiver if the effects were measured based on the child's outcome. Exclusion criteria included any works published before 2018 to create more relevant information about the topic. Articles were also excluded if they had additional interventions that heavily influenced the effect of nutrition on the outcome. Rapid critical appraisals were completed for 18 articles, and 10 final articles were chosen for this literature review. Out of the ten articles selected, there were five randomized controlled trials and five systematic reviews.

Critical Appraisal and Synthesis of Evidence

To determine the study quality, along with the level of evidence, the rapid critical appraisal process developed by Melnyk and Fineout-Overholt (2019) was used for the selected articles. Overall, the quality of evidence was high, as most articles were RCTs with few systematic reviews and only one quasi-experimental. Therefore, only quantitative studies (see Appendix A, Table A1) were included in the evaluation and synthesis tables (see Appendix A, Table A2) to evaluate the decisive role of nutrition-based interventions on health outcomes in the pediatric population.

The sample characteristics were relatively homogenous, as most participants had mean ages in the school age and adolescent ranges. Bias was minimally stated within the articles, with selection bias or high attrition rates as probable sources. Randomization of participants was the most common strength within the studies, and half stated a relatively short timeline as the main limitation. Half of the studies focused specifically on children with a BMI greater than 25, while the other half was nonspecific regarding BMI. Settings were heterogeneous as they took place in schools, hospitals, or a combination of school and home or hospital and home environments throughout many different countries. All the studies included education-based interventions conducted in individual, group, or family-based sessions. Regardless of the type of nutrition education session, all the studies revealed homogenous results of decreased BMI, improved dietary habits, or both.

Discussion

Evidence suggests that interventions aimed at educating the pediatric population on nutrition can help improve overall health outcomes. Group, family, and individual teaching can help create healthy dietary habits and decrease BMI in growing children. The included studies display the feasibility of nutrition-based education programs for the pediatric population.

Children are highly impressionable, and starting these healthy trends early in life can set them up for a healthy future void of co-morbid conditions associated with obesity. Because of an increase in childhood obesity rates, screening and treatment strategies for healthy lifestyles in children should consider incorporating an education-based interactive nutrition program to encourage the development of healthy bodies.

Theory/Theoretical Framework Application

The health belief model (HBM) was created in the 1950s and was adapted from behavioral science to health problems (Glanz, 2001). The four core constructs of the HBM are perceived susceptibility, perceived severity, perceived benefits, and perceived barriers (see Appendix B, Figure B1). While this model was initially conceived as an explanatory model, its most promising use is to create a foundation that persuades individuals to make health decisions (Glanz, 2001). Health motivation and self-efficacy are recent adaptations to this model that create confidence in one's ability to carry out behaviors. This theory has demonstrated substantial usefulness in the realm of healthy behaviors, as it can help to produce positive changes and reduce the development of the onset of chronic disease.

Pediatric primary care office providers must see how critical their role is in initiating conversations about healthy weight management behaviors for at-risk patients. Having conversations with patients and their families brings to light the importance of healthier lifestyles, who then can understand the perceived threat of future illness for their children. While the HBM has gained credibility in most categories associated with health behavior changes, it is perfectly fitting to influence providers to take the initiative in discussing the topic of childhood obesity and helping patients create positive change for a healthier future.

Implementation Framework

To implement this project, the intervention mapping (IM) framework was utilized to plan and implement health promotion within the pediatric population in the clinical setting. IM explicitly provides a systematic process that includes a detailed protocol with step-by-step decision-making for developing the intervention, implementation, and final evaluation (see Appendix B, Figure B2). It is an appropriate framework for this project because it is used to understand behavioral and environmental causes of health problems and identify their determinants, leading to addressing them through change methods (Fernandez et al., 2019).

Childhood obesity has become a relevant topic in recent years, especially here in the United States, where busy pediatric primary care providers have little time to discuss relating to lifestyle and behavior changes. The six steps in the IM framework create a comprehensive approach to health education planning that links the intervention development and design to behavioral and environmental health factors (Bartholomew et al., 2016). The steps begin with identifying the problem, specifying outcomes, designing the intervention, implementing the intervention, and evaluating the outcomes. Each step comprises several tasks, and completing each step lays the foundation for the next (see Appendix B, Figure B2). The IM framework blended itself into the exploration of childhood obesity and how interventions can prove to provide evidence-based change.

Methods

Ethics and Human Subject Protection

Two medical doctors and one nurse practitioner were recruited through flyers posted in the primary care office, and written consent was obtained from the three participants (see Appendix C, Figure C1; see Appendix D, Figure D1). Their participation identification (ID) was linked via an anonymous reproducible ID in which participants used the last four digits of their

phone number. This anonymous ID was used to collect and analyze the data collected. Additionally, all information collected from patient charts was kept HIPPA compliant, and patients were given randomized IDs to prevent any personal information from being shared. Further, approval from the office manager of the project site was obtained (see Appendix E, Figure E1). On September 17, 2023, an exemption was granted by the Institutional Review Board (see Appendix F, Figure F1). For this project, all written materials were kept in a secure digital folder and will be disposed of on June 1, 2024.

Setting and Participants

The project site is a primary care pediatric office in the southwestern United States with a primarily middle-class population. They see patients aged 0-18 for yearly well-child visits and sick visits. The providers at this office include two medical doctors and one pediatric nurse practitioner. There are also four medical assistants responsible for obtaining vitals. For this project, the inclusion criteria for the providers were that they see patients ten years of age and older for well-child visits. They were only excluded if they did not meet the inclusion criteria mentioned.

Project Description and Timeline

The project took place over a three-month timeline and in three phases. The first phase took place in September. During this time, the providers were recruited and educated on the intervention that was to take place. The second phase of the project began with the providers completing the pretest, which assessed their knowledge of current AAP guidelines and their confidence in discussing childhood obesity with patients and their families. Over the next four weeks, the alert system was implemented. At this project site, every patient who comes in for a well-child visit gets a printed-out growth chart that also displays the patient's BMI. The medical

assistants were instructed to highlight the BMI on the growth chart if the child was over 10 years of age and had a BMI greater than the 85th percentile. They were also instructed to ensure that the providers were directly given the growth chart before handing it to the patients, which then served as the alert system. The third and final phase took place in November, with a chart review of the four weeks before the intervention and four weeks during the intervention. The chart review looked to see how often the providers used the ICD-10 codes for overweight or obesity, if laboratory studies were ordered, and if dietician referrals were placed for every patient meeting the criteria for overweight or obese. The providers also completed the post-test during the final stage.

Data Collection, Instrument, and Outcomes Measurement

The pre and post-tests were modified from a prior Doctor of Nursing Practice (DNP) student's project with permission and completed by the providers to evaluate the intervention (see Appendix G, Figure G1; Larery, 2016). This test encompassed elements of the current AAP guidelines for children and adolescents with obesity, as well as their confidence level in having conversations related to weight management with patients and their parents. This assessment tool was validated by two nurse practitioners and one pediatrician who deemed the test reliable before implementation. Increased levels of knowledge, frequency of utilization of labs or dietician referrals, and confidence will reveal that the project was successful.

Additional data collection was gathered by the DNP student through chart reviews of patients who met the criteria for being overweight or obese, as mentioned previously. Overall, an increased frequency of ICD-10 codes, lab orders, and dietician referrals is one outcome that will be measured to see if the intervention was influential in the practice setting. Demographic information, including gender, age, ethnicity, and BMI, was also collected to understand the

population evaluated better. A secondary outcome that was evaluated was whether the patients obtained the laboratory studies and if a follow-up was completed with the provider.

Data Analysis Plan

Data obtained from the project were analyzed and compared to determine statistical significance and outcomes. Descriptive statistics was used to evaluate the data from the provider's pre and post-test to evaluate changes in knowledge, utilization of the AAP guidelines, and comfort levels in diagnosing and treating childhood obesity. For the chart review, descriptive statistics was used to evaluate the demographic information of the patients. Additionally, an independent T-test was used to compare the number of ICD-10 codes used for increased BMI, laboratory studies ordered, and dietician referrals. All data was checked two times for accuracy to prevent any errors from occurring.

Budget

No funding was received for this project. Total costs for the project were covered by the DNP student and by donations from the project site. There were no indirect costs as this project did not require additional professionals or increased time spent by the office staff and providers (see Appendix H, Figure H1). Direct costs remained low and included costs for materials and printing. Altogether, the project's total cost was projected to be \$144.07.

Results

Intellectus Statistics software was utilized to analyze the data from the provider's pre and post-tests and chart reviews.

Provider Pre and Post-Test

Demographics

A total of three providers participated in the project. Demographic data analysis revealed two males ($n=2$, 66.67%) and one female ($n=1$, 33.33%). Two of the providers were medical doctors ($n=2$, 66.67%), and one was a nurse practitioner ($n=1$, 33.33%). The average years of experience was 22.67 years ($SD = 14.0$), ranging from 7 to 34 years. The results are presented in Table 1. Frequencies and percentages are presented in Table 2.

Table 1*Frequency Table for Provider Demographic Variables*

Variable	<i>n</i>	%
Gender		
Female	1	33.33
Male	2	66.67
Role		
NP	1	33.33
MD	2	66.67

Note. Due to rounding errors, percentages may not equal 100%.

Table 2*Summary Statistics Table for Provider Years of Experience*

Variable	<i>M</i>	<i>SD</i>	<i>n</i>	Min	Max	<i>Mdn</i>
Years of Experience	22.67	14.01	3	7.00	34.00	27.00

AAP Knowledge-Based Questions

All providers were aware of the most recent AAP guidelines for child and adolescent overweight and obesity. All questions regarding the guidelines were answered correctly before and after the intervention.

Level of Comfort

Before the intervention, 33% of the providers felt very comfortable discussing overweight and obesity with patients and families, while 33% felt somewhat comfortable or neutral. After the intervention, 33% remained comfortable and 66% felt somewhat comfortable. Additionally, all the providers remained comfortable ordering the necessary laboratory studies before and after the intervention. Lastly, before the intervention, 33% felt very comfortable in referring to dietitians, and 66% felt somewhat comfortable. After the intervention, 66% felt very comfortable, and only 33% felt somewhat comfortable. Frequencies and percentages of the provider's level of comfort before the intervention are presented in Table 3. Frequencies and percentages of the provider's level of comfort after the intervention are presented in Table 4.

Table 3*Frequency Provider Level of Comfort Before the Intervention*

Variable	<i>n</i>	%
Comfort in discussing overweight/obesity with patients		
Very comfortable	1	33.33
Somewhat comfortable	1	33.33
Neutral	1	33.33
Comfort in Ordering labs for Overweight/Obese patients		
Very comfortable	3	100.00
Comfort in Sending Referrals to a dietitian for Overweight/Obese Patients		
Very comfortable	1	33.33
Somewhat comfortable	2	66.67

Note. Due to rounding errors, percentages may not equal 100%.

Table 4*Frequency Provider Level of Comfort After the Intervention*

Variable	<i>n</i>	%
Comfort in discussing overweight/obesity with patients		
Very comfortable	1	33.33
Somewhat comfortable	2	66.67
Comfort in Ordering labs for Overweight/Obese patients		
Very Comfortable	3	100.00
Comfort in Sending Referrals to a dietician for Overweight/Obese Patients		
Very comfortable	2	66.67
Somewhat comfortable	1	33.33

Note. Due to rounding errors, percentages may not equal 100%.

Chart Review*Demographics*

A total of 30 patients met the criteria for overweight or obese in the four weeks collected before the intervention. There were 16 males ($n = 16, 53.33\%$) and 14 females ($n = 14, 46.67\%$). The average age was 12.87 years ($SD = 2.19$), ranging from 12 to 18 years. The average weight was 68.19kg ($SD = 18.11$), ranging from 43.36kg to 124kg. The average height was 159.45cm ($SD = 10.89$), ranging from 142.31cm to 185.42cm. Lastly, the average BMI was 93.98% ($SD = 3.74$), ranging from 87.86% to 99.34%. Frequencies and percentages are presented in Table 5. The summary statistics can be found in Table 6.

Table 5*Frequency Table for Patient Gender*

Variable	<i>n</i>	%
Gender		
Male	16	53.33
Female	14	46.67

Note. Due to rounding errors, percentages may not equal 100%.

Table 6*Summary Statistics Table for Patients Before the Intervention*

Variable	<i>M</i>	<i>SD</i>	<i>n</i>	<i>Mdn</i>	Min	Max
Age (years)	12.87	2.19	30	12.00	10.00	18.00
Weight (kg)	68.19	18.11	30	64.05	45.36	124.10
Height (cm)	159.45	10.89	30	157.48	142.31	185.42
BMI (%)	93.98	3.74	30	93.62	87.86	99.34

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

A total of 27 patients met the criteria for overweight or obese in the four weeks collected during the intervention. There were 14 males ($n = 14$, 51.85%) and 13 females ($n = 13$, 48.15%). The average age was 13.22 years ($SD = 2.33$), ranging from 10 to 18 years. The average weight was 68.94kg ($SD = 18.83$), ranging from 46.08kg to 102.42kg. The average height was 159.14m ($SD = 11.97$), ranging from 133.35cm to 186.69cm. Lastly, the average BMI was 93.80% ($SD = 4.69$), ranging from 85.90% to 99.40%. Frequencies and percentages are presented in Table 7. The summary statistics can be found in Table 8.

Table 7*Frequency Table for Patient Gender*

Variable	<i>n</i>	%
Gender		
Male	14	51.85
Female	13	48.15

Note. Due to rounding errors, percentages may not equal 100%.

Table 8*Summary Statistics Table for Patients During the Intervention*

Variable	<i>M</i>	<i>SD</i>	<i>n</i>	<i>Mdn</i>	Min	Max
Age (years)	13.22	2.33	27	13.00	10.00	18.00
Weight (kg)	68.94	18.83	27	66.13	46.08	102.42
Height (cm)	159.14	11.97	27	158.12	133.35	186.69
BMI (%)	93.80	4.69	27	94.41	85.90	99.40

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.

Statistical Significance

A two-tailed independent samples *t*-test was conducted to examine whether the mean of ICD 10 codes used was significantly different between the group before the intervention and the group during the intervention. The result of the two-tailed independent samples *t*-test was significant based on an alpha value of .05, $t(43.20) = -2.16$, $p = .036$, indicating the null hypothesis can be rejected. This finding suggests the mean number of ICD-10 codes used was significantly different between the groups before the intervention and during the intervention. The results are presented in Table 9. A bar plot of the means is presented in Figure 1.

Table 9

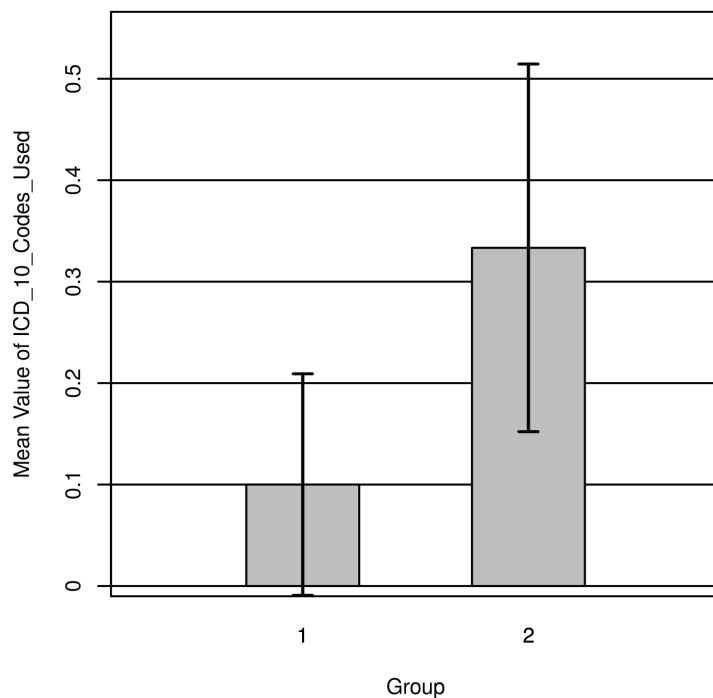
Two-Tailed Independent Samples t-Test for ICD 10 Codes Ordered Before and During the Intervention

Variable	Before the Intervention			During the Intervention			<i>t</i>	<i>p</i>	<i>d</i>
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>			
ICD 10 Codes Used	0.10	0.31	30	0.33	0.48	27	-2.16	.036	0.58

Note. N = 57. Degrees of Freedom for the *t*-statistic = 43.20. *d* represents Cohen's *d*.

Figure 1

The mean number of ICD 10 codes used by levels of Group with 95.00% CI Error Bars



Note. The mean value is used to represent the percentage of ICD-10 codes used by the providers. Group 1 represents the patient charts reviewed before the intervention and group 2 represents the patient charts reviewed during the intervention.

A two-tailed independent samples t-test was conducted to examine whether the mean number of laboratory studies ordered was significantly different between the group before the

intervention and after the intervention. The result of the two-tailed independent samples *t*-test was significant based on an alpha value of .05, $t(32.70) = -3.05$, $p = .004$, indicating the null hypothesis can be rejected. This finding suggests the mean of laboratory studies ordered was significantly different between the group before the intervention and the group during the intervention. The results are presented in Table 10. A bar plot of the means is presented in Figure 2.

Table 10

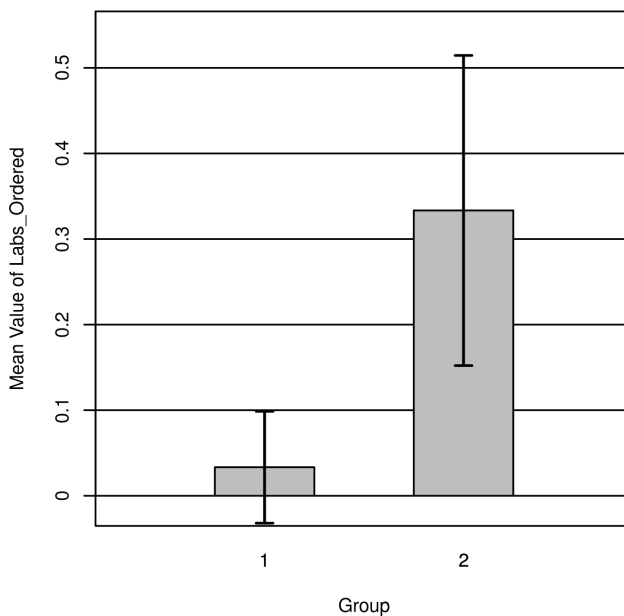
Two-Tailed Independent Samples t-Test for Laboratory Studies Ordered Before and During the Intervention

Variable	1			2			<i>t</i>	<i>p</i>	<i>d</i>
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>			
Laboratory Studies Ordered	0.03	0.18	30	0.33	0.48	27	-3.05	.004	0.83

Note. N = 57. Degrees of Freedom for the *t*-statistic = 32.70. *d* represents Cohen's *d*.

Figure 2

The Mean Number of Laboratory Studies Ordered by Levels of Group with 95.00% CI Error Bars



Note. The mean value is used to represent the percentage of the number of times laboratory studies were ordered by the providers. Group 1 represents the patient charts reviewed before the intervention and group 2 represents the patient charts reviewed during the intervention.

While a statistically significant change was observed in the number of ICD-10 codes used and laboratory studies ordered with the provider alert system in place, it is important to note that a referral to a dietician was only placed once. Additionally, of the 33% of patients for whom laboratory studies were ordered, only 19% of the patients completed the lab work.

Impact of Project and Sustainability

The provider alert system has shown a positive impact on providers' responses to child and adolescent obesity. Clinical and statistical significance indicate that this intervention can be useful in the pediatric primary care environment. With high patient volumes, pediatric primary care providers often do not spend enough time discussing and intervening when a child or adolescent's BMI is in the abnormally high range, so this intervention is needed. Additionally, a well-child exam encompasses so many different aspects of the child and adolescent that they can easily get distracted and forget to do steps such as including the ICD 10 code for increased BMI or order laboratory studies. The provider alert system is a way to quickly remind providers to take the appropriate steps as outlined by the most recent AAP guidelines.

The alert system is relatively easy to sustain at this office. Highlighting a BMI on a growth chart is a simple and easy task that the medical assistant can continue to do with very little cost. A possible alternative way to continue the alert system could be to incorporate it into the electronic health record (EHR). The alert could pop up when the provider clicks on the patient's chart; however, this would require integration from the EHR system, which can have added costs. It should also be noted that during the four weeks of implementing the alert system,

there may have been enough repetition for the providers to continue to follow through with the proper steps for diagnosing and treating childhood obesity without the alert system.

Discussion

Summary of Findings

Evidence supports the use of a provider alert system intervention for addressing childhood obesity in the pediatric primary care setting. Utilization of the alert system led pediatric primary care providers in this setting to increase the number of times they used ICD-10 codes relating to increased BMI and ordered laboratory studies for children and adolescents with obesity. Additionally, providers were noted to have a small increase in confidence when discussing childhood obesity with patients and their parents. To increase the number of referrals to the dietician that are sent for these patients to better fit the guidelines outlined by the AAP for children and adolescents with obesity, further interventions may be warranted.

Limitations and Barriers

There were two major limitations and barriers to this project. The most obvious limitation included the small timeline. The intervention was only implemented for four weeks, which is a relatively short time to get a good understanding of how the alert system will work for the providers over time. The second limitation was that there were only three providers in this specific pediatric primary care office. With only three providers, it can be difficult to get a full understanding of how the intervention will work amongst numerous providers from different backgrounds with varying levels of experience.

What Others Have Found

To date, no other studies have looked at the effects of an alert system for providers about childhood obesity. There are, however, other studies that have been found that reviewed the facts

of utilizing an EHR alert base system for other health problems. A recent study by Niemantsverdriet et al. (2023) found that an automatic EHR alert to providers for patients with increased plasma creatinine measurements was found to increase acute kidney injury awareness and ensure the cessation of nephrotoxic medication within seven days of the alert. Another EHR-based alert system was used in a study by Kraweic et al. (2020), which identified children who have been strongly suspected of being maltreated. For this specific study, the alert system was not successful because of the complex nature of diagnosing suspected maltreatment. They found that for the alert system to be successful, a comprehensive list of diagnostic codes related to child maltreatment was necessary to better assist the alert system in identifying those at risk. Based on what has been found by other studies, it remains clear that an alert system can prove to be beneficial when it properly identifies a medical problem and can encourage healthcare providers to take further steps in diagnosing or treating it. Healthcare providers in all fields of medicine remain very busy, and using an alert system can serve as an additional level of vigilance to ensure patient details are not missed.

Recommendations

Childhood obesity is a problem that isn't going away anytime soon. Pediatric primary care providers must continue to incorporate the AAP guidelines for pediatric and adolescent obesity. Further research and interventions are needed to help ensure that proper diagnosis and treatment are occurring promptly. A recommendation to further incorporate this intervention into practice could be utilizing the electronic health record (EHR). There is potential to have the alert pop up in the EHR when the provider opens that patient chart, and this can be especially helpful in clinics where the child's growth chart is not printed out for the parent and patient to take home.

Conclusion

Evidence remains clear that childhood obesity is rising, and something must be done to help address this population. Pediatric annual well-child visits are an excellent time for providers to begin discussing healthy lifestyles with parents and children and discuss the future implications of their choices. An alert system through either an electronic health record or by trained medical assistants highlighting critical BMIs for patients over the age of 10 with BMIs greater than the 85th percentile can further enhance the provider's thought and willingness to intervene in alignment with the AAP guidelines for child and adolescent obesity.

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Appendix A

Evaluation and Synthesis Tables

Table A1

Evaluation Table for Quantitative Studies

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>Adab et al., (2018), Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomized controlled trial (WAVES study)</p> <p>Country: England</p> <p>Funding: The National Institute for Health Research (NIHR) Health Technology Assessment Programme</p> <p>Bias:</p>	<p>Not stated within the research article but the Health Belief Model (HBM) fits this research.</p>	<p>Design: Randomized Controlled Trial</p> <p>Purpose: To assess the effectiveness of a school and family-based healthy lifestyle programme.</p>	<p>N= 1,397</p> <p>Demographics: CG: 735 IG: 662 Mean age: 6.3 years</p> <p>Setting: UK primary schools from the West Midlands</p> <p>Exclusion: Not stated</p> <p>Attrition: 20%</p>	<p>IV1: Obesity program (30-minute school time physical activity, 6week interactive skill-based program signposting of local physical activity opportunities through mail-outs every six months, and family-led workshops on healthy cooking skills)</p> <p>DV1: BMI z-score</p>	<p>Tools: 5-point Likert scale</p> <p>Validity/ Reliability: Likert scales are a reliable and valid questionnaire</p>	<p>Statistical Tests Used: Mixed linear regression models Poisson mixed regression</p>	<p>DV1: P=0.66 indicating that the results were not statistically significant.</p>	<p>Level of Evidence: Level 1</p> <p>Strengths: A large number of participants.</p> <p>Weakness: The study only took place over 30 months.</p> <p>Feasibility: A program can be developed to encompass numerous aspects of nutrition and physical activity at school to promote healthy weight.</p>

Key: CG Control Group, BMI Body Mass Index DV Dependent Variable, IG Intervention Group, IV Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Possible selection bias due to parental consent for study measurements.								Application: This could be something that primary care providers can advocate for, however, schools would have to budget for this type of program.
<p>Barnes et al., (2021), Efficacy of a school-based physical activity and nutrition intervention on child weight status: Findings from cluster randomized controlled trial</p> <p>Country: Australia</p> <p>Funding: Hunter Children's Research Foundation</p>	Not stated within the research article but the Health Belief Model (HBM) fits this research.	<p>Design: Randomized Controlled Trial</p> <p>Purpose: Evaluate the impact of physical activity and nutrition invention on child weight status and quality of life</p>	<p>N= 742</p> <p>Demographics: CG: 202 IG(1):283 IG(2): 163 Age: 5-12 BMI: nonspecific</p> <p>Setting: Primary schools in New South Wales, Australia</p> <p>Exclusion: Schools solely for children with special needs,</p>	<p>IV1: physical activity (150 min planned in school)</p> <p>IV2: Healthy school lunchbox</p> <p>DV1: BMI</p> <p>DV2: Waist Circumference</p> <p>DV3: Quality of life</p>	<p>Tools: Pediatric Quality of Life Inventory (PedsQL)</p> <p>Validity/ Reliability: This is both a valid and reliable tool.</p>	<p>Statistical Tests Used: Mixed effects regression models</p> <p>Linear mixed model</p> <p>Kenward Roger degrees of freedom</p>	<p>DV1: p= 0.3606 (for IV1); p= 0.1744 (for IV2)</p> <p>DV2: p= 0.0304 (for IV1); p= 0.6240 (for IV2)</p> <p>DV3: p= 0.8836 (for IV1); p=0.8958 (for IV2)</p>	<p>Level of Evidence:</p> <p>Strengths: Randomization and blinding.</p> <p>Weakness: Relatively short timeline for study.</p> <p>Feasibility: It would be a difficult process to convince primary schools to incorporate these changes and the funding required as well.</p> <p>Application: Primary care</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
Bias: Large attrition rates.			catered for children 13-18 years, or if they were currently participating in another physical activity or nutrition intervention. Attrition: 20%					providers can advocate for healthier lunches provided by parents and physical activity can be encouraged outside of school.
Duncanson et al., (2020) , Impact of weight management nutrition interventions on dietary outcome in children and adolescents with overweight or obesity: A systematic review with meta-analysis Country: Australia	Not stated within the research article but the Health Belief Model (HBM) fits this research.	Design: Systematic review with meta-analysis Purpose: To investigate the impact of the dietary component of weight management interventions on the change in diet in children and adolescents with overweight or obesity.	N= 109 Demographics: Randomized controlled trials Mean age: 2-20 years BMI: Classified as having overweight or obesity Setting: Numerous different countries	IV1: Positive dietary changes DV1: Calorie intake DV2: Fruit & vegetable intake DV3: Sugar-sweetened beverage intake	Tools: None discussed. Validity/ Reliability:	Statistical Tests Used: No statistical tested stated, however, each RCT utilized statistical analysis	DV1: P < 0.001 DV2: Increased intake (+1.5 servings) DV3: Decrease in intake (-1.5 servings)	Level of Evidence: Level 1 Strengths: Utilization of only peer-reviewed articles Weakness: Limited number of high methodological quality studies. Feasibility: Strategies aimed at diet changes can be difficult for kids to implement

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>Funding: Australian National Health and Medical Research Council</p> <p>Bias: None stated in the study.</p>			<p>Exclusion: Non-RCT, the dietary interventions were the same in multiple arms, involved dietary supplements, or focused on eating habits rather than dietary intake.</p>					<p>since they are not buying the food.</p> <p>Application: Well-child exams can provide an opportunity to discuss healthy food options but this may not be enough to help change the home food environment.</p>
<p>Gato-Moreno et al., (2020), Early nutrition education in the prevention of childhood obesity.</p> <p>Country: Spain</p> <p>Funding: No external funding</p>	<p>Not stated within the research article but the Health Belief Model (HBM) fits this research.</p>	<p>Design: Randomized Controlled Trial.</p> <p>Purpose: To determine the impact of a school-based educational intervention on eating behavior and physical activity aimed at parents of children aged 3 to 4 years and on the evolution of BMI and</p>	<p>N= 261 CG: n=139; F 43.90% IG: n=122; F 49.20%</p> <p>Demographics: Mean age = 44.9 months</p> <p>Setting:</p>	<p>IV1: Group Training sessions on healthy eating</p> <p>DV1: zBMI</p> <p>DV2: Development of obesity</p> <p>Definitions:</p>	<p>Tools: Taurus Oslo model scale</p> <p>Validity/</p> <p>Reliability: The Taurus Oslo model scale Is both a valid and reliable scale to measure the weight</p>	<p>Statistical Tests Used: Shapiro-Wilk Test T-tests Mann-Whitney U test Wilcoxon signed-rank test X² test</p>	<p>DV1: zBMI P=0.002 in IG</p> <p>DV2: Development of Obesity P=0.0027 in IG</p>	<p>Level of Evidence: Level I</p> <p>Strengths: Randomization; length of study; Use of dietician technicians</p> <p>Weakness: Loss to follow-up of participants and</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>Bias:</p> <p>None stated, possible selection bias due to the number of participants lost to follow-up</p>		<p>the prevalence of overweight or obesity in their children in the 2 years following the intervention.</p>	<p>Public schools in the province of Malaga, Spain.</p> <p>Exclusion: Those with serious chronic diseases with a high risk of malnutrition</p> <p>Attrition: 18%</p>	<p>BMI- weight in kg divided by the square of height in meters</p> <p>Overweight- BMI between 85th and 95th percentiles</p> <p>Obesity- BMI equal to or above the 95th percentile</p>	<p>of patients consistently.</p>	<p>McNamar's test</p>		<p>the decreased adherence to the intervention in the annual follow-up phase</p> <p>Feasibility: School is a great place to provide education to parents, however, busy parents do not have the time to attend numerous training sessions.</p> <p>Application: Provides primary care providers the option to provide nutrition education to parents which will help ensure children are getting fed healthy diets.</p>
<p>Lee et al., (2020), A 24-week intervention based on the nutrition</p>	<p>Not stated within the</p>	<p>Design:</p>	<p>N= 168</p> <p>Demographics:</p>	<p>IV1: Continuous monitoring and</p>	<p>Tools:</p>	<p>Statistical Tests Used:</p>	<p>DV1: BMI-z-score P<.05 in IG</p>	<p>Level of Evidence:</p>

Key: CG Control Group, BMI Body Mass Index DV Dependent Variable, IG Intervention Group, IV Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>care process improves diet quality, BMI, and motivation in children and adolescents with obesity.</p> <p>Country: South Korea</p> <p>Funding: Korean Centers for Disease Control and Prevention</p> <p>Bias Potential for selection bias due to 38% drop out rate.</p> <p>A wide range of participant age due to low enrollment possibly causes selection bias.</p>	<p>research article but the Health Belief Model (HBM) fits this research.</p>	<p>Quasi-experimental trial with randomization</p> <p>Purpose: To evaluate the effects of a nutrition care process-based intervention targeted on diet and weight status in moderate to severe obese children and adolescents.</p>	<p>CG: n= 84 IG: n= 84 Mean age: 10.95 years. BMI: >= 97th percentile</p> <p>Further demographics of participants were not provided.</p> <p>Setting: Completed in South Korea; Exact setting not mentioned within the study</p> <p>Exclusion: Children and adolescents with mental illness/learning disabilities</p> <p>Attrition: 38%</p>	<p>goal setting for nutritional problems.</p> <p>DV1: BMI-z-score</p> <p>DV2: Consumption of high-calorie, low-nutrient (HCLN) food</p> <p>DV3: Diet Quality Index-International (DQI-I) score</p> <p>Definitions: BMI- weight in kg divided by the square of height in meters</p>	<p>Bioelectrical Impedance Analysis</p> <p>Stadiometer</p> <p>5-point Likert Scale</p> <p>Validity/ Reliability:</p>	<p>Paired t-test</p> <p>X² test</p> <p>Multiple regression analysis</p>	<p>DV2: Consumption of HCLN food P<.001 in IG</p> <p>DV3: DQI-I Score P<.01 in IG</p>	<p>Level II</p> <p>Strengths: Randomization of participants Length of the study</p> <p>Weakness: Large attrition rate (38%) A wide range of participants' age</p> <p>Feasibility: This can be difficult to implement because children and adolescents are often not the ones buying food at home.</p> <p>Application: Pediatric primary care providers can provide greater</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								education related to nutrition to help combat rates of childhood obesity.
<p>Likhitweerawong et al., (2021), Effectiveness of mobile application on changing weight, healthy eating habits, and quality of life in children and adolescents with obesity: A randomized controlled trial</p> <p>Country: Thailand</p> <p>Funding: Faculty of Medicine, Chiang Mai University</p> <p>Bias:</p>	<p>Not stated within the research article but the Health Belief Model (HBM) fits this research.</p>	<p>Design: Randomized Controlled Trial</p> <p>Purpose: To evaluate the effectiveness of a new mobile/tablet-based application in reducing weight and encouraging healthy eating habits in children with obesity.</p>	<p>N= 77</p> <p>Demographics: CG: 39 IG: 38 Mean age: 10-15 years BMI: at or above the 95th percentile</p> <p>Setting: Hospital and school-based setting</p> <p>Exclusion: non-android device users; having a chronic medical illness; not living in Chiang Mai; having an intellectual disability; not being ethnically</p>	<p>IV1: mobile/tablet application</p> <p>DV1: Weight</p> <p>DV2: BMI</p> <p>DV3: Quality of life</p>	<p>Tools: Eating behaviors questionnaire</p> <p>Pediatric Quality of Life Inventory (PedsQL)</p> <p>Validity/ Reliability: The eating behaviors questionnaire is not valid since it was used only for this study.</p> <p>PedsQL is both reliable and valid.</p>	<p>Statistical Tests Used: Independent t-tests</p>	<p>DV1: p = 0.42</p> <p>DV2: p= 0.33</p> <p>DV3: p=0.82</p>	<p>Level of Evidence: Level 1</p> <p>Strengths: Application developed specifically for children; promoted self-awareness; relatively low dropout rate</p> <p>Weakness: Participants in the intervention groups were more obese at baseline; small sample size; low compliance rate</p> <p>Feasibility: Using smartphones to target education</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
			Thai; being morbidly obese Attrition: 10%					among children and adolescents is quite significant, given that most children have access to them. Application: Creating an application such as the one described in the study is a great idea; however, it would involve many resources such as dieticians and app developers.
Lopez-Contreras et al., (2020), Dietary habits and metabolic response improve in obese children whose others received an intervention to promote healthy eating: Randomized clinical trial	Not stated within the research article but the Health Belief Model (HBM) fits this research.	Design: Randomized controlled trial Purpose: To evaluate the change in eating behaviors, metabolic condition, and nutritional status, in children with obesity who were prescribed	N= 177 Demographics: CG: 87 IG: 90 Mean age: 8.6 in IG; 8.7 in CG BMI: 25 in IG; 25.2 in CG	IV1: Group nutrition education sessions with parents DV1: Filling of their dishes DV2: Forcing children to finish meals	Tools: Anthropometry measurements; Blood pressure; sociodemographic data questionnaires; blood samples Validity/Reliability:	Statistical Tests Used: t-test for independent samples Mann Whitney test Pearson X2 test	DV1: p=0.009 DV2: p=0.003 DV3: p<0.001 DV4: p=0.046 DV5: p<0.001 DV6: p=0.488	Level of Evidence: Level 1 Strengths: More benefits were seen when mothers were involved in dietary habit conversations. Weakness: High desertion rate;

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>Country: Mexico</p> <p>Funding: Federico Gomez Children's Hospital of Mexico</p> <p>Bias: None stated in the study.</p>		<p>diet changes compared to those whose mothers participated in the nutritional education.</p>	<p>Setting: The obesity Clinic at Federico Gomez Children's Hospital of Mexico</p> <p>Exclusion: Those receiving pharmacological treatment, morbidly obese, or had a genetic syndrome</p> <p>Attrition: 20%</p>	<p>DV3: Food Substitution</p> <p>DV4: Consumption of roasted foods</p> <p>DV5: Consumptions of Vegetables</p> <p>DV6: BMI</p>	<p>All list tools are both valid and reliable</p>	<p>Mixed effect linear regressions models</p>		<p>reduced size and scarcity of spaces for education activities in health institutes; short length of follow-up/study</p> <p>Feasibility: Having both parents and their children available for educational sessions could be difficult for working parents who have busy schedules.</p> <p>Application: Parents almost always accompany their children to a well-child, so a thorough discussion about nutrition at that time can be beneficial.</p>
<p>Mack et al., (2020), The kids' obesity prevention program: Cluster</p>	<p>Not stated within the</p>	<p>Design:</p>	<p>N= 82</p> <p>Demographics: CG: 42</p>	<p>IV1: KOP program game</p>	<p>Tools: Likert scale questionnaire</p>	<p>Statistical Tests Used:</p>	<p>DV1: P<0.001</p>	<p>Level of Evidence:</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>randomized controlled trial to evaluate a serious game for the prevention and treatment of Childhood obesity</p> <p>Country: Germany</p> <p>Funding: Leibniz-Science Campus Informational Environments</p> <p>Bias: Self-answered questionnaires may lead to bias.</p>	<p>research article but the Health Belief Model (HBM) fits this research.</p>	<p>Cluster Randomized Controlled Trial</p> <p>Purpose:</p> <p>To evaluate the Kids Obesity Prevention (KOP) program game and how well children can understand and apply the dietary energy density principle (DED-P).</p>	<p>IG: 40 Mean age: 9.7 years old.</p> <p>Study groups did not differ in sex, age, or BMI z-score.</p> <p>Setting: Fourth-grade students in a primary school</p> <p>Exclusion: Children with major linguistic difficulties.</p> <p>Attrition: 3.6%</p>	<p>DV1: Knowledge of nutrition and stress coping</p>	<p>Validity/ Reliability:</p> <p>Likert scales are a reliable and valid questionnaire</p>	<p>Levene test</p> <p>Unpaired t-tests</p> <p>Mann-Whitney U test</p> <p>Chi-square test</p> <p>Fisher-freeman-halton test</p> <p>Wilcoxon sign-rank test</p>		<p>Level I</p> <p>Strengths:</p> <p>Detailed descriptions of every aspect of the game that the children were playing allowed for a greater understanding of what the children were learning.</p> <p>Weakness:</p> <p>The study only took place over 4 weeks.</p> <p>Feasibility: Interactive games are a great way to get the attention of children. Other educational games have proven effective, so a game relating to nutrition could be promising.</p> <p>Application: Primary care</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								providers can use this game as a tool to suggest to parents, so they can teach children how to learn about healthy eating.
<p>Perdew et al., (2020), Family-based nutrition interventions for obesity prevention among school-aged children: A systematic review</p> <p>Country: Canada</p> <p>Funding: Mitacs</p> <p>Bias: Selection bias within the studies; possible response bias</p>	<p>Not stated within the research article but the Health Belief Model (HBM) fits this research.</p>	<p>Design: Systematic Review</p> <p>Purpose: (a) Assess the number and quality of published RCTs incorporating family-based nutrition interventions for childhood obesity management (b) identify attributes used in successful interventions</p>	<p>N= 8</p> <p>Demographics: Randomized controlled trials Mean age: 5-18 years. BMI: Not stated</p> <p>Setting: Majority Completed within the US (n=7)</p> <p>Exclusion: Non-RCT, studies not published in peer-reviewed journals, & studies that did not meet age criteria</p>	<p>IV1: Nutrition or healthy eating component</p> <p>DV1: Child dietary habits</p>	<p>Tools: Quality Assessment Tool for Quantitative Studies</p> <p>Validity/ Reliability: This tool is both valid and reliable.</p>	<p>Statistical Tests Used: No statistical tested stated, however, each RCT utilized statistical analysis</p>	<p>DV1: Successful nutrition interventions include setting family-based goals, modifying the home food environment, hands-on approaches to teaching nutrition, and fruit and vegetable vouchers.</p>	<p>Level of Evidence: Level 1</p> <p>Strengths: Utilization of only peer-reviewed articles</p> <p>Weakness: Relatively few RCTs testing the efficacy of family-based childhood obesity interventions.</p> <p>Feasibility: Family-based approaches can be difficult for working parents, interventions like Zoom meetings might be feasible.</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
								Application: Including families in interventions for preventing and managing childhood obesity is optimal, as they largely impact behaviors around food and the food environment.
<p>Yu et al., (2020), Improving the metabolic and mental health of children with obesity: A school-based nutrition education and physical activity intervention in Wuhan, China. Country: China</p> <p>Funding: The National Natural Science Foundation of China</p> <p>Bias:</p>	Not stated within the research article but the Health Belief Model (HBM) fits this research.	<p>Design: Randomized Controlled Trial</p> <p>Purpose: To evaluate the effectiveness of a school-based nutrition education and physical activity intervention on cardiovascular risk profile and mental health outcomes among Chinese children with obesity.</p>	<p>N= 203</p> <p>Demographics: CG: 89 IG: 114 Mean age: 9.7 years</p> <p>BMI: Based on Chinese childhood obesity BMI cut-off points (kg/m²)</p> <p>Setting: Two primary schools in Xinzhou District, Wuhan</p>	<p>IV1: Nutrition and physical activity education classes</p> <p>DV1: Anthropometric parameters and blood pressure (SBP & DBP) measurements (Height, weight, blood pressure, waist circumference)</p> <p>DV2: Fasting blood test (Fasting glucose, triglycerides,</p>	<p>Tools: Social Anxiety Scale for Children (SASC)</p> <p>Validity/</p> <p>Reliability: The SASC has been examined in Chinese children and showed acceptable reliability and validity.</p>	<p>Statistical Tests Used: Mann-Whitney U test X² test Wilcoxon sign-rank test McNemar's test</p>	<p>DV1: No significant change P=0.886 for BMI; P=0.478 for waist circumference</p> <p>DV2: Significant improvements in SBP (P<0.001) and FPG (P<0.001).</p> <p>DV3: Significant improvements in well-being (P=0.051) and</p>	<p>Level of Evidence: Level I</p> <p>Strengths: Randomization</p> <p>Weakness: Limited age range and short time of follow-up do not indicate future health. This study was performed in one district in China which will make a difference compared to children from</p>

Key: **CG** Control Group, **BMI** Body Mass Index **DV** Dependent Variable, **IG** Intervention Group, **IV** Independent Variable

Citation	Theoretical/ Conceptual Framework	Design/ Method/ Purpose	Sample/Setting	Variables	Measurement/ Instrumentation	Data Analysis	Results/ Findings	Level of Evidence; Application to practice; Generalization
<p>Self-reported mental can lead to potential bias.</p> <p>Measurement bias based on BP measurements from different times of the year from pre and post study can lead to potential bias.</p>			<p>Exclusion: Children who suffer from serious illnesses such as heart disease, diabetes, asthma, etc.</p> <p>Attrition: 10%</p>	<p>and high-density lipoprotein)</p> <p>DV3: Psychological factors (well-being and depression)</p> <p>Definitions: BMI- weight in kg divided by the square of height in meters</p>			<p>Social Anxiety (0.029)</p>	<p>other cultural backgrounds.</p> <p>Feasibility: School is a great place to provide education to the children as they are already there and does not require additional transportation for parents.</p> <p>Application: Provides primary care providers with ideas about educating not only when the children come in for their well-child exams, but also when they are at school.</p>

Table A2
Synthesis Table

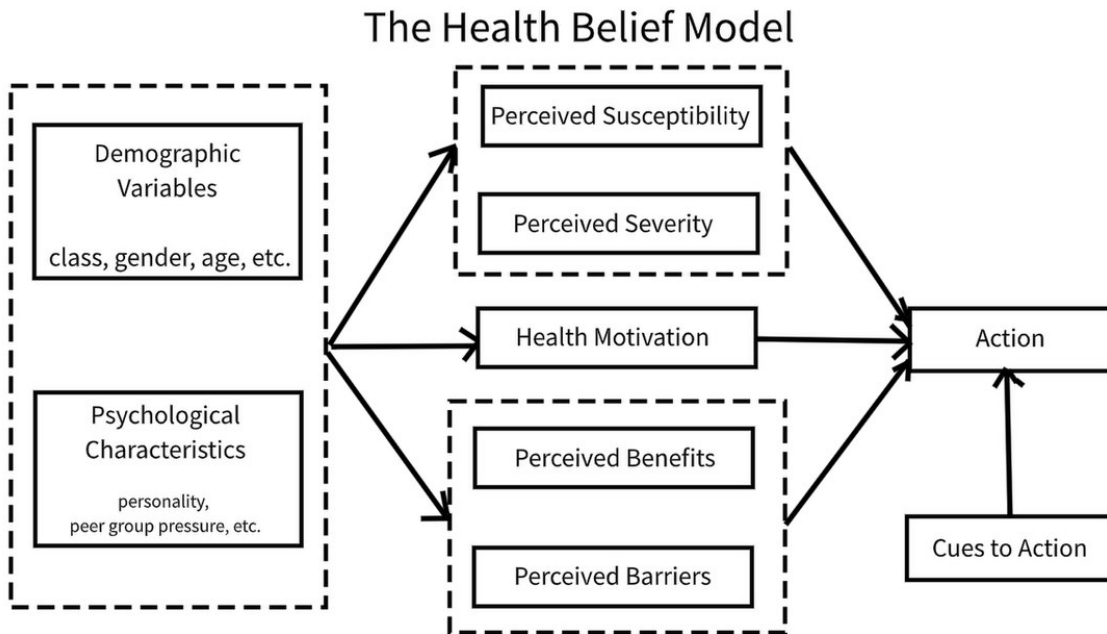
Study (Author, year)	Adab et al., 2018	Barens et al., 2021	Dunca nson et al., 2020	Gato-Moreno et al., 2020	Lee et al., 2020	Likhitweer awong et al., 2021	Lopez-Contreras et al., 2020	Mack et al., 2020	Perdew et al., 2020	Yu et al., 2020
Design LOE	Level I	Level I	Level I	Level I	Level I	Level I	Level I	Level I	Level I	Level I
Study Design	RCT	RCT	SR	RCT	QE	RCT	RCT	RCT	SR	RCT
Sample										
<i>Sample Size</i>	1,397	742	109	261	168	77	177	82	8	203
<i>M-Age/age range</i>	6.3 years	5-12 years	2-20 years	44.9 months	10.95 years	10-15 years	8.65 years	9.7 years	5-18 years	9.7 years
<i>BMI</i>	NS	NS	>25	NS	>30	>30	>25	NS	NS	>25
<i>Attrition Rate</i>	20%	20%		18%	38%	10%	20%	3.6%		10%
Setting										
<i>School-Based</i>	X	X		X				X		X
<i>Home Based</i>										
<i>Hospital Based</i>							X			
<i>Combination</i>			X		X	X			X	
Interventions										
<i>Nutritional Goal Setting</i>					X					
<i>Group ED sessions</i>	X			X			X		X	X
<i>KOP program</i>										
<i>Diet changes</i>		X	X							
<i>Nutritional App</i>						X		X		
Outcomes/ Themes										
<i>BMI</i>	↓	↓		↓	↓	↓	↓		↓	↑
<i>Waist Circumference</i>		↓							↓	
<i>Blood Pressure</i>										↓
<i>Well-being/QoL</i>		↑				↑				↑
<i>Improved Dietary Habits</i>			↑		↑		↑	↑	↑	

Key: **App** Application **ED** Education **KOP** Kids Obesity Prevention **LOE** Level of Evidence **M-Age** Mean Age **NS** Not Stated **PA** Physical Activity **QoL** Quality of Life **QE** Quasi Experimental **RCT** Randomized Controlled Trial **SR** Systematic Review

Appendix B

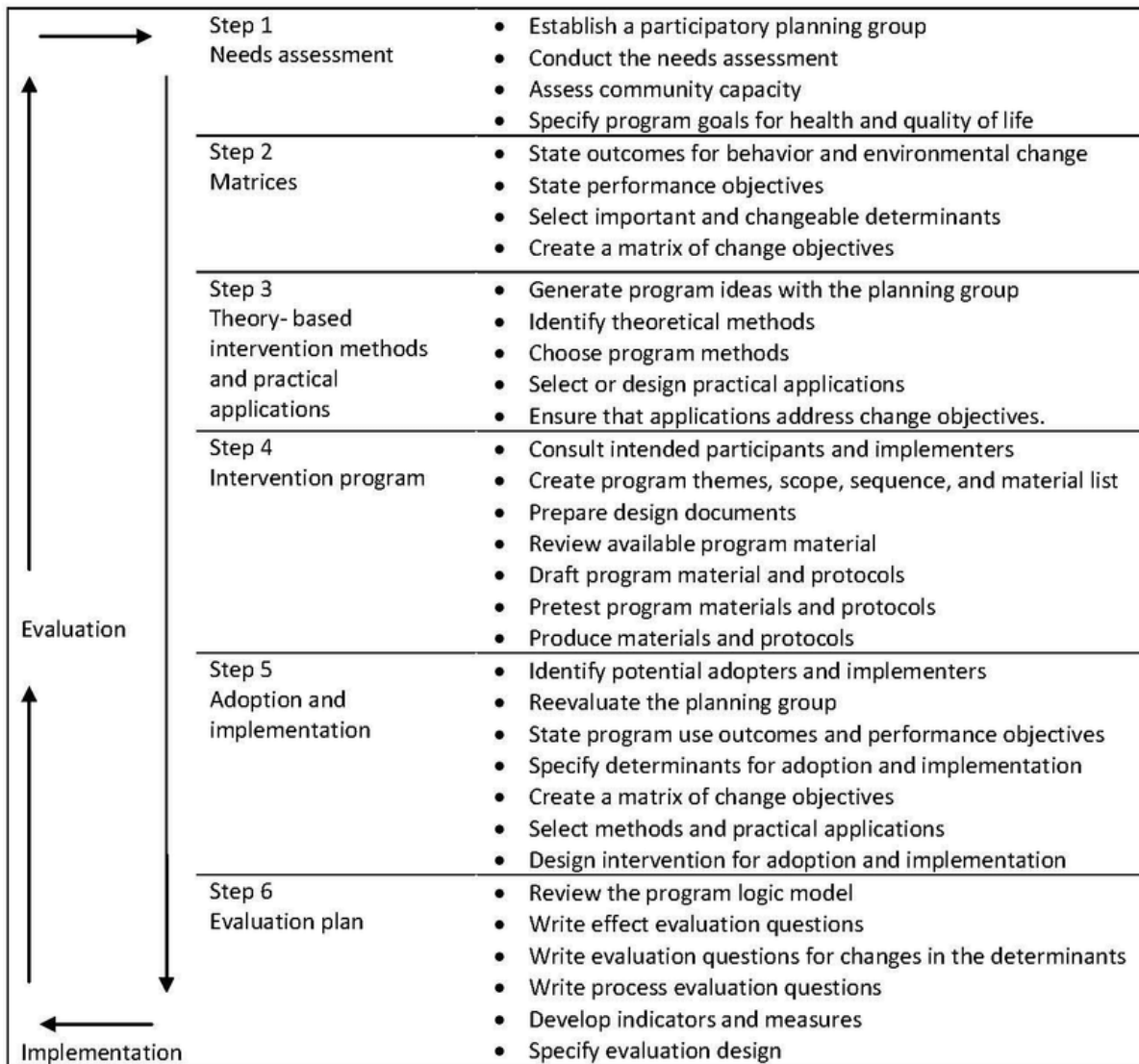
Models and Frameworks

Figure B1
Health Belief Model



(Rosenstock, 1974)

Figure B2
Intervention Mapping



(Bartholomew-Eldredge, 2016)

Appendix C

Figure C1
Project Flyer



Appendix D

Figure D1

Provider Consent

Consent Form

Addressing Childhood Obesity: Implementing A Provider Alerting System

I am a graduate student under the direction of Dr. Mandy Esperas at the Edson College of Nursing and Health Innovation at Arizona State University. I am conducting a research study to determine the effectiveness of an alert system aimed at enhancing provider awareness and involvement in overweight and obese children and adolescents.

I am inviting your participation, which will involve one month of your time. You will begin by taking a short 5-minute pretest followed by a 15-minute education session by the student. The last 4 digits of your phone number will be used as your participant ID to keep you anonymous and allow for comparison with the post-test at the completion. Medical assistants will also receive a 15-minute education session that details their participation instructions. Once the project goes into implementation, the medical assistants will be instructed to highlight any BMI that is higher than 85% for children greater than 10 years of age on the printed-out growth chart. You will respond by handing out a form created by the student that describes the importance of healthy weight management to that patient or parent. You are also encouraged to order laboratory studies as suggested by the American Academy of Pediatrics (AAP) and send a referral to a registered dietician for consultation. A 5-minute post-test will be given at the completion to assess how this changed the way you practice regarding managing overweight and obese children and adolescents. You have the right not to answer any question and to stop participation at any time.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty.

If you are not already including ICD-10 codes Z68.53 and Z68.54 for all overweight/obese percentiles, you might be able to increase insurance reimbursement, which can serve as a benefit to you. Additionally, further addressing healthy weight management in pediatrics can prove to be beneficial to decrease future chronic health diseases for your patients. There are no foreseeable risks or discomforts to your participation.

Any answers recorded in the pre-, and post-test will remain anonymous. The results of this study may be used in reports, presentations, or publications, but your name will not be used.

If you have any questions concerning the research study, please contact the research team at: Dr. Mandy Esperas (Amanda.Esperas@asu.edu) or Madeline Aaron (mbaaron@asu.edu). If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Please let me know if you wish to be part of the study.

By signing below, you are agreeing to be part of the study.

Name:

Signature:

Date:

Appendix E**Figure E1**
*Site Approval***SITE APPROVAL LETTER**

Arizona State University, Edson College of Nursing and Health Innovation
550 N 3rd St,
Phoenix, AZ 85004

Subject: Site Approval Letter

To whom it may concern:

This letter acknowledges that I have received and reviewed a request by Madeline Aaron to conduct a research project entitled “*Addressing Childhood Obesity: Implementing A Provider Alerting System*” at East Valley Children’s Center, and I approve of this research to be conducted at our facility. She has permission to access all necessary medical records to perform a formal chart review in compliance with HIPAA. Additionally, she has permission to train the medical assistants to highlight BMI’s on the growth charts that are significant for the purposes of this project.

When the researcher receives approval for her research project from the Arizona State University’s Institutional Review Board, I agree to provide access for the approved research project. If I have any concerns or need additional information, I will contact the Arizona State University’s IRB at (480) 965-6788 or research.integrity@asu.edu.

Appendix F

Figure F1
IRB Approval



APPROVAL: EXPEDITED REVIEW

[Amanda Esperas](#)
EDSON: DNP
Amanda.Esperas@asu.edu

Dear [Amanda Esperas](#):

On 9/17/2023 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Addressing Childhood Obesity: Implementing A Provider Alerting System
Investigator:	Amanda Esperas
IRB ID:	STUDY00018593
Category of review:	5,6
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	<ul style="list-style-type: none"> • Chart Audit Form Stored in Excel, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Consent Form, Category: Consent Form; • IRB Review Letter, Category: Other; • Madeline Aaron IRB Protocol , Category: IRB Protocol; • Project Site HIPAA Form, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc); • Recruitment Flyer, Category: Recruitment Materials; • Site Approval Letter, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);

The IRB approved the protocol effective 9/17/2023. Continuing Review is not required for this study.

Appendix G**Figure G1***Provider Pre/Post Test***Your Clinical Practice**

- 1) Are you aware of the 2023 clinical practice guidelines on childhood obesity? Yes ___
No ___
- 2) In your current practice, how frequently do you use the diagnosis of **overweight** with children aged 2-17?
___ 1-3 times a week
___ 3-6 times a week
___ Daily
___ Monthly
___ Never
- 3) In your current practice, how frequently do you use the diagnosis of **obesity** with children aged 2-17?
___ 1-3 times a week
___ 3-6 times a week
___ Daily
___ Monthly
___ Never
- 4) In your current practice, how frequently do you order labs for **overweight** children aged 2-17?
___ 1-3 times a week
___ 3-6 times a week
___ Daily
___ Monthly
___ Never
- 5) In your current practice, how frequently do you order labs for **obese** children aged 2-17?
___ 1-3 times a week
___ 3-6 times a week
___ Daily
___ Monthly
___ Never
- 6) In your current practice, how frequently do you refer to a dietician for **overweight** children aged 2-17?
___ 1-3 times a week
___ 3-6 times a week
___ Daily
___ Monthly
___ Never

- 7) In your current practice, how frequently do you refer to a dietician for **obese** children aged 2-17?
- 1-3 times a week
 - 3-6 times a week
 - Daily
 - Monthly
 - Never

Knowledge of guidelines

- 8) What measurement triggers a diagnosis of being **overweight**?
- BMI>95th percentile/growth chart
 - BMI>85th percentile/growth chart
 - BMI>30
 - Weight above average/age
- 9) What measurement triggers a diagnosis of **obesity**?
- BMI>95th percentile/growth chart
 - BMI>85th percentile/growth chart
 - BMI>25
 - BMI>30
 - Weight above average/age
- 10) According to current practice guidelines, **at what age** should lipid panels be ordered for children if their BMI percentile is over 85%?
- Over the age of 2
 - Over the age of 5
 - Over the age of 10
 - Over the age of 15
- 11) According to current practice guidelines, what lab testing should be routinely ordered for children who are **overweight/obese**? (Check all that apply)
- TSH
 - Hemoglobin A1c
 - Lipid panel
 - Insulin level

Level of Comfort

- 12) How comfortable do you feel in discussing overweight/obesity with patients and their parents?
- Very comfortable
 - Somewhat comfortable
 - Neutral
 - Not comfortable
- 13) How comfortable do you feel ordering labs for patients who are overweight/obese?
- Very comfortable
 - Somewhat comfortable
 - Neutral

- ___ Not comfortable
- 14) How comfortable do you feel sending referrals to dieticians who are overweight/obese?
- a) Very comfortable
 - b) Somewhat comfortable
 - c) Neutral
 - d) Not comfortable

Appendix H

Figure H1

Provider Alert System Budget Explanation

EXPENSE ITEMS	FUNDS BUDGETED
<i>Direct Costs</i>	
Materials	\$85.58
Printing	\$58.49
<i>Indirect Costs</i>	
Labor Costs	\$0.00
Electronic Medical Record System	\$0.00
Medical Office Costs	\$0.00
TOTAL PROJECT BUDGET	\$144.07

BUDGET KEY	
	Student personally funding
	Project site voluntarily funding
	Total budget

BUDGET JUSTIFICATION*Direct Costs:*

A. Materials

- a. Highlighters (\$5.58/12-pack)-used to highlight BMI on growth charts.
- b. Intellectus Statistics Software (up to \$80/year for individual access via an educational institution): will be used to run data analysis.

B. Printing

- a. Paper (\$8.49/reem of 500 sheets) -used to print out the growth charts, to print out information graphic for patients/parents, and the provider pre and post assessments.
- b. Printer ink (\$50/black ink cartridge)

Indirect Costs:

A. Labor Costs*

- a. Medical Assistant salary (about \$20/hour): they will be responsible for highlighting BMIs of patients greater than the age of 10 with BMIs greater than the 85th percentile.
- b. Medical Providers Income/Salary: they will be responsible for ordering labs and sending referrals.

B. Electronic Medical Record System*

- a. E Clinical (EMR used at this specific site): used to store patient health information - DNP student will have access to the charting system to perform chart review both pre and post intervention.

C. Medical Office Costs*

- a. Mortgage
- b. Electricity
- c. Water/sewer
- d. Scale/Stadiometer

*Not factored in since project will be run during regular business hours.

COST VERSUS REVENUE*Cost:*

DNP unable to retrieve data from average number of patients greater than the age of 10 with BMIs greater than the 85th percentile for a 1-month period in the fall, so exact cost divided per patient were unable to be retrieved at this time. All values are based on an estimated total cost and expected preparation cost to implement the project.

Revenue:

This project could result in increased revenue for the project site due to more frequent follow ups dependent on lab work abnormalities and/or need to recheck patient weight/health status (dependent upon insurance contracts).