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Provider Adherence to National Heart, Lung, and Blood Institute's Guidelines on Screening, Diagnosis, and Treatment of Hypercholesterolemia in the Pediatric Population Aged 9-11 Years

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Abstract

Purpose: High cholesterol levels have been directly linked to atherosclerosis, which is a leading cause of cardiovascular disease (CVD). Risk factors that accelerate the development of atherosclerosis, such as high cholesterol can begin in childhood. The purpose of this project was to evaluate provider adherence to the National Heart, Lung, and Blood Institute's (NHLBI) *Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents*, specifically the guidelines on universal lipid screening in children aged 9-11 years. The objectives were: 1) determine the rate of lipid screening in children 9-11 years old; 2) determine the number of children who meet the criteria for the diagnosis of dyslipidemia; and 3) determine the method of treatment of children diagnosed with dyslipidemia.

Method: The setting was a pediatric clinic in a large healthcare organization in the Midwest. A retrospective chart review was performed on 97 randomly selected charts of patients ages 9 to 11 years old who were seen in the clinic for a well-child exam from February 1, 2018 through July 31, 2018.

Results: The majority of patients were 11 years old (49.5%), male (55.7%), and white (84.5%). Providers ordered lipid panels 47.4% of the time. Abnormal results were found in 44.2% of patients and additional testing was ordered in 26.3% of those patients which were outside recommended guideline parameters. No patients met the criteria for a diagnosis of hypercholesterolemia according to the guideline recommendations.

Conclusion: Providers in this clinic were not consistently following recommended NHLBI guidelines regarding lipid panel screening in the pediatric population. Providers were more likely to perform lipid panels on patients who are 11 years old and male. There is an opportunity to improve lipid screening rates in the pediatric population in an effort to prevent the development of cardiovascular disease in later life. Educating providers on the NHLBI's recommended guidelines for practice may improve screening rates and identification of those at risk.

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Dedication

My nursing journey has been long and hard, not only on me but my whole family. My decision to go to nursing school was a joint decision between my husband, our two daughters, and myself. We all decided together that this journey would be worth it for our family's future, and we would make the necessary sacrifices for me to reach this dream of mine. So, I dedicate my nursing career to my loving and supportive family; my husband, Thomas, and our daughters, Marisa and Lauren. Without them my dreams would not have been able to come true. Thank you for always being there for me, reminding me that I could do it, and being the light at the end of a dark tunnel. I love you all more than you could possibly know!

Table of Contents

List of Tables

List of Figures

Introduction

One-third of the world's cases of cardiovascular disease are related to high cholesterol and an estimated 2.6 million deaths will be caused by hypercholesterolemia globally in 2018 (World Health Organization [WHO], 2018). In 2018, the WHO reported that the United States (US) had the second highest prevalence of high cholesterol levels in the world at 48%, with Europe coming in first at 54% (WHO, 2018). The Centers for Disease Control and Prevention (CDC) report that from 2011-2014, 95 million Americans over the age of 20 years had high total cholesterol levels (U.S. Department of Health and Human Services [HHS], 2017a). During those same years, an astounding number of children and adolescents, as many as 1 of every 5, had at least one high cholesterol level (Nguyen, Kit, & Carroll, 2015). The National Health and Nutrition Examination Survey (NHANES) data collected during the years 1998-2010 showed that 24.6% of children between the ages of 9-11 years had an elevated non-high-density-lipoprotein cholesterol (non-HDL-C) level or an abnormally low HDL-C (Valle, Binns, Quadri-Sheriff, Benuck, & Patel, 2015). High cholesterol is linked to atherosclerosis which is a leading cause of cardiovascular disease. In 2012, the National Heart, Lung, and Blood Institute (NHLBI) developed an expert panel to conduct a study and make recommendations in an effort to reduce the risk of developing cardiovascular disease in children and adolescents. The purpose of this project was to assess provider adherence to the National Heart, Lung, and Blood Institute's guidelines on universal lipid screening in children aged 9-11 years.

Background

High cholesterol levels have been directly linked to atherosclerosis, which is a leading cause of cardiovascular disease (CVD) and stroke. Atherosclerosis afflicts an estimated 1.5 million Americans every year and costs approximately $316.6 billion annually (HHS, 2011).

Atherosclerosis progresses slowly beginning with the abnormal accumulation of lipids in the vascular intima forming an innocuous lesion called a fatty streak. This fatty streak, if left untreated, progresses to a fibrous plaque with the potential to rupture or occlude the lumen culminating in thrombosis, vascular dissection, or acute ischemic syndrome (HHS, 2012). Researchers from two different studies identified the presence of atherosclerotic lesions in the aortic and coronary arteries at autopsy of children and young adults who had died of various causes (Berenson, Srinivasan, Bao, Newman, Tracy, & Wattigney, 1998; Strong, Malcom, McMahan, Tracy, Newman, Herderick, & Cornhill, 1999). These studies suggest that the behaviors leading to atherosclerosis begin in childhood; therefore, early intervention to reduce cardiovascular risk should begin early in the life cycle.

Based on the scientific evidence review of cardiovascular risk factors and the development of atherosclerosis in childhood, the NHLBI expert panel concluded that early identification and intervention of hypercholesterolemia in childhood could significantly reduce CVD risk in adulthood (HHS, 2012). Therefore, the NHLBI, with the endorsement of the American Academy of Pediatrics (AAP), developed cholesterol screening guidelines strongly recommending primary care providers (PCP) begin performing universal lipid screening (fasting or non-fasting) in children aged 9-11 years (HHS, 2012).

Targeted values for a fasting lipid panel in children are low-density lipoprotein cholesterol (LDL-C) $<$ 130 mg/dL, non-HDL-C less than 145 mg/dL, and HDL-C greater than 40 mg/dL. The targeted value for triglycerides (TG) for children under age 10 is less than 100 mg/dL or less than 130 mg/dL if 10 years or older (HHS, 2012). The NHLBI's expert panel strongly recommends screening be performed using a non-fasting lipid panel (non-FLP) and then calculating the non-HDL-C by subtracting the HDL-C from the total cholesterol (TC) (HHS, 2012). The expert panel found that the non-HDL-C is a better predictor of CVD risk later in life (HHS, 2012).

In a study tracking children into adulthood over a 27-year period, children with high non-HDL-C levels were found to be 4.5 times more likely to develop dyslipidemia in adulthood, whereas children with high LDL-C levels were 3.5 times more likely to develop dyslipidemia in adulthood (Srinivasan, Frontini, Xu, & Berenson, 2006). Srinivasan and colleagues (2006) also revealed elevated levels of non-HDL-C in childhood can predict adulthood hyperglycemia, hyperinsulinemia, and low-HDL-C levels. High levels of non-HDL-C in childhood has also been associated with increased prevalence of obesity, increased triglycerides and LDL-C levels (Srinivasan, Frontini, Xu, & Berenson, 2006).

An abnormal non-FLP results when a non-HDL-C level is greater than or equal to 145 mg/dL and an HDL-C is less than 40mg/dL (HHS, 2012). For children with an abnormal non-FLP the NHLBI panel recommends obtaining two FLP's within two weeks to three months apart (HHS, 2012). Abnormal results should be evaluated for secondary causes and risk factors to determine the best intervention which may include lifestyle changes and/or pharmacological treatment (HHS, 2012). The NHLBI developed algorithms to assist in determining the course of treatment dependent upon LDL-C (Figure 1) and TG (Figure 2) levels. Addressing CVD risk factors in childhood may reduce the risk of developing lifelong chronic disease in adulthood leading to a longer, healthier life.

Universal cholesterol screening is the recommended and preferred method of hypercholesterolemia identification in the pediatric population aged 9-11 years (HHS, 2012). The screening can be performed in the primary care office during a well-child visit. Universal screening can identify more cases of hypercholesterolemia than considering familial or individual risk factors, such as familial hypercholesterolemia, obesity, and diabetes, to determine the need for cholesterol screening. For example, using the universal screening method in children has proven to identify 30-60% more hypercholesterolemia cases in children allowing for early intervention and decreasing mortality and morbidity rates in adulthood (Wilson et al., 2015). These results support using universal cholesterol screening in the primary care office as a first line strategy to identify children at risk for CVD.

de Ferranti and colleagues (2017) surveyed 1,627 U.S. pediatricians to determine screening practices of providers and to identify any barriers to recommended practice. Over half (68%) of pediatricians did not universally screen children 9 to 11 years old. More providers screened based on family history and obesity. In addition, pediatricians were more likely to screen older children than younger. Lack of knowledge of guidelines was identified as one barrier with only 26% of providers surveyed expressing familiarity with current NHLBI guidelines. Nearly all pediatricians surveyed provided lifestyle modification education. While some pediatricians identified interpretation of cholesterol profile as a barrier (35%), a higher percentage identified patients not returning for a fasting lipid test (89%), and inability to obtain an accurate family history (60%) (de Ferranti et al., 2017). The advent of the electronic health record (EHR) has offered the potential for enhanced decision support and reminders which could increase provider adherence to universal screening guidelines (DeSantes, Dodge, Eickoff, & Peterson, 2017).

Research shows that providers are not consistently following the NHLBI guidelines. DeSantes and colleagues (2017) performed a retrospective review of EHRs in a pediatric practice in an academic health center to determine if publication of the NHLBI guidelines on pediatric lipid screening changed practice of universal screening. Records of 22,374 patients from

January 2010 to December 2015 were reviewed. The researchers found screening orders increased from 8.9% before publication of the guideline to a high of 60.9% after publications. Lipid screening was ordered more often for older children 17 to 21 years old (45.5%) than younger children 9 to 11 years old (32.5%). There was no difference in screening orders between males and females. The researchers attributed the increase in screening orders to publication of the guidelines, provider education and EHR modifications. Mihalopoulis and colleagues (2018) analyzed data from two large health care systems and an insurance company to evaluate provider adherence to universal screening guidelines for children 9 to 11 years old. A lipid screening test was obtained for 3.5% of the 63,951 patients seen for well child visits during the study period. Of those screened, 43% had an abnormal result.

Valle and colleagues (2015) found slightly better adherence to the guidelines in their retrospective review of medical records of 298 children. When comparing screening rates before and after publication of the NHLBI guidelines, the researchers found 12.4% of the 298 children were screened prior to publication and 16.9% of the remaining 261 children were screened after publication.

Purpose and Objectives

The overall goal of this project was to assess provider adherence to the National Heart, Lung, and Blood Institute's (2012) guidelines on universal lipid screening in children aged 9-11 years in a pediatric practice in a large healthcare organization. More specifically the following objectives were explored:

1. Determine the rate of lipid screening in children 9-11 years old.
2. Determine the number of children who meet the criteria for the diagnosis of dyslipidemia.

3. Determine the method of treatment of children diagnosed with dyslipidemia.

Setting

The setting was a pediatric clinic within a large healthcare organization in the Midwest. This organization serves patients all across the life span, but for purposes of this study the focus was on patients aged 9-11 years.

Methods

A retrospective chart review of 97 randomly selected patient charts was performed to determine current practice regarding dyslipidemia screening, diagnosis, and treatment in the pediatric population aged 9-11 years. The health care organization's information technology (IT) department utilized inclusion criteria to obtain chart information for the population of interest. That data was analyzed to determine if lipid screening is being performed per NHLBI recommended guidelines. A further detailed manual review of the patient chart determined if the provider documented a discussion regarding why or why not lipid screening was performed. In addition, the manual chart review consisted of reviewing risk factors, family history, lab results and provider documentation.

Sample

A data information request was provided to the healthcare organization to obtain records for evaluation. Inclusion criteria were any patient between the ages of 9-11 years old having a well child visit using ICD-10 code Z00.129 during February 1, 2018 and July 31, 2018. The healthcare organization IT department provided a list of patients meeting the inclusion criteria from the approved pediatric clinic with a sample goal of 100 charts to be studied. The initial data compilation returned 326 patient charts. The 100 charts included in this study were randomly selected from the 326 charts.

Informed Consent

This project involved a retrospective chart review therefore informed consent was not practical. A waiver of documentation of informed consent was requested and granted by the University of Kentucky Institutional Review Board and the healthcare organization's research office.

Procedure

A crosswalk table was constructed providing the only link between the patient's medical record number to a unique study identifier thus ensuring confidentiality of the chart information. The crosswalk table and the data collection files were saved in separate locations on the healthcare organization's secured drive that is firewall protected. Charts were evaluated for well child visit ICD-10 code Z00.129 and CPT code 80061 for lipid panel. If a lipid panel was completed then the results and the provider's documentation of acknowledgement of results as well as treatment ordered were reviewed. If a lipid panel was not completed, the provider notes were reviewed for explanation. Provider documentation was compared to NHLBI recommended guidelines to determine adherence. Charts were also reviewed to determine patient compliance with additional testing requirements, when appropriate, within the time frame of the study.

Data Analysis

Descriptive statistics with frequency intervals were used to determine provider adherence to NHLBI recommended guidelines for universal lipid screening in the pediatric population aged 9-11 years. Frequency intervals were also used to determine how often a diagnosis of hypercholesterolemia was made and a treatment recommended. A chi-square test for independence was performed to determine significant differences in lipid screening for gender, age and race with an alpha level of $p < .05$.

Results

Of the 100 charts randomly selected, 3 charts were found to not include the well child visit code Z00.129; therefore, those charts were excluded from the sample, decreasing the sample size to 97. Of the remaining 97 well visit charts reviewed, the majority of the patients were aged 11 years (49.5%), followed by aged 10 years (28.9%), then aged 9 years (21.6%).The majority of the sample was male (55.7%) and White (84.5%) (see Table 1). During the well child visit a lipid panel was ordered and completed for 44.3%, ordered and not completed 3.1%, and not ordered 52.6% (see Table 2). Of those with a completed lipid panel none met criteria to require further lipid testing as outlined in the NHLBI guidelines. Of the lipid panels performed only one had a non-HDL-C greater than 145 but the HDL-C was greater than 40 excluding the need for further testing.

Providers interpreted lipid panels as being abnormal in 44.2% of the sample and ordered additional testing in 26.3% of that sample. These results were outside recommended guideline parameters and therefore should not have been reported as abnormal and did not require additional testing. Two patients had abnormal non-fasting lipid panels and were subsequently diagnosed with hypercholesterolemia even though they did not meet the guideline's criteria for the diagnosis. The results of the chi-square test for gender ($p = .013$) indicate there was a statistically significant relationship between gender and lipid panels being performed at well child visits. Boys were more likely to be screened than girls. There was also a statistically significant relationship between age and whether a lipid panel was performed ($p < .001$). Patients who were 11 years old were more likely to have a lipid panel performed than younger patients. There was no statistical significance between race and whether or not a lipid panel was performed (p = .602; See Table 3).

Data was collected on risk factors for cardiovascular disease such as hypertension, obesity, and family history in addition to lipid levels (See Table 4). According to the hypertension guidelines provided by the American Academy of Pediatrics (Flynn et al., 2017), 24 male patients (44%) and 22 female patients (51%) met the criteria for elevated blood pressure. Of those patients meeting hypertension criteria, 17 males (71%) and 8 females (36%) had lipid panels ordered.

Obesity in the pediatric population is defined by the CDC to be a body mass index (BMI) greater than the 95th percentile of the CDC sex and age specific growth chart (HHS, 2018; HHS, 2000). Using the data from these growth charts, 11 males (20%) and 15 females (35%) met obesity criteria. Lipid panels were drawn on 5 of the obese males (45%) and on 6 of the obese females (40%). Some patients met criteria for both hypertension and obesity. Of the sample, 6 males (11%) and 13 females (30%) met those criteria and lipid panels were ordered on 3 of those male patients (50%) and 5 of the female patients (38%).

Family history was reviewed for cardiovascular risk factors such as diabetes, heart disease, hyperlipidemia, hypertension, and stroke. A positive family history was determined if one of these risk factors were reported on a child's mother, father, or grandparents. At least one risk factor was reported in 74 patients (76%), 37 males (50%) and 37 females (50%) with lipid panels being ordered on 25 of those male patients (68%) and 16 of those female patients (43%).

In an attempt to find a correlation between lipid testing in relation to insurance coverage, data collected showed 75% of the patients had commercial insurance, 24% had government issued insurance coverage, and 1% had no insurance coverage (See Table 5). The patients with commercial insurance had lipid panels ordered 49% of the time whereas patients with government issued insurance was 44%. Under commercial insurance, children 11 years of age had a lipid panel ordered 87% of the time regardless of gender, with males slightly more often at 89% than females at 82%. Of the 19 children aged 9 with commercial insurance, none had orders for a lipid panel and only 13% of 10-year-olds received lipid panel orders, 1 male and 1 female. Under government issued insurance 11-year-old children received orders for a lipid panel 78% of the time regardless of gender, with males at 67% and females at 100%. Of the 4 children aged 9 with government issued insurance none had orders for a lipid panel and only 30% of the 10-year-olds received lipid panel orders, all female. These data show that children aged 11, regardless of insurance carrier, had a higher percentage of lipid panels ordered than those 9-10 years of age. Males had higher percentages of lipid panel orders under both types of insurance.

In 100% of the sample lifestyle modification was discussed in the form of diet and exercise. Each patient was counseled on eating a balanced diet with meats, fish, vegetables, fruit, and healthy snacks. Patients were encouraged to limit junk food and eat low fat dairy products including low fat milk. Education was provided on drinking mostly water with the occasional sports drinks, soft drinks, juice, and sweet tea. Each child was encouraged to limit screen time and get plenty of exercise, although no specific information was documented as to how much exercise weekly or how long to exercise.

Discussion

The results of this study show that providers in this pediatric clinic are not consistently ordering universal lipid screening on pediatric patients between the ages of 9-11 years. In addition, these data show that these providers are ordering universal lipid screening, according to NHLBI guidelines, only 47.4% of the time. This rate is much higher than other studies found which show providers performing universal screening at much lower rates, such as 3.5% and 3.2% (Mihalopoulis et al., 2018; Wilson et al., 2018). Other studies have found a higher compliance of screening at a rate of 27.2% (Valle et al., 2015), but still lower rates than demonstrated in this study. This study found these providers were more likely to order lipid panels on children who are aged 11 years and male (see Table 3). These data show that most of the children in this study did not meet the criteria for further testing according to the NHLBI guidelines resulting in no diagnoses of hypercholesterolemia within the parameters of this study. In addition, providers were inconsistent in following guideline recommendations regarding when to consider results abnormal and performing further testing. Some providers ordered additional fasting lipid panels outside guideline recommendations. Lack of provider knowledge concerning universal screening recommendations could be a contributing factor to the lower compliance rates of this study.

According to the data collected, no pattern was revealed for ordering of the lipid panels. Patients with multiple risk factor criteria were not always tested whereas some without any risk factors were tested. EMR reminders could be used to improve compliance to universal cholesterol testing as well as guideline education.

Limitations

Some limitations to this study include small sample size and study participants from only one clinic. The study period for this review was 6 months which did not allow time to see if lipid panels had been completed during a different well child visit during ages 9-11 years. Three of the charts reviewed did not contain well child visit ICD-10 code Z00.129. In addition, providers' charting did not specifically address treatment or rationale for treatment or lack of. Also, neither providers nor parents were interviewed to determine barriers to lipid screening.

Implications for Further Study

Further study about this topic should include a wider time span for the collection of data and correlation between risk factors and lab testing. Lipid panel trends could be followed to determine if test results improve with lifestyle modification as the only intervention or if pharmaceutical treatment is warranted. Also, following patients into adulthood could provide additional information into CVD development among this population. Additionally, interviewing pediatric providers to understand why they are not ordering universal cholesterol screening amongst this population, the barriers to testing, and parents' receptiveness to testing and education would provide valuable information.

Implications for Practice

Providers in this pediatric clinic did not follow recommended guidelines for lipid screening in the pediatric population. Lipid screening at an early age has the potential to identify early signals for cardiovascular disease later in life. Screening can identify risk factors and provide opportunity for early intervention that can carry over through the life span possibly improving patient morbidity, mortality, and overall quality of life.

Conclusion

Cardiovascular disease is one of the leading causes of death in the United States (HHS, 2017b). Early signs of heart disease have been found in young adults in the form of atherosclerotic plaques in the coronary arteries and aorta. Lifestyle modification at an early age is expected to decrease cardiovascular disease later in life. The NHLBI (2012) developed lipid screening guidelines for the pediatric population in an effort to decrease the incidence of cardiovascular disease in adults. This study found that providers in this clinic were not following recommended guidelines regarding universal lipid screening in the pediatric population aged 9-11 years. The results of this study imply there is an opportunity to improve lipid screening rates in the pediatric population in an effort to decrease or possibly prevent the development of cardiovascular disease later in life. Educating providers on the NHLBI's recommended guidelines for practice may improve screening rates and the identification of those at risk.

Table 1. Demographic characteristics of sample (*N* = 97)

Characteristics	n (%)
Age	
9	21 (21.6%)
10	28 (28.9%)
11	48 (49.5%)
Sex	
Male	54 (55.7%)
Female	43 (44.3%)
Race/ethnicity	
White	82 (84.5%)
Black	5 (5.2%)
Hispanic	8 (8.2%)
Unknown	2 (2.1%)

Table 2. Frequency of lipid panel (*N* = 97)

Lipid panel ordered/collected	n (%)
Yes, ordered and collected	43 (44.3%)
Yes, but not collected	3 (3.1%)
No, not ordered	51 (52.6%)

Table 3. Demographic characteristics by lipid panel (*N* = 97)

Characteristics	Completed	Ordered but not completed	Not ordered	p-value
Age				(p = .000)
9	0 (0.0%)	0 (0.0%)	21 (100.0%)	
10	4 (14.3%)	1 (3.6%)	23 (82.1%)	
11	39 (81.3%)	2 (4.2%)	7 (14.6%)	
Sex				(p = .013)
Male	30 (55.6%)	0 (0.0%)	24 (44.4%)	
Female	13 (30.2%)	3 (7.0%)	27 (62.8%)	
Race				(p = .602)
White	37 (45.1%)	3 (3.7%)	42 (51.2%)	
Black	2 (40.0%)	0 (0.0%)	3 (60.0%)	
Hispanic	2 (25.0%)	0 (0.0%)	6 (75.0%)	
Other	2 (100.0%)	0 (0.0%)	0 (0.0%)	

Table 4. Risk Factors for cardiovascular disease (*N* = 97)

	Male	Female	Lipids Drawn Male	Lipids Drawn Female
HTN	24 (44%)	22 (51%)	17 (71%)	8 (36%)
Obesity	11 (20%)	15 (35%)	5 (45%)	6 (40%)
HTN and Obesity	6 (11%)	13 (30%)	3 (50%)	5 (38%)
FHx	37 (50%)	37 (50%)	25 (68%)	16 (43%)

Table 5. Insurance carrier by lipid panel (*N* = 97)

	Lipid Drawn Commercial Insurance	Lipid Drawn Government Insurance
Overall lipid drawn	36 (49%)	10 (44%)
Age 11 years	34 (87%)	7 (78%)
Age 10 years	2 (13%)	3 (30%)
Age 9 years	0	0

Figure 1. Dyslipidemia Algorithm Target LDL-C. Reprinted from NHLBI Guidelines (HHS, 2012).

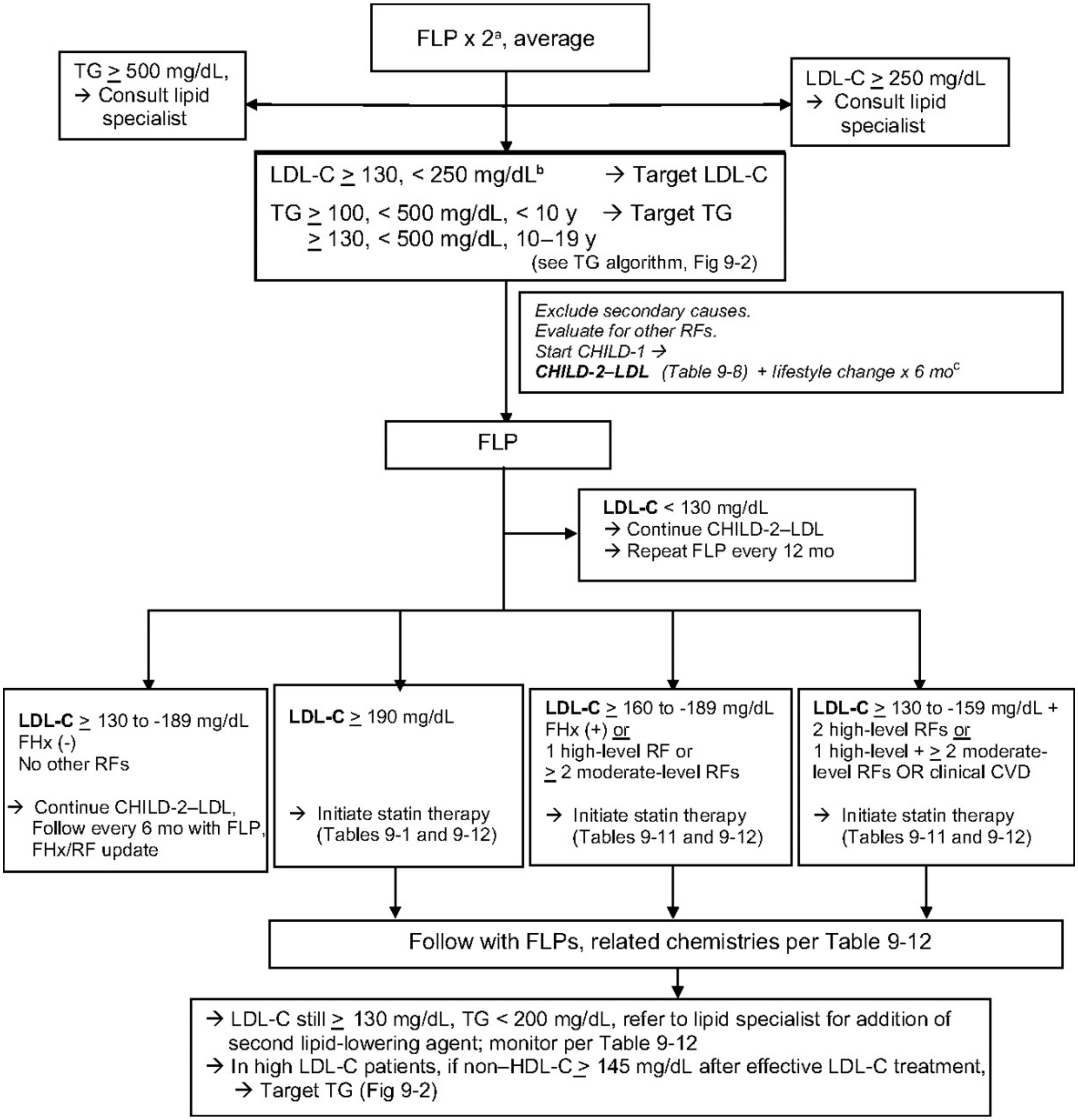
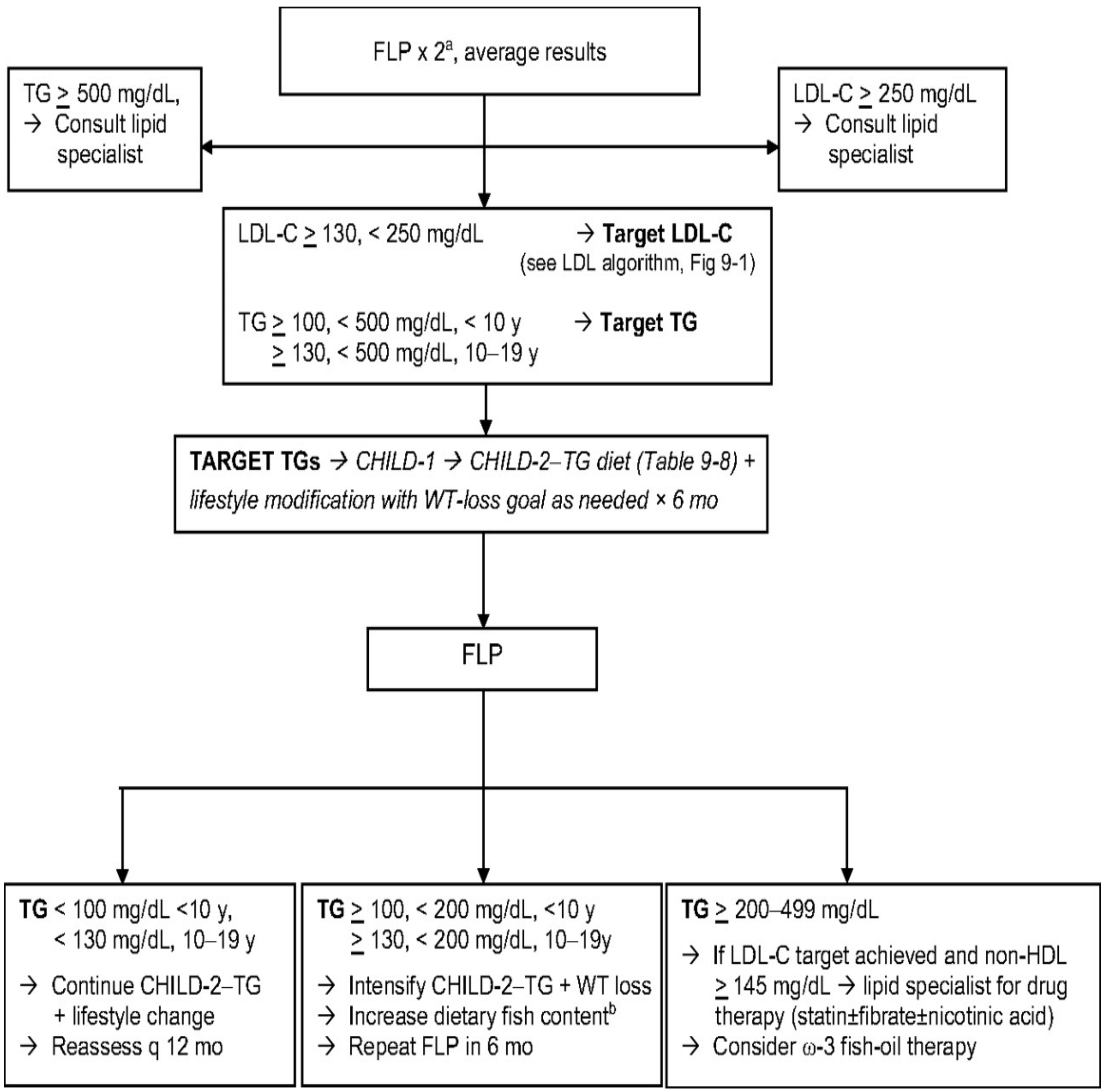


Figure 2. Dyslipidemia Algorithm Target TG. Reprinted from NHLBI Guidelines (HHS, 2012).



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