A Commentary on the 2017 Clinical Practice Guidelines on Hypertension in Children and Adolescents

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COMMENTARY

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Introduction

The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (Fourth Report) was published in 2004. [1] These guidelines recommended an evaluation of confirmed childhood hypertension that was not limited to a secondary cause of hypertension, but also included recommendations to test for associated risk factors and target organ damage (TOD). Subsequent research on blood pressure (BP) in children led to many reports on the increasing prevalence of abnormal BP in children, and on factors associated with abnormal BP that contributed to heightened risk for cardiovascular disease in early adulthood. Based on an expanded body of findings, the American Academy of Pediatrics sponsored an update of the pediatric BP guidelines. The Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents (CPG) was published in 2017. [2] This update on high BP guidelines for children and adolescents provides detailed and comprehensive clinical guidance for detection, diagnosis, and management of abnormal BP in pediatric patients. The overall clinical approach in evaluation and management of hypertension in children and adolescents is similar to the previous 4th Report. However, there are several key changes in the 2017 CPG that are important in pediatric and primary care practice. This commentary will discuss the key changes in the new CPG as well as recent publications on the impact of the CPG.

The strong association of overweigh and obesity status with higher BP in childhood is well established. [3, 4] Removal of BP data on children with body mass index (BMI) >85th percentile in the child normative BP database resulted in somewhat lower BP level at each sex, age, and height percentile. [5] The new BP tables in the CPG are now based on normal weight children; and the BP levels at the 90th and 95th percentile, used to define abnormal BP and hypertension, are 2 to 3 mmHg lower than the systolic and diastolic BP levels in the 4th Report.

The definition of hypertension in children <13 years of age remains unchanged as systolic and/or diastolic BP >95th percentile. The terminology for staging is somewhat different with stage 1 hypertension designated as 95th percentile + 12 mmHg, and stage 2 hypertension is >95 percentile + 12 mmHg. BP levels in children previously termed “prehypertension” are now termed “elevated BP” and for children <13 years of age elevated BP is defined as BP >90th percentile and <95th percentile. Normal BP for children <13 is <90th percentile on the sex, age, height adjusted BP tables. More significant changes were made in the definition of hypertension for adolescents >13 years of age. For both males and females from age 13 and above a

numerical value is used to define BP status. Normal BP is <120/80 mmHg. Elevated BP is 120-129/<80 mmHg. Hypertension stage 1 is 130-139/80-89 mmHg. Hypertension stage 2 is >140/90 mmHg. These numerical values for hypertension in adolescents are close to the 95th percentile for most adolescents beginning at age 13 years, with the exception of young very short adolescents. These definitions are also identical to the new definitions of elevated BP and hypertension in the recent update of the adult hypertension guidelines developed by the American Heart Association and the American College of Cardiology. [6] The new CPG definitions of elevated BP and hypertension in adolescents is expected to simplify recognition of abnormal BP in adolescents and also to harmonize management in the progression from adolescence to young adulthood.

Recommendation on use of ambulatory blood pressure monitoring (ABPM) is another key change in the 2017 CPG. It is now established that ABPM provides important additional information on BP patterns outside the clinical setting and contributes to a more accurate determination of the BP status. [7] The condition of white coat hypertension, defined as hypertensive office BP and normotensive ABPM is commonly identified in pediatric patients. Patients with out of office normal BP do not require a hypertensive evaluation or antihypertensive medication, thus saving the burden of additional testing. In addition, the condition of masked hypertension, defined as office BP below the hypertension level but hypertensive by ABPM, is also now recognized as a clinical condition with increased risk. Therefore, to verify hypertension status, the new CPG recommends obtaining an ABPM to confirm hypertension before beginning a diagnostic evaluation of hypertension in a pediatric patient. ABPM is also recommended in pediatric patients with abnormal office BP and associated high risk conditions such as diabetes and chronic kidney disease.

Since publication of the 4th Report in 2004, measurement of BP in children beginning at age 3 years has become routine in pediatric practices. However, it has been found that abnormal BP measurements, both prehypertension and hypertension, are often not recognized. [8]

To improve detection of abnormal BP, a simplified table that provides the BP level at the 90th percentile at the 5th height percentile for age <13 years is included in the CPG. This table is designed for use in the intake room of pediatric offices where BP is generally measured along with weight and height. The table serves to provide an alert on possible abnormal BP measurements that should be repeated by a clinician to determine if a child's measurement is abnormal and to determine if additional clinical decisions or further BP monitoring are required.

Since publication of the CPG in 2017, several reports on the impact of the new guideline have been published. These recent reports are based on analysis of existing data previously obtained on child populations or longitudinal cohorts with initial BP measurements obtained in childhood. Sharma et al. [9] examined data on 15, 647 generally healthy children age 5 -18 years from the National Health and Nutrition Examination Surveys (NHANES) in the period 1999 to 2014. Participants had BP classification based on the 4th Report. Using the CPG to redefine BP status in these children resulted in an increase in prevalence of hypertension from 11.8% based on the 4th Report, to 14.2% based on the CPG. Within the entire cohort, 905 children (5.8%) had newly diagnosed hypertension or an increase in BP status based on the new CPG. These children were matched by sex, age, and height with controls having normal BP. Children having BP status reclassified upward were more likely to be obese, have adverse lipid profiles and increased hemoglobin A1c levels. These results indicate that the upward classification of BP status, based on the CPG, in this cohort of otherwise healthy children, represent a high-risk group of children whose cardiovascular risk may have been underestimated.

Another recent report examined the impact of the CPG in a cohort of high-risk youth. Khoury et al. [10] examined application of the CPG on hypertension and association with TOD measures in a cohort of 364 adolescents age 10 -18 years with obesity and type 2 diabetes. TOD measurements included carotid artery intima-

media thickness, pulse wave velocity, left ventricular mass, and diastolic function. The prevalence of hypertension increased from 8% based on the 4th Report to 13% based on the CPG. The two guidelines both showed similar associations BP with TOD. However, the new CPG demonstrated improved sensitivity for TOD detection. As an example, the portion of participants, designated as hypertensive, who also had abnormal left ventricular mass increased from 20%, based on the 4th Report, to 32% based on the new CPG. These results indicate that the new CPG may improve detection of markers of cardiovascular injury in high-risk children.

In another study, Bell et al. [11] reanalyzed data from the Houston Pediatric and Hypertension school screening program on 22,224 children age 10 – 17 years. BP status in this cohort had been classified according to criteria in the 4th Report. The authors reported that with application of the new CPG, the prevalence of elevated BP, previously termed prehypertension, increased from 14.8% to 16.3%. The prevalence of confirmed hypertension, based on repeated measurement, remained at 2% to 4%. Additionally, it was noted that shorter children <13 years and taller older children (>13 years) were more likely to be up-classified in BP status based on the CPG.

The new CPG was compared to the 4th Report on an even larger cohort by Dong et al. [12] The BP status and related risk factors based on the CPG and 4th Report were compared in 50,336 Chinese youth age 6 - 17 years. The prevalence of high BP (both elevated BP and hypertension) was higher based on the CPG at 16.7% of children <13 years and 7.9% of adolescents compared to 10.6% in children and 6.3% of adolescents based on the 4th Report. The prevalence estimates for high BP differed the greatest for boys, children aged 11 years, those with high BMI, and those with tall stature. In support of the CPG validity were strong associations of high BP with BMI and other medical and behavioral factors such as family history, diet, tobacco use and physical activity.

In another recent study, Kharbanda et al. [13] examined clinical BP data of children and adolescents who were well-child patients, age 10 to 17 years, in a large primary care health system. Data were available in electronic clinical records on individual patients over several years. The investigators designed a prospective study and sought to determine the rates of incident hypertension following persistent elevated BP based on the new CPG compared to the 4th Report. In this large cohort, 2025 youth (mean age 14.6 years) had elevated BP on repeated visits. During a two-year follow-up period, 5.9% progressed to hypertension based on CPG criteria compared to 1.1% based on 4th Report criteria. Those who progressed to hypertension tended to be older and obese. Overall, the progression from elevated BP to hypertension was over 5-fold greater based on the CPG compared to the 4th Report. These results indicate that the CPG appears to have greater capacity to identify youth with heightened risk for progression in BP status.

The Bogalusa Heart Study is a longitudinal cohort study that enrolled 3940 children. Child participants were then followed with repeated measurements into mid-adulthood. Age at enrollment ranged from 3 to 18 years. Du et al. [14] conducted a study to evaluate the consequences of the CPG definition of hypertension compared to the 4th Report definition of hypertension in childhood. The major goal of this study was to compare performance of these two guidelines in predicting adult hypertension, metabolic syndrome, and left ventricular hypertrophy (LVH). In childhood, hypertension was identified in 7% of the cohort by 4th report criteria compared to 11% of the cohort according to the CPG. Both guidelines had similar significant associations of childhood BP with adult hypertension, metabolic syndrome, and LVH. However, the portion of children identified as hypertensive in childhood who developed LVH in adulthood increased from 12% identified by the 4th Report to 19% of those identified by the CPG. Thus, the new CPG guideline identified a group of children with heightened risk for adverse cardiovascular outcomes, a risk that was under-estimated by the 4th Report guideline.

Since the CPG was published in 2017, several studies to evaluate the impact of the new guideline have been published. Because the BP level at the 90th and 95th percentile is lower in the CPG, compared to the 4th Report,

it was expected that the prevalence of elevated BP and hypertension in childhood would be somewhat higher. The publications discussed above confirmed that expectation. Of greater importance are the findings that the CPG can identify children with heightened cardiovascular risk including associated risk factors (high BMI, abnormal lipids, hemoglobin A1c) and increased risk for subsequent TOD including left ventricular hypertrophy. The CPG provides clinicians who care for children both tools and guidance on detection, evaluation, and management of abnormal BP. It contains several key action statements, directions on accurate BP measurement in children, and a screening tool to improve recognition of abnormal BP. Thus, the CPG can be a valuable clinical resource for guidance on children with abnormal BP. This advancement in health care of children should call attention to the childhood origin of cardiovascular disease.

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