



NCC Pediatrics Continuity Clinic Curriculum: **Hypertension in Infants, Children, & Teens** *Faculty 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-95th 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 50th and the 95th + 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,⁹⁰ 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

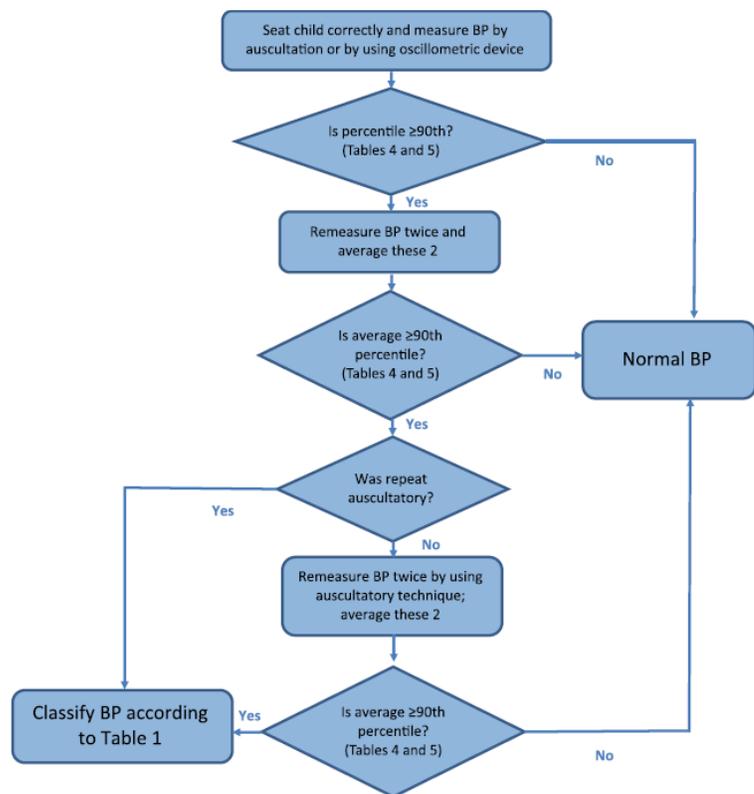


TABLE 9 Conditions Under Which Children Younger Than 3 Years Should Have BP Measured

- 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,¹¹⁴ etc)
- Evidence of elevated intracranial pressure

Adapted from Table 3 in the Fourth Report.¹



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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 ^a	Diagnostic Evaluation ^b	Initiate Treatment ^c	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 ^d	Initial measurement	X	X	—	—	—	—
	Second measurement: repeat, refer to specialty care within 1 wk	X	—	X	X	X	X

X, recommended intervention; —, not applicable.

^a ABPM is done to confirm HTN before initiating a diagnostic evaluation.

^b See Table 15 for recommended studies.

^c Treatment may be initiated by a primary care provider or subspecialist.

^d 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

Adapted from Wiesen J, Adkins M, Fortune S, et al. Evaluation of pediatric patients with mild-to-moderate hypertension: yield of diagnostic testing. *Pediatrics*. 2008;122(5). Available at: www.pediatrics.org/cgi/content/full/122/5/e988.



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QUIZ

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

Kids \geq 3 years old.

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

Kids with obesity, BP-raising medications, renal disease, history of coarctation, or diabetes – even if $<$ 3 years old.

Which pediatric patients should get an ambulatory BP monitor?

Kids with elevated BPs (90-94th percentile) for over a year and kids with 3 BPs \geq 95th percentile at 3 separate clinic visits.

Name 5 common conditions associated with Hypertension.

D iabetes
R enal Disease
O besity
P rematurity
S leep Disordered Breathing

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

- *> 6 years old*
- *Obesity/overweight*
- *No history or PE findings suggestive of secondary HTN*

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

See Table 14 of AAP CPG

- VS: tachycardia, LE BPs = or $<$ UE BP, growth retardation, obesity, bradycardia
- HEENT: proptosis, retinal vessel changes, large tonsils, elfin/moon facies, thyromegaly, goiter, webbed neck



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- Skin: pallor, flushing, diaphoresis, acne, hirsutism, striae, café-au-lait spots, adenoma sebaceum, malar rash, acanthosis nigricans
- Chest: wide spaced nipples, murmur, friction rub,
- Abdomen: mass, palpable kidneys, epigastric or flank bruit
- GU: ambiguous genitalia
- Extremities: joint swelling
- Neuro: muscle weakness,

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

- *Perinatal History*
- *Nutrition History*
- *Physical activity*
- *Psychosocial History*
- *Family History*

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

- *DASH Diet*
- *Aerobic exercise (3-5 days per week for 30-60 minutes each day)*

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

- *ACE inhibitor, ARB, long-acting calcium channel blocker, thiazide*



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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?

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
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- Treatment with drugs known to raise BP
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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?

- *The simplified screening BP table lists 100/55 as the alert threshold. The screener should take the BP twice more and average the two. If the BP is still above 100/55, the screener should alert you.*
- *You would double-check that a correctly-sized cuff was used on the correct extremity, take the BP twice with auscultation, average the two readings, and check the tables or an app to see the 90th and 95th percentiles for age, gender, and height percentile (which are 100/55 and 105/58)*
- *This patient's BP is just over the 95th percentile..*

Screening BP Values Requiring Further Evaluation

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

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

- *No. Elevated BP at 3 separate visits is required.*



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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?

- *Label this stage 1 hypertension. Order urinalysis, renal function panel, lipid panel (fasting or non-fasting), and a renal ultrasound (since the child is < 6 years old). Any additional testing would need a clear indication from history or physical.*
- *Refer to pediatric nephrology for possible pharmacologic therapy, or call your nephrology consultant to help guide dietary or pharmacologic treatment.*
- *Code this as preventive care visit with abnormal findings, add hypertension, and use the 25-modifier.*

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?

- *Her BP is in the Stage 2 hypertension range ($\geq 140/90$ for teens ≥ 13 years old).*
- *Assessment of cardiovascular risk – get lipids and history to be able to assess. While the [Framingham 10-Year Cardiovascular Risk calculator](#) is designed for adults 30-74 years old, it is a useful tool to identify risk factors.*
- *Assessment of end-organ target damage – must get echocardiogram in this case.*
- *As long as there is no LVH, she can participate in volleyball.*

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

- *For high-static sports like wrestling, boxing, or weight-lifting, reduce BP to less than the Stage 2 Hypertension threshold (140/90 for teens) if no LVH or less than 90th percentile if LVH present before clearing the patient.*
- *The BP goal for a diabetic would be a BP < 50th percentile.*



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What further workup would you choose for this child?

- *Urinalysis, renal function panel, and non-fasting lipid panel. A renal ultrasound is not recommended unless there is a personal or family history of renal disease, or urinary symptoms.*

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?

- *DASH Diet (ask residents specifically what this means: consult to nutrition? Low sodium recommendation? Or do they outline an actual DASH Diet plan?)*
- *Aerobic exercise (cleared if she has no LVH and BP < 140/90)*
- *Urinalysis, renal function panel, and non-fasting lipid panel. A renal ultrasound is not recommended unless there is personal history, family history, or physical exam findings suggestive of kidney or renovascular disease, the creatinine is abnormal, or there is proteinuria on the urinalysis.*
- *For Stage 1 hypertension or elevated BP for the last year, order an Ambulatory BP monitor before doing any additional workup.*