



# NCC Pediatrics Continuity Clinic Curriculum: **Hypertension in Infants, Children, & Teens** *Resident Version*



## **Goals & Objectives**

- Be able to correctly identify hypertension in a child based on age, gender and height
- List the components & steps of a BP screening protocol for a primary care clinic
- Know the 'DROPS' mnemonic for pediatric populations at special risk for hypertension
- Recognize signs of secondary hypertension and initiate an appropriate diagnostic workup
- Plan a workup for hypertension for various age groups and hypertensive stages
- Describe three modalities of hypertension management
- List the steps to clear a hypertensive teen for sports participation

## **Pre-Meeting Preparation**

- Read the highlights and tables drawn from the AAP CPG for Blood Pressure Evaluation in Children and Adolescents (Sep 2017)

## **Conference Agenda**

- Review the Quiz.
- Review the patient vignettes and answer the questions.

## **Extra-Credit:**

- [AAP CPG for Blood Pressure Evaluation in Children and Adolescents \(Sep 2017\)](#)
- [Framingham 10-Year Cardiovascular Risk Calculator](#)



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## Key Updates to the new 2017 pediatric BP guidelines

- BP normative values slightly lower than previously (excluded overweight children from the normative population)
- “Pre-hypertension” now called “Elevated BP” – still means BP between 90th-95<sup>th</sup> percentiles
- Teen BP norms (> 13 y/o) align with adult norms (normal < 120/80, HTN > 130/80)
- Screening BP table and flow chart for screening BP provided
- The 50<sup>th</sup> and the 95<sup>th</sup> + 12 mm Hg BPs have been added to the tables (the former to guide treatment for some patients, and the latter to indicate referral/admission).
- Ambulatory BP monitoring inserted before labs and imaging in the workup of elevated BP
- Echocardiograms only indicated when starting pharmacologic therapy or following up treated patients.
- Renal ultrasound only indicated for the workup in children under the age of 6 years unless there is no history, exam, or lab findings suggestive of kidney disease.
- More aggressive BP treatment for patients with diabetes and chronic kidney disease.

**TABLE 3** Updated Definitions of BP Categories and Stages

For Children Aged 1–13 y	For Children Aged ≥ 13 y
Normal BP: <90th percentile	Normal BP: <120/<80 mm Hg
Elevated BP: ≥90th percentile to <95th percentile or 120/80 mm Hg to <95th percentile (whichever is lower)	Elevated BP: 120/<80 to 129/<80 mm Hg
Stage 1 HTN: ≥95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mm Hg (whichever is lower)	Stage 1 HTN: 130/80 to 139/89 mm Hg
Stage 2 HTN: ≥95th percentile + 12 mm Hg, or ≥140/90 mm Hg (whichever is lower)	Stage 2 HTN: ≥140/90 mm Hg



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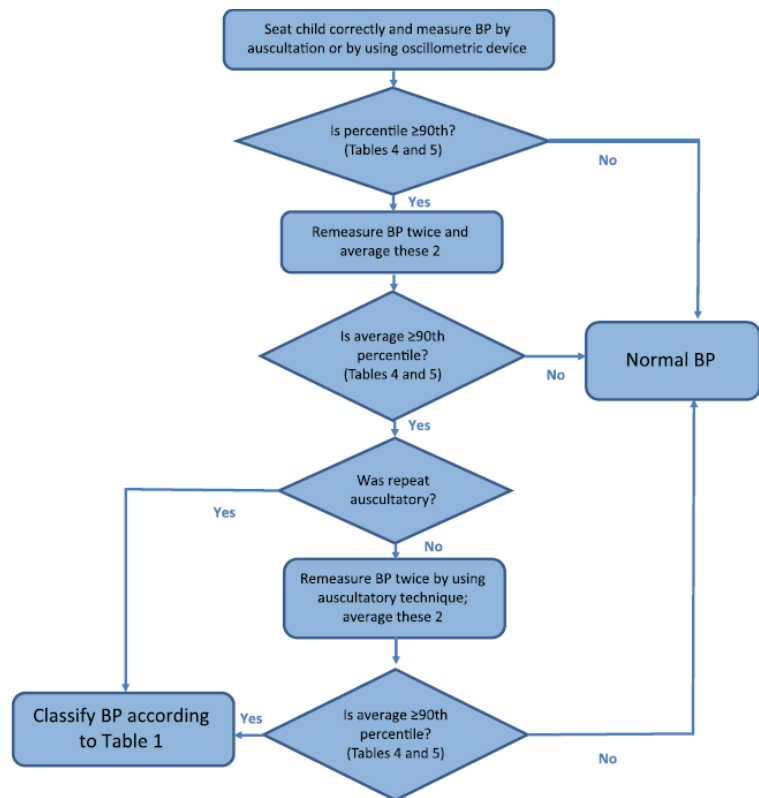
**TABLE 7** Best BP Measurement Practices

1. The child should be seated in a quiet room for 3–5 min before measurement, with the back supported and feet uncrossed on the floor.
2. BP should be measured in the right arm for consistency, for comparison with standard tables, and to avoid a falsely low reading from the left arm in the case of coarctation of the aorta. The arm should be at heart level,<sup>90</sup> supported, and uncovered above the cuff. The patient and observer should not speak while the measurement is being taken.
3. The correct cuff size should be used. The bladder length should be 80%–100% of the circumference of the arm, and the width should be at least 40%.
4. For an auscultatory BP, the bell of the stethoscope should be placed over the brachial artery in the antecubital fossa, and the lower end of the cuff should be 2–3 cm above the antecubital fossa. The cuff should be inflated to 20–30 mm Hg above the point at which the radial pulse disappears. Overinflation should be avoided. The cuff should be deflated at a rate of 2–3 mm Hg per second. The first (phase I Korotkoff) and last (phase V Korotkoff) audible sounds should be taken as SBP and DBP. If the Korotkoff sounds are heard to 0 mm Hg, the point at which the sound is muffled (phase IV Korotkoff) should be taken as the DBP, or the measurement repeated with less pressure applied over the brachial artery. The measurement should be read to the nearest 2 mm Hg.
5. To measure BP in the legs, the patient should be in the prone position, if possible. An appropriately sized cuff should be placed mid thigh and the stethoscope placed over the popliteal artery. The SBP in the legs is usually 10%–20% higher than the brachial artery pressure.

Adapted from Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the Subcommittee of Professional and Public Education of the American Heart Association Council on High Blood Pressure Research. *Circulation*. 2005;111(5):697–716.

**TABLE 6** Screening BP Values Requiring Further Evaluation

Age, y	BP, mm Hg			
	Boys		Girls	
	Systolic	DBP	Systolic	DBP
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



**TABLE 9** Conditions Under Which Children Younger Than 3 Years Should Have BP Measured

- History of prematurity <32 week's gestation or small for gestational age, very low birth weight, other neonatal complications requiring intensive care, umbilical artery line
- Congenital heart disease (repaired or unrepaired)
- Recurrent urinary tract infections, hematuria, or proteinuria
- Known renal disease or urologic malformations
- Family history of congenital renal disease
- Solid-organ transplant
- Malignancy or bone marrow transplant
- Treatment with drugs known to raise BP
- Other systemic illnesses associated with HTN (neurofibromatosis, tuberous sclerosis, sickle cell disease,<sup>114</sup> etc)
- Evidence of elevated intracranial pressure

Adapted from Table 3 in the Fourth Report.<sup>1</sup>



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**TABLE 11** Patient Evaluation and Management According to BP Level

BP Category (See Table 3)	BP Screening Schedule	Lifestyle Counseling (Weight and Nutrition)	Check Upper and Lower Extremity BP	ABPM <sup>a</sup>	Diagnostic Evaluation <sup>b</sup>	Initiate Treatment <sup>c</sup>	Consider Subspecialty Referral
Normal	Annual	X	—	—	—	—	—
Elevated BP	Initial measurement	X	—	—	—	—	—
	Second measurement: repeat in 6 mo	X	X	—	—	—	—
	Third measurement: repeat in 6 mo	X	—	X	X	—	X
Stage 1 HTN	Initial measurement	X	—	—	—	—	—
	Second measurement: repeat in 1–2 wk	X	X	—	—	—	—
	Third measurement: repeat in 3 mo	X	—	X	X	X	X
Stage 2 HTN <sup>d</sup>	Initial measurement	X	X	—	—	—	—
	Second measurement: repeat, refer to specialty care within 1 wk	X	—	X	X	X	X

X, recommended intervention; —, not applicable.

<sup>a</sup> ABPM is done to confirm HTN before initiating a diagnostic evaluation.

<sup>b</sup> See Table 15 for recommended studies.

<sup>c</sup> Treatment may be initiated by a primary care provider or subspecialist.

<sup>d</sup> If the patient is symptomatic or BP is >30 mm Hg above the 95th percentile (or >180/120 mmHg in an adolescent), send to an ED.

**TABLE 10** Screening Tests and Relevant Populations

Patient Population	Screening Tests
All patients	Urinalysis
	Chemistry panel, including electrolytes, blood urea nitrogen, and creatinine
	Lipid profile (fasting or nonfasting to include high-density lipoproteina and total cholesterol)
	Renal ultrasonography in those <6 y of age or those with abnormal urinalysis or renal function
In the obese (BMI >95th percentile) child or adolescent, in addition to the above	Hemoglobin A1c (accepted screen for diabetes)
	Aspartate transaminase and alanine transaminase (screen for fatty liver)
	Fasting lipid panel (screen for dyslipidemia)
Optional tests to be obtained on the basis of history, physical examination, and initial studies	Fasting serum glucose for those at high risk for diabetes mellitus
	Thyroid-stimulating hormone
	Drug screen
	Sleep study (if loud snoring, daytime sleepiness, or reported history of apnea)
	Complete blood count, especially in those with growth delay or abnormal renal function



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## QUIZ

**Which pediatric patients should have their BP checked at well child visits only?**

**Which pediatric patients should have their BP checked at every single health-care encounter?**

**Which pediatric patients should get an ambulatory BP monitor?**

**Name 5 common conditions associated with Hypertension.**

**D** \_\_\_\_\_  
**R** \_\_\_\_\_  
**O** \_\_\_\_\_  
**P** \_\_\_\_\_  
**S** \_\_\_\_\_

**Name 3 criteria for a limited evaluation of hypertension in children.**

**What are the History and PE findings suggestive of secondary HTN?**

**What are the key history components to take on a patient with elevated BP?**

**What 2 non-pharmacologic interventions for elevated BP should be recommended in the primary care clinic?**

**From which 4 classes of anti-hypertensive medications should clinicians choose an agent for treating hypertension in patients failing non-pharmacologic interventions?**



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## Cases

**1) A two-year old boy presents to your clinic for a well visit. The child was a NICU graduate due to prematurity (31 wks gestation) and therefore a blood pressure (105/62) was obtained at check-in. Height is 82.1 cm. No other blood pressures are recorded in the EHR.**

What other conditions would prompt a BP measurement before the age of 3 years?

What should your screener do upon obtaining this blood pressure? State how you would determine whether this blood pressure is in the normal range. What range is it in?

Repeat manual and auscultatory BPs are unchanged. Would you give the patient a diagnosis of hypertension?

**Your screener excitedly tells you that there were duplicate charts for this patient, and there are 2 other BPs that are exactly the same from last week at a visit for a scrape in the ED and from the ED follow-up visit at an outlying clinic.**

What orders would you enter into the A/P part of this clinic visit? And how would you code this?



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**2) A 16-year-old young woman presents for a sports physical. Her blood pressure is 152/95 with the screener, and averages 142/90 on repeat auscultatory measurements. Review of her chart reveals BPs in the 140s/90s for the last several years. She is asymptomatic. She takes no prescribed or over-the-counter medications, has never been sexually active, and has average height and a normal BMI for age. The rest of her physical exam is normal.**

Would you clear her for volleyball? If not, what would you do to clear her?

Would your recommendation changed based on the sport? What if she was a type 1 diabetic with well-controlled blood sugars?

What further workup would you choose for this child?

How would you treat this patient? What if the BP was in the stage 1 range or had been in the “elevated BP” range for the past year?