

# Pediatric Hypertension: Review of Updated Guidelines

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## INTRODUCTION

After the publication of my review on pediatric hypertension, the American Academy of Pediatrics' Subcommittee on Screening and Management of High Blood Pressure in Children issued new Clinical Practice Guidelines for Screening and Management of High Blood Pressure in Children and Adolescents. (1)(2) These guidelines represent an update to the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents that was published in 2004. (3) For the new guidelines, the subcommittee consisted of 17 members and was co-chaired by a pediatric nephrologist and a general pediatrician. To develop these recommendations, an extensive literature review addressing the diagnosis, management, and treatment of pediatric hypertension was conducted. Articles were then reviewed by 2 subcommittee members. Selected articles were then evaluated for quality of evidence based on an AAP grading matrix. From this, 30 key action statements were developed. In addition, 27 additional recommendations based on consensus expert opinion were also provided. Herein I highlight 7 significant changes in the initial screening and management of pediatric patients with hypertension that are important to primary care pediatricians.

### New Definitions of Pediatric Hypertension

Recently, the American Heart Association and the American College of Cardiology updated the definition of adult hypertension based on large observational studies that established a graded association between increased blood pressure (BP) and risk of cardiovascular disease, end-stage renal disease, and mortality. (4) Specifically, a meta-analysis of 61 prospective studies determined that the risk of cardiovascular disease increased beginning at systolic BP levels greater than 115 mm Hg and diastolic BP levels greater than 75 mm Hg. The risk of death from ischemic heart disease and stroke increases linearly with BPs higher than 115/75 mm Hg. Therefore, the cutoff values for adult hypertension have been lowered. Stage 1 hypertension is now defined as a BP of 130/80 to 139/89 mm Hg, and stage 2 hypertension is now defined as a BP greater than or equal to 140/90 mm Hg.

To be more consistent with these recommendations, the new pediatric guidelines also updated the definitions of pediatric hypertension (Table 1). For children 1 to less than 13 years of age, elevated BP is defined as a BP equal to or greater than the 90th percentile to less than the 95th percentile or between 120/80 mm Hg and less than the 95th percentile. Stage 1 hypertension is a BP equal to or greater than the 95th percentile and less than the 95th percentile + 12 mm Hg or 130/80 to 139/89 mm Hg. Stage 2 hypertension is a BP equal to

**AUTHOR DISCLOSURE** Dr Weaver has disclosed that he is a member of the speakers' bureau for Alexion Pharmaceuticals. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

### ABBREVIATIONS

ABPM	ambulatory blood pressure monitoring
BMI	body mass index
BP	blood pressure
DASH	Dietary Approach to Stop Hypertension

TABLE 1. Updated Definitions of Pediatric BP Categories and Stages

	FOR CHILDREN AGED 1–<13 Y	FOR CHILDREN AGED ≥13 Y
Normal BP	<90th percentile	<120/<80 mm Hg
Elevated BP	≥90th percentile to <95th percentile or 120/80 mm Hg to <95th percentile (whichever is lower)	120/<80–129/<80 mm Hg
Stage 1 HTN	≥95th percentile to <95th percentile + 12 mm Hg or 130/80–139/89 mm Hg (whichever is lower)	130/80–139/89 mm Hg
Stage 2 HTN	≥95th percentile + 12 mm Hg or ≥140/90 mm Hg (whichever is lower)	≥140/90 mm Hg

BP=blood pressure, HTN=hypertension.

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or greater than the 95th percentile + 12 mm Hg or greater than or equal to 140/90 mm Hg. For children 13 years and older, an elevated BP is defined as a systolic BP of 120 to 129 mm Hg and a diastolic BP less than 80 mm Hg. Stage 1 hypertension is a BP between 130/80 and 139/89 mm Hg. Finally, stage 2 hypertension is a BP equal to or greater than 140/90 mm Hg. It is also important to note that the term *prehypertension* has been replaced by *elevated BP*.

### New Normative BP Tables

Current definitions of pediatric BPs are based on normative data in healthy children because of the lack of long-term outcome data. In the current guidelines, new BP tables were developed that include systolic BP as well as diastolic BP based on age, sex, and height. Similar to the Fourth Report, the values are based on auscultatory measurements of approximately 50,000 healthy children and adolescents. The primary difference is that the current tables include only BP values from patients with a body mass index (BMI) less than the 85th percentile or normal weight for height. The subcommittee made the decision to exclude overweight and obese patients based on the strong association between elevated BPs and elevated BMI. The primary implication of these changes for practicing physicians is that the BP cutoffs in the new tables are lower than those in the Fourth Report, and electronic medical records that flag elevated values based on the previous guidelines will need to be updated. The authors did provide a simplified table to facilitate recognition of BP values that require additional follow-up in the current guidelines (Table 2).

### Change in the Frequency of BP Measurement

The Fourth Report recommended that all patients 3 years or older in the medical setting should have a BP measurement,

including both well and sick visits. In the new guidelines, healthy children 3 years and older should have their BP measured annually. However, children at risk for hypertension, including patients with obesity, chronic kidney disease, or diabetes or taking medications that increase BP, should continue to have BPs monitored at every health-care encounter. Similarly, patients who are younger than 3 years with conditions known to increase BPs, such as prematurity, chronic kidney disease, and malignancy, should also have their BPs measured annually.

### Initial Management of Office-Based Elevated BPs

The current guidelines provide more specific recommendations for the initial management and follow-up of office-based elevations in BP (Fig 1). First, wrist and forearm BP measurements are not recommended in children and adolescents. Similar to previous guidelines, initial BPs may be obtained using an oscillometric device with an appropriately sized cuff on the right arm. If the BP is greater than the 90th percentile, repeated BP measurements performed by auscultation should be obtained and averaged. If the averaged BP is normal or less than the 90th percentile, BPs should be monitored as discussed previously herein. However, if elevated, 2 additional auscultatory readings should be obtained and averaged. If these BPs are greater than the 90th percentile, the current recommendations are as follows. For elevated BPs, lifestyle recommendations should be implemented and a repeated BP measurement scheduled in 6 months. If the 6-month BP is elevated, upper and lower extremity BPs should be obtained, lifestyle changes should be reiterated, and BP should be rechecked in 6 months. If after a year BPs remain elevated, ambulatory BP monitoring (ABPM) should be obtained and a diagnostic evaluation should be completed. For the asymptomatic child with BP

TABLE 2. Screening BP Values Requiring Further Evaluation

AGE, Y	BLOOD PRESSURE, MM HG			
	BOYS		GIRLS	
	SYSTOLIC	DIASTOLIC	SYSTOLIC	DIASTOLIC
1	98	52	98	54
2	100	55	101	58
3	101	58	102	60
4	102	60	103	62
5	103	63	104	64
6	105	66	105	67
7	106	68	106	68
8	107	69	107	69
9	107	70	108	71
10	108	72	109	72
11	110	74	111	74
12	113	75	114	75
≥13	120	80	120	80

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consistent with stage 1 hypertension, lifestyle changes should be addressed and the BP rechecked in 1 to 2 weeks. If the reading continues to be abnormal, upper and lower extremity measurements should be obtained with consideration of nutrition referral or weight management as well as a repeated measurement in 3 months. If the elevations

persist after 3 visits, ABPM should be obtained and a diagnostic evaluation should be initiated. Subspecialty referral is also suggested at this stage. For stage 2 hypertension, upper and lower extremity readings should be obtained, with a repeated measurement within a week. If the reading remains consistent with stage 2 hypertension on repeated

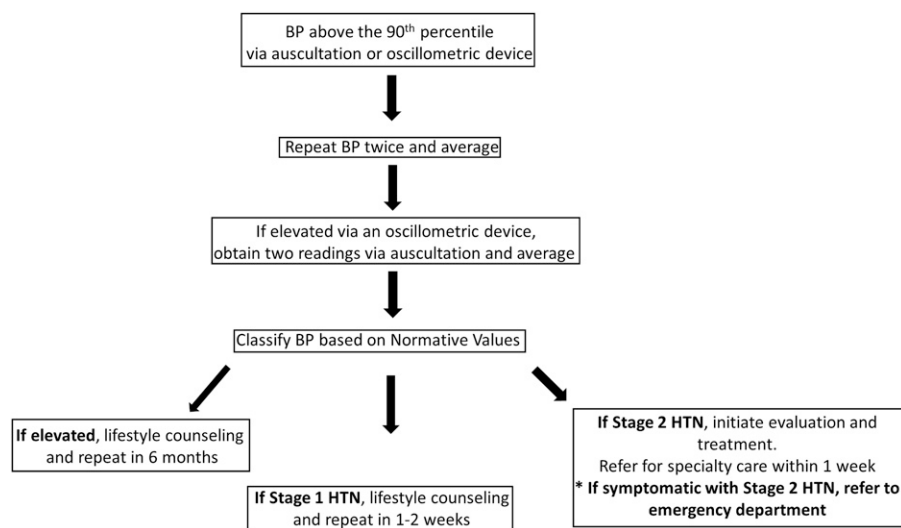


Figure 1. Algorithm for the evaluation of initial elevation in office-based blood pressures (BPs). HTN=hypertension.

measurement, a diagnostic evaluation including ABPM as well as treatment of those elevated BPs should be initiated. Any patient with symptomatic stage 2 hypertension or BP more than 30 mm Hg higher than the 95th percentile should be treated urgently in the emergency department or inpatient setting.

### Expanded Use of ABPM

As discussed in the previous review, ABPM involves a BP cuff and associated recording device that measures BP every 15 to 30 minutes during the day and night outside of the medical setting. These readings are then analyzed using separate guidelines. (5) Recent pediatric data suggest that ABPM is more accurate than office-based BP measurements. More importantly, end-organ changes, such as left ventricular hypertrophy, are more closely associated with ABPM-based readings than office-based BP readings. As a result, the new guidelines recommend that ABPM should be used in children and adolescents to confirm elevated office-based BP readings. Certainly, in children 5 years or younger, this may be technically difficult. Also, ABPM should be considered annually in children with high-risk conditions, such as chronic kidney disease or diabetes. This recommendation is based on the finding that masked hypertension (normal office-based BPs but abnormal ABPM) is associated with increased risk of end-organ damage and is prevalent in patients with chronic kidney disease.

### A More Limited Diagnostic Evaluation

Recent studies suggest that primary hypertension is the most common diagnosis of hypertension in children. As a result, the new guidelines recommend a limited diagnostic evaluation for children and adolescents 6 years or older with findings of secondary hypertension on history or physical examination, particularly children with a positive family history of hypertension and a BMI greater than the 85th percentile. Screening tests should include a urinalysis, chemistry panel (electrolytes, blood urea nitrogen, and creatinine), and lipid panel. In patients with a BMI greater than the 95th percentile, hemoglobin A<sub>1c</sub>, aspartate aminotransaminase, alanine aminotransaminase, and a fasting lipid panel should be obtained. Renal ultrasonography is recommended in all patients younger than 6 years or in those 6 years or older with an abnormal urinalysis finding or abnormal renal function. Additional studies should be obtained based on history, physical examination, and abnormalities on screening laboratory studies.

An additional key action statement in the new guidelines recommends against the use of electrocardiography in children with hypertension because of poor sensitivity. Instead, echocardiography should be performed to assess for

changes in left ventricular mass, geometry, or function when pharmacologic therapy is considered for the treatment of hypertensive children. Repeated echocardiography should be performed at 6- to 12-month intervals in patients with refractory hypertension despite treatment, the presence of left ventricular hypertrophy, or impaired cardiac function. Annual evaluation should also be considered in patients with stage 2 hypertension or secondary hypertension. Routine assessment of uric acid, microalbuminuria, pulse wave velocity, or carotid intimal thickness as surrogates for increased cardiovascular risk is not recommended in the new guidelines.

### New Treatment Goals

Consistent with the previous guideline, lifestyle interventions are the initial recommendation for treatment of hypertension in children and adolescents. Specifically, the Dietary Approach to Stop Hypertension (DASH) diet and moderate to vigorous physical activity 3 to 5 days a week should be initiated. The DASH diet recommends increasing the servings of fresh vegetables and fruits, limiting foods high in sugars, and choosing lean protein sources as well as fat-free or low-fat dairy products. Pharmacologic treatment should be considered for patients who fail lifestyle interventions, who have symptomatic hypertension, who have stage 2 hypertension, or who have hypertension in the setting of chronic kidney disease or diabetes. The current guidelines recommend that regardless of lifestyle modifications or pharmacologic treatment, goal BPs should be a decrease in systolic and diastolic values to less than the 90th percentile or less than 130/80 mm Hg in patients 13 years or older. Moreover, patients with chronic kidney disease should be treated to lower BP to less than the 50th percentile based on 24-hour ABPM.

In children with hypertension and chronic kidney disease, proteinuria, or diabetes mellitus, an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker is recommended as the initial medication unless there are other contraindications. Otherwise, an angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, long-acting calcium channel blockers, and thiazide diuretics are appropriate initial agents.  $\alpha$ -Blockers,  $\beta$ -blockers, centrally acting agents, vasodilators, and potassium-sparing diuretics should be used in patients whose hypertension is refractory to 2 or more agents.

### CONCLUSION

As noted previously herein, the prevalence of hypertension in the pediatric population is increasing, in part

related to worsening obesity. More concerning, hypertension in children is often underdiagnosed. Based on knowledge gained in the past 14 years since publication of the Fourth Report, the current Clinical Practice Guideline aims to improve the recognition, evaluation, and treatment children and adolescents with hypertension.

The new guideline also highlights the need for ongoing research in pediatric hypertension to improve patient outcomes.

*References for this article are at <http://pedsinreview.aappublications.org/content/40/7/354>.*

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of periodic and longitudinal examinations in the first weeks and months of life is critical. Enlisting the support of a multidisciplinary team consisting of a neurologist, a neurosurgeon, an orthopedist, physical and occupational therapists, and social workers is needed in more severe cases. The goal is for preservation of function of the hand grasp, in addition

to elbow and shoulder mobility and function. Ongoing research is critical to better delineate best treatment strategies and the timing to enhance function and quality of life.

– Janet R. Serwint, MD  
Associate Editor, *In Brief*

### Correction

An error appeared in the print version of the July 2019 article “Pediatric Hypertension: Review of Updated Guidelines” (Weaver DJ Jr. *Pediatr Rev.* 2019;40(7):354–358; doi: 10.1542/pir.2018-0014). The second sentence of the second paragraph should read: “Specifically, a meta-analysis of 61 prospective studies determined that the risk of cardiovascular disease increased beginning at systolic BP levels greater than 115 mm Hg and diastolic BP levels greater than 75 mm Hg.” The online version of the article has been corrected, and a correction notice has been posted with the online version of the article. The journal regrets the error.

#### ANSWER KEY FOR SEPTEMBER 2019 PEDIATRICS IN REVIEW

**SIDS, BRUE, and Safe Sleep Guidelines:** 1. D; 2. D; 3. E; 4. E; 5. E.

**Sudden Cardiac Death: A Pediatrician’s Role:** 1. C; 2. B; 3. E; 4. C; 5. D.

**Pediatric Head Trauma: A Review and Update:** 1. A; 2. B; 3. A; 4. E; 5. E.



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