A Cost Analysis of Universal versus Targeted Cholesterol Screening in Pediatrics

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Objective To compare the number of children needed to screen to identify a case of childhood dyslipidemia and estimate costs under universal vs targeted screening approaches.

Study design We constructed a decision-analytic model comparing the health system costs of universal vs targeted screening for hyperlipidemia in US children aged 10 years over a 1-year time horizon. Targeted screening was defined by family history: dyslipidemia in a parent and/or early cardiovascular disease in a first-degree relative. Prevalence of any hyperlipidemia (low-density lipoprotein [LDL] ≥130 mg/dL) and severe hyperlipidemia (LDL ≥190 mg/dL or LDL ≥160 mg/dL with family history) were obtained from published estimates. Costs were estimated from the 2016 Maryland Medicaid fee schedule. We performed sensitivity analyses to evaluate the influence of key variables on the incremental cost per case detected.

Results For universal screening, the number needed to screen to identify 1 case was 12 for any hyperlipidemia and 111 for severe hyperlipidemia. For targeted screening, the number needed to screen was 7 for any hyperlipidemia and 49 for severe hyperlipidemia. The incremental cost per case detected for universal compared with targeted screening was $1980 for any hyperlipidemia and $32 170 for severe hyperlipidemia.

Conclusions Our model suggests that universal cholesterol screening detects hyperlipidemia at a low cost per case, but may not be the most cost-efficient way to identify children with severe hyperlipidemia who are most likely to benefit from treatment. *(J Pediatr 2018;196:201-7).*

Of cardiovascular disease risk factors, dyslipidemia is among the most prevalent, affecting 1 in 3 US adults.[1] It is also among the most treatable with strong evidence that cholesterol-lowering medication reduces cardiovascular disease and mortality in adults.[2] Because long-term cohort studies suggest that the atherosclerotic damage from high cholesterol may begin in childhood and is generally progressive, early identification and treatment of dyslipidemia could be beneficial for cardiovascular disease prevention.[3]

In 2014, the American Academy of Pediatrics changed their cholesterol screening guidelines from targeted to universal screening of children, following the guidance of an earlier expert panel from the National Heart, Lung, and Blood Institute (NHLBI).[4,5] Previously, the American Academy of Pediatrics (AAP) and the NHLBI recommended screening of children with a family history of dyslipidemia and/or early cardiovascular disease. However, targeted screening fails to detect 30%-60% of children with dyslipidemia.[3]

The expansion from targeted to universal screening has been controversial, given limited data on universal screening. Childhood dyslipidemia represents a range of diagnoses from familial dyslipidemia to obesity-related dyslipidemia, the natural histories of which differ substantially. Few studies examine behavior change or health outcomes after universal childhood cholesterol screening, and there are no estimates of cost consequences to the US health system.[6] Decision analysis is the main strategy available to stakeholders when comparative trials are infeasible, such as a trial of universal vs targeted childhood screening where decades-long follow-up would be needed. Our objective was to use decision-analysis techniques to compare the number of children needed to screen to identify dyslipidemia and estimate the costs of universal vs targeted screening for childhood dyslipidemia from a health systems perspective.

Methods

We constructed a decision-analytic model comparing the US health system costs of universal vs targeted screening for dyslipidemia in children over a 1-year time horizon. The model was based on the screening and management algorithm from the NHLBI expert guidelines, which were the basis of the AAP recommendations

AAP	American Academy of Pediatrics
HDL	High-density lipoprotein
LDL	Low-density lipoprotein
NHLBI	National Heart, Lung, and Blood Institute

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(**Figure**). We simulated a cohort of all US children aged 10 years old (4.1 million children) undergoing universal or targeted screening.[7] Children are recommended to undergo screening once during the age range of 9-11 years. Under the universal screening simulation, all children receive screening and proceed through the decision-analytic model, which includes follow-up testing and initial treatment decisions. Under the targeted screening simulation, only children with a positive family history receive screening; follow-up testing and treatment guidelines are the same. We used a 1-year time horizon to account for time necessary for dyslipidemia screening, follow-up testing, initial 6-month dietary treatment if diagnosed with hyperlipidemia, and consideration of medication if limited response to dietary treatment and severe hyperlipidemia.

We used the NHLBI definitions of dyslipidemia (high-density lipoprotein [HDL] ≤40 mg/dL or non-HDL cholesterol ≥145 mg/dL), hyperlipidemia (low-density lipoprotein [LDL] ≥130 mg/dL or triglycerides ≥130 mg/dL), and severe hyperlipidemia (LDL ≥190 mg/dL or LDL ≥160 mg/dL with positive family history). Children who screened positive for dyslipidemia (low HDL and/or high non-HDL) underwent repeat cholesterol testing and evaluation of secondary causes before diagnosis of hyperlipidemia (elevated LDL and/or triglycerides). Children diagnosed with hyperlipidemia underwent 6 months of diet therapy (ie, 2 visits with a nutritionist to assist with low-fat diet). Per the NHLBI expert panel algorithm, medication would be recommended for children with severe hyperlipidemia whose LDL levels do not improve after 6 months of diet therapy. We defined a positive family history, according to prior AAP guidelines, as dyslipidemia (total cholesterol >240 mg/dL or abnormal LDL or HDL levels) in a parent and/or premature cardiovascular disease in parent, aunt/uncle, sibling or grandparent (cardiovascular disease before age 55 for male relatives or before age 65 years for female relatives).[8]

For universal screening, we used published data on the prevalence of dyslipidemia in children from the 2011-2014 waves of National Health and Nutritional Annual Survey (**Table I**).[9,10] We obtained other clinical data (ie, prevalence of hyperlipidemia at repeat testing, secondary dyslipidemia, and severe hyperlipidemia) from large cohort studies of universal screening in school-age children. We used the most recent study with similar definitions of dyslipidemia and hyperlipidemia to the AAP/NHLBI expert panel recommendations as the base estimate and the estimates from other studies as ranges in the sensitivity analyses.[8,12-17,19-21] For evaluation of secondary causes, we included a repeat clinic visit, a complete metabolic profile (eg, glucose level, liver function tests, and basic kidney function), an HIV test, and a thyroid-stimulating hormone test to identify the most common causes of secondary dyslipidemia in this age group.[4,29] Although childhood obesity may contribute to hyperlipidemia, especially hypertriglyceridemia, we did not exclude obesity-associated hyperlipidemia as a secondary dyslipidemia. Children diagnosed with secondary dyslipidemia do not count as a case detected as they would receive alternative treatment and follow-up.

For targeted screening, we estimated that 35% of children had a positive family history based on a recent cohort study[22]; this is the midpoint of prior estimates.[3,14,15,17,21-25] We obtained other clinical data from published cohort studies of family history-based screening and/or of lipid clinic patients.[11,18,21,22,24] We used the most recent study with similar definition of a positive family history to prior AAP guidelines as the base estimate and estimates from other studies in sensitivity analyses (**Table I**).

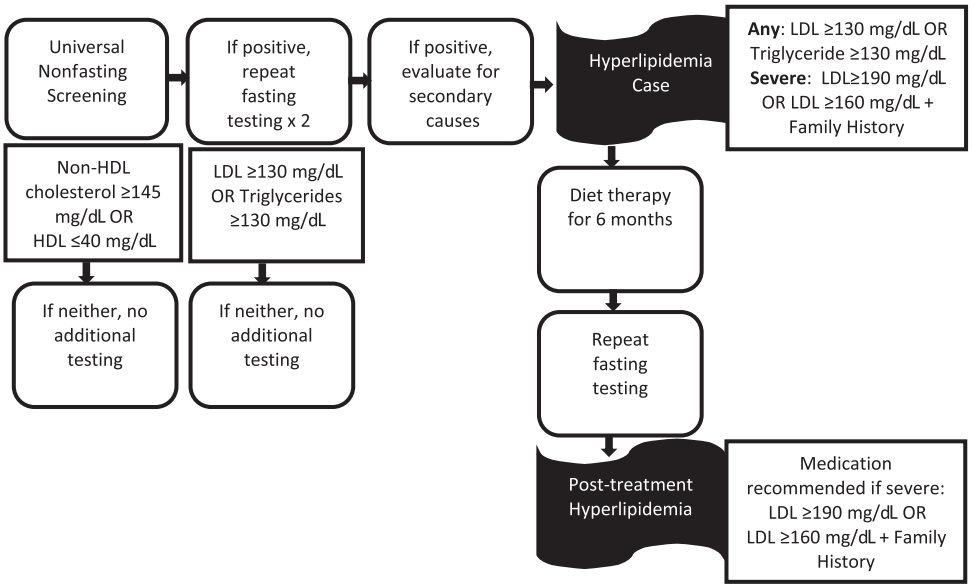

Figure. Universal cholesterol screening model.