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PEDIATRIC HYPERTENSION (B FALKNER, SECTION EDITOR)

Updated Guideline May Improve the Recognition and Diagnosis of Hypertension in Children and Adolescents; Review of the 2017 AAP Blood Pressure Clinical Practice Guideline

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Abstract
Purpose of Review Hypertension in children and adolescents is under-recognized and under-diagnosed in clinical practice. The 2017 AAP Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents provides updated recommendations that may improve hypertension identification and management.
Recent Findings The AAP blood pressure guideline recommends annual screening for hypertension in children at preventive care visits and targeted routine screening in high-risk populations. A simplified blood pressure screening table is provided for easier recognition of blood pressures that may require attention. Normative blood pressure tables have been revised to include only data from normal-weight children as more representative of a healthy population. Classification of blood pressure in adolescents has been simplified to threshold values consistent with adult guidelines.
Summary The updated AAP blood pressure guideline has clarified and simplified recommendations for hypertension screening, diagnosis, and management based on a systematic review of current best evidence.

Keywords Pediatric blood pressure · Pediatric hypertension · Hypertension diagnosis · Hypertension screening · Blood pressure guideline

This article is part of the Topical Collection on *Pediatric Hypertension*

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Introduction

After more than 10 years, an updated clinical practice guideline for the management of blood pressure in children and adolescents has recently been published by the American Academy of Pediatrics (AAP) [1••]. The AAP Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents, the unofficial 5th Report, has continued the tradition of updating the definitions and normative data for blood pressure in children and adolescents based on emerging evidence. The 4th Report on the management of blood pressure in children from 2004, sponsored by the National Heart, Lung, and Blood Institute, was the reference guideline for years but was not without criticisms that the updated guideline attempts to address [2•]. Much of the focus of the AAP Subcommittee on Screening and Management of High Blood Pressure in Children was on improving and simplifying the recognition of hypertension in children and developing recommendations that reduce discrepancies between pediatric and adult guidelines. In addition, the updated guideline employed a strict systematic review of the literature and clearly describes the level of evidence and strength of the recommendations to improve the quality and transparency of the clinical practice guideline [1••].

Hypertension Screening Recommendations

There is mounting evidence that elevated blood pressure in childhood is not only associated with target organ damage in children but also with adulthood cardiovascular disease risk. Childhood end organ damage is not insignificant with up to 40% of the children with hypertension having left ventricular hypertrophy at presentation and 35–50% having abnormalities on detailed retinal examination [3, 4•, 5, 6]. Theodore et al.

identified blood pressure trajectories that begin as early as 7 years of age that track into adulthood with hypertensive children more likely to be hypertensive adults [7]. The Metabolic Lifestyle and Nutrition Assessment in Young Adults (MELANY) cohort showed an incremental increased risk for adulthood hypertension by increasing adolescent blood pressure values without an obvious threshold cutoff for increased risk [8]. The Fels Longitudinal Study has demonstrated that even a single elevated blood pressure reading during childhood increases the risk of adulthood hypertension and metabolic syndrome with the risk increasing as the number of elevated readings during childhood increases [9•]. The International Childhood Cardiovascular Cohort Consortium also demonstrated that when elevated childhood blood pressure resolved by adulthood, the carotid intima media thickness (cIMT) in the adults was not different than those participants who had never had elevated blood pressure but was less than those with persistently elevated blood pressure from childhood to adulthood [10]. Based on this evidence and more, the AAP Subcommittee continues to recommend screening blood pressure measurements in children although the frequency is reduced to annual preventive care encounters only rather than at every healthcare visit as previously recommended by the 4th Report (Table 1) [1••, 2•].

The prevalence of pediatric hypertension is reported as 2–4% in population studies but is under-diagnosed in clinical practice [11, 12, 13•]. In fact, a recent study of hospitalized children found that more than half had never previously had their blood pressure measured [14]. The ambulatory setting is similar with hypertension screening in only 35% of the childhood clinic visits and 67% of the preventive care visits, although rates have increased over time [15]. Even when an initial blood pressure is measured and elevated, only 20% of the patients had a subsequent repeat blood pressure reading within a month in another report [16]. In a recent study of over 14,000 children from a large US healthcare organization, the prevalence of hypertension was 3.6% based on repeated blood pressure measurements but 74% were undiagnosed including some with stage 2 hypertension [13•]. Patients were more likely to be identified if they had multiple elevated readings or if the readings were in the stage 2 hypertension range as well as when the patients were taller, older, or had obesity. When pediatricians were surveyed about factors affecting appropriate diagnosis, 71% stated they only measure blood pressure in children with a disease or risk factor for hypertension, and blood pressures are compared to reference data only one third of the time [17]. Most would consult the normative data only when they suspected the blood pressure reading was elevated, but in case scenarios, the physicians underestimated the blood pressure percentiles leading to a lack of recognition of hypertension.

Given the poor rates of recognition of elevated blood pressure in children, the AAP Subcommittee developed a simple table for the initial blood pressure screening [1••]. This table contains the 90th percentile blood pressure for children at the lowest height percentile (fifth) of each age and gender (Table 2). With a negative predictive value of 99%, the table is meant to flag blood pressure measurements that may need repeating while avoiding missing any children with elevated blood pressure [18]. In many clinics, a nursing aide, nurse, or physician trainee not familiar with normal blood pressure values in children may do the initial blood pressure measurements and not recognize or flag the measurement as abnormal [19]. In a busy pediatric clinic where blood pressure is unlikely the reason for presentation, an abnormal blood pressure reading may be missed. This small, user-friendly table could be attached to or near the blood pressure monitor so that the care provider completing the initial blood pressure measurement could quickly determine if the treating practitioner needs to review the potentially abnormal value. It is not meant to diagnose hypertension as the vast majority of children are taller than the fifth height percentile, and the most responsible clinician will need to evaluate the blood pressure value according to the more detailed normative data to determine if it needs to be repeated (Tables 3a and b). Application of this type of simplified blood pressure table for children has been correlated with the adulthood pulse wave velocity in the Cardiovascular Risk in Young Finns cohort, although as expected, the simplified definition had lower specificity than the complete childhood blood pressure tables [20]. The goal of

Table 1 Hypertension screening recommendations from the 2017 AAP Clinical Practice Guideline on Blood Pressure Management in Children [1••]

Statement type	Recommendation
Key action statement	Blood pressure should be measured annually in children and adolescents ≥ 3 years of age.
Key action statement	Blood pressure should be checked in all children and adolescents ≥ 3 years of age at every healthcare encounter if they have obesity, are taking medications known to increase blood pressure, have renal disease, a history of aortic arch obstruction or coarctation, or diabetes.
Consensus opinion	Measure blood pressure at every healthcare encounter in children < 3 years of age if they have an underlying condition that increases their risk for hypertension.
Consensus opinion	Use simplified blood pressure tables to screen for blood pressure values that may require further evaluation by a clinician.

Table 2 Blood pressure screening values based on the fifth percentile of height

Age (years)	Blood pressure (mmHg)			
	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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this simplified table is to improve the recognition of elevated blood pressure in children starting with the frontline care providers.

Targeted screening may be effective in pediatric populations known to be at a higher risk of having or developing hypertension. Obesity and elevated body mass index in children have frequently been shown to be associated with hypertension as well as with the development of hypertension over time [21, 22]. The risk seems to be incremental with the degree of adiposity with a recent study showing a twofold higher risk compared to normal-weight children in those with obesity and a fourfold higher risk in those with severe obesity [23•]. In secondary hypertension, renal causes are the most common in general pediatric patients and more than 50% of the patients with chronic kidney disease have hypertension [24–26]. There are many potential mechanisms in patients with kidney disease such as activation of the renin-angiotensin-aldosterone system, salt and water retention, and activation of the sympathetic nervous system that increase the risk of developing hypertension [27]. In children who have had early repair of an aortic coarctation, one quarter to one third will have hypertension later in childhood [28]. There is an association between blood pressure and residual aortic obstruction as well as with interventricular septal thickness [28]. In children with diabetes, rates of hypertension are elevated compared to the general population. In type 1 diabetes, the prevalence of hypertension is reported from 4 to 8% but much higher in type 2 diabetes at 23–40% [29•]. Even early life factors including prematurity and intrauterine growth restriction have been correlated with increased risk of hypertension in childhood and young adulthood [30, 31]. As all these populations are at a significantly higher risk of hypertension, the AAP Subcommittee recommends measuring blood pressure at every clinical encounter in these targeted populations to improve the recognition and diagnosis of this modifiable cardiovascular risk factor (Table 1) [1••].

Updated Blood Pressure Standards

The AAP Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents includes updated normative blood pressure values based on normal-weight children (Table 3) [1••]. Recognizing the influence that elevated weight may have on blood pressure values, the Subcommittee wanted to ensure the updated normative data represented healthy population data. Using the same dataset as the 4th Report with auscultatory blood pressure measurements from 11 studies, the revised normative data now excludes over 20% of the readings that came from children who had a body mass index ≥ 85th percentile [32•]. This has reduced the number of children contributing values from 63,227 to 49,967, but this is still the largest normative dataset available. Using these normal-weight blood pressure standards, Rosner et al. analyzed National Health and Nutrition Examination Survey (NHANES) III and NHANES 1999–2008 data from children and adolescents to show that the prevalence of elevated blood pressure increased over time and was related to body mass index, waist circumference, and salt intake [33].

The blood pressure tables continue to be presented by gender, age, and height/height percentile for both systolic and diastolic blood pressure (Table 3a and b). They also contain the 50th, 90th, 95th, and 95th + 12 mmHg values to be consistent with the revised definitions of normotension, elevated blood pressure, stage 1 hypertension, and stage 2 hypertension, respectively. Revision of the blood pressure standards to include only normal-weight children has shifted the 95th percentile down by around 1–4 mmHg (Table 3a and b). These updated reference values are consistent with a recent analysis that developed an international blood pressure reference standard [34]. Xi et al. found that when international norms developed from datasets of normal-weight children were compared to those from the 4th Report, the international systolic blood pressure 95th percentiles were lower by 1–5 mmHg [34]. Values were comparable within a few millimeters of mercury when the international norms were compared to the normal-weight 4th Report data used in the current AAP blood pressure guideline.

The practical implication of the lower blood pressure norms is that potentially more children will be diagnosed with hypertension. On the other hand, fewer children with elevated blood pressure will be missed. Some experts in hypertension

Table 3 Blood pressure values by age and height percentile for boys and girls

A Boys

Age (y)	Blood Pressure Percentile	Systolic Blood Pressure (mmHg) Height Percentile or Measured Height							Diastolic Blood Pressure (mmHg) Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (in)	30.4	30.8	31.6	32.4	33.3	34.1	34.6	30.4	30.8	31.6	32.4	33.3	34.1	34.6
	Height (cm)	77.2	78.3	80.2	82.4	84.6	86.7	87.9	77.2	78.3	80.2	82.4	84.6	86.7	87.9
	50th	85	85	86	86	87	88	88	40	40	40	41	41	42	42
	90th	98	99	99	100	100	101	101	52	52	53	53	54	54	54
	95th	102	102	103	103	104	105	105	54	54	55	55	56	57	57
	95th + 12 mmHg	114	114	115	115	116	117	117	66	66	67	67	68	69	69
2	Height (in)	33.9	34.4	35.3	36.3	37.3	38.2	38.8	33.9	34.4	35.3	36.3	37.3	38.2	38.8
	Height (cm)	86.1	87.4	89.6	92.1	94.7	97.1	98.5	86.1	87.4	89.6	92.1	94.7	97.1	98.5
	50th	87	87	88	89	89	90	91	43	43	44	44	45	46	46
	90th	100	100	101	102	103	103	104	55	55	56	56	57	58	58
	95th	104	105	105	106	107	107	108	57	58	58	59	60	61	61
	95th + 12 mmHg	116	117	117	118	119	119	120	69	70	70	71	72	73	73
3	Height (in)	36.4	37	37.9	39	40.1	41.1	41.7	36.4	37	37.9	39	40.1	41.1	41.7
	Height (cm)	92.5	93.9	96.3	99	101.8	104.3	105.8	92.5	93.9	96.3	99	101.8	104.3	105.8
	50th	88	89	89	90	91	92	92	45	46	46	47	48	49	49
	90th	101	102	102	103	104	105	105	58	58	59	59	60	61	61
	95th	106	106	107	107	108	109	109	60	61	61	62	63	64	64
	95th + 12 mmHg	118	118	119	119	120	121	121	72	73	73	74	75	76	76
4	Height (in)	38.8	39.4	40.5	41.7	42.9	43.9	44.5	38.8	39.4	40.5	41.7	42.9	43.9	44.5
	Height (cm)	98.5	100.2	102.9	105.9	108.9	111.5	113.2	98.5	100.2	102.9	105.9	108.9	111.5	113.2
	50th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95th + 12 mmHg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
5	Height (in)	41.1	41.8	43.0	44.3	45.5	46.7	47.4	41.1	41.8	43.0	44.3	45.5	46.7	47.4
	Height (cm)	104.4	106.2	109.1	112.4	115.7	118.6	120.3	104.4	106.2	109.1	112.4	115.7	118.6	120.3
	50th	91	92	93	94	95	96	96	51	51	52	53	54	55	55
	90th	103	104	105	106	107	108	108	63	64	65	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th + 12 mmHg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
6	Height (in)	43.4	44.2	45.4	46.8	48.2	49.4	50.2	43.4	44.2	45.4	46.8	48.2	49.4	50.2
	Height (cm)	110.3	112.2	115.3	118.9	122.4	125.6	127.5	110.3	112.2	115.3	118.9	122.4	125.6	127.5
	50th	93	93	94	95	96	97	98	54	54	55	56	57	57	58
	90th	105	105	106	107	109	110	110	66	66	67	68	68	69	69
	95th	108	109	110	111	112	113	114	69	70	70	71	72	72	73
	95th + 12 mmHg	120	121	122	123	124	125	126	81	82	82	83	84	84	85
7	Height (in)	45.7	46.5	47.8	49.3	50.8	52.1	52.9	45.7	46.5	47.8	49.3	50.8	52.1	52.9
	Height (cm)	116.1	118	121.4	125.1	128.9	132.4	134.5	116.1	118	121.4	125.1	128.9	132.4	134.5
	50th	94	94	95	97	98	98	99	56	56	57	58	58	59	59
	90th	106	107	108	109	110	111	111	68	68	69	70	70	71	71
	95th	110	110	111	112	114	115	116	71	71	72	73	73	74	74
	95th + 12 mmHg	122	122	123	124	126	127	128	83	83	84	85	85	86	86
8	Height (in)	47.8	48.6	50	51.6	53.2	54.6	55.5	47.8	48.6	50	51.6	53.2	54.6	55.5
	Height (cm)	121.4	123.5	127	131	135.1	138.8	141	121.4	123.5	127	131	135.1	138.8	141
	50th	95	96	97	98	99	99	100	57	57	58	59	59	60	60
	90th	107	108	109	110	111	112	112	69	70	70	71	72	72	73
	95th	111	112	112	114	115	116	117	72	73	73	74	75	75	75
	95th + 12 mmHg	123	124	124	126	127	128	129	84	85	85	86	87	87	87
9	Height (in)	49.6	50.5	52	53.7	55.4	56.9	57.9	49.6	50.5	52	53.7	55.4	56.9	57.9
	Height (cm)	126	128.3	132.1	136.3	140.7	144.7	147.1	126	128.3	132.1	136.3	140.7	144.7	147.1
	50th	96	97	98	99	100	101	101	57	58	59	60	61	62	62
	90th	107	108	109	110	112	113	114	70	71	72	73	74	74	74
	95th	112	112	113	115	116	118	119	74	74	75	76	76	77	77
	95th + 12 mmHg	124	124	125	127	128	130	131	86	86	87	88	88	89	89

Table 3 (continued)

Age (y)	Blood Pressure Percentile	Systolic Blood Pressure (mmHg) Height Percentile or Measured Height							Diastolic Blood Pressure (mmHg) Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
10	Height (in)	51.3	52.2	53.8	55.6	57.4	59.1	60.1	51.3	52.2	53.8	55.6	57.4	59.1	60.1
	Height (cm)	130.2	132.7	136.7	141.3	145.9	150.1	152.7	130.2	132.7	136.7	141.3	145.9	150.1	152.7
	50th	97	98	99	100	101	102	103	59	60	61	62	63	63	64
	90th	108	109	111	112	113	115	116	72	73	74	74	75	75	76
	95th	112	113	114	116	118	120	121	76	76	77	77	78	78	78
	95th + 12 mmHg	124	125	126	128	130	132	133	88	88	89	89	90	90	90
11	Height (in)	53	54	55.7	57.6	59.6	61.3	62.4	53	54	55.7	57.6	59.6	61.3	62.4
	Height (cm)	134.7	137.3	141.5	146.4	151.3	155.8	158.6	134.7	137.3	141.5	146.4	151.3	155.8	158.6
	50th	99	99	101	102	103	104	106	61	61	62	63	63	63	63
	90th	110	111	112	114	116	117	118	74	74	75	75	75	76	76
	95th	114	114	116	118	120	123	124	77	78	78	78	78	78	78
	95th + 12 mmHg	126	126	128	130	132	135	136	89	90	90	90	90	90	90
12	Height (in)	55.2	56.3	58.1	60.1	62.2	64	65.2	55.2	56.3	58.1	60.1	62.2	64	65.2
	Height (cm)	140.3	143	147.5	152.7	157.9	162.6	165.5	140.3	143	147.5	152.7	157.9	162.6	165.5
	50th	101	101	102	104	106	108	109	61	62	62	62	62	63	63
	90th	113	114	115	117	119	121	122	75	75	75	75	75	76	76
	95th	116	117	118	121	124	126	128	78	78	78	78	78	79	79
	95th + 12 mmHg	128	129	130	133	136	138	140	90	90	90	90	90	91	91
13	Height (in)	57.9	59.1	61	63.1	65.2	67.1	68.3	57.9	59.1	61	63.1	65.2	67.1	68.3
	Height (cm)	147	150	154.9	160.3	165.7	170.5	173.4	147	150	154.9	160.3	165.7	170.5	173.4
	50th	103	104	105	108	110	111	112	61	60	61	62	63	64	65
	90th	115	116	118	121	124	126	126	74	74	74	75	76	77	77
	95th	119	120	122	125	128	130	131	78	78	78	78	80	81	81
	95th + 12 mmHg	131	132	134	137	140	142	143	90	90	90	90	92	93	93
14	Height (in)	60.6	61.8	63.8	65.9	68.0	69.8	70.9	60.6	61.8	63.8	65.9	68.0	69.8	70.9
	Height (cm)	153.8	156.9	162	167.5	172.7	177.4	180.1	153.8	156.9	162	167.5	172.7	177.4	180.1
	50th	105	106	109	111	112	113	113	60	60	62	64	65	66	67
	90th	119	120	123	126	127	128	129	74	74	75	77	78	79	80
	95th	123	125	127	130	132	133	134	77	78	79	81	82	83	84
	95th + 12 mmHg	135	137	139	142	144	145	146	89	90	91	93	94	95	96
15	Height (in)	62.6	63.8	65.7	67.8	69.8	71.5	72.5	62.6	63.8	65.7	67.8	69.8	71.5	72.5
	Height (cm)	159	162	166.9	172.2	177.2	181.6	184.2	159	162	166.9	172.2	177.2	181.6	184.2
	50th	108	110	112	113	114	114	114	61	62	64	65	66	67	68
	90th	123	124	126	128	129	130	130	75	76	78	79	80	81	81
	95th	127	129	131	132	134	135	135	78	79	81	83	84	85	85
	95th + 12 mmHg	139	141	143	144	146	147	147	90	91	93	95	96	97	97
16	Height (in)	63.8	64.9	66.8	68.8	70.7	72.4	73.4	63.8	64.9	66.8	68.8	70.7	72.4	73.4
	Height (cm)	162.1	165	169.6	174.6	179.5	183.8	186.4	162.1	165	169.6	174.6	179.5	183.8	186.4
	50th	111	112	114	115	115	116	116	63	64	66	67	68	69	69
	90th	126	127	128	129	131	131	132	77	78	79	80	81	82	82
	95th	130	131	133	134	135	136	137	80	81	83	84	85	86	86
	95th + 12 mmHg	142	143	145	146	147	148	149	92	93	95	96	97	98	98
17	Height (in)	64.5	65.5	67.3	69.2	71.1	72.8	73.8	64.5	65.5	67.3	69.2	71.1	72.8	73.8
	Height (cm)	163.8	166.5	170.9	175.8	180.7	184.9	187.5	163.8	166.5	170.9	175.8	180.7	184.9	187.5
	50th	114	115	116	117	117	118	118	65	66	67	68	69	70	70
	90th	128	129	130	131	132	133	134	78	79	80	81	82	82	83
	95th	132	133	134	135	137	138	138	81	82	84	85	86	86	87
	95th + 12 mmHg	144	145	146	147	149	150	150	93	94	96	97	98	98	99

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Table 3 (continued)

B Girls

Age (y)	Blood Pressure Percentile	Systolic Blood Pressure (mmHg) Height Percentile or Measured Height							Diastolic Blood Pressure (mmHg) Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (in)	29.7	30.2	30.9	31.8	32.7	33.4	33.9	29.7	30.2	30.9	31.8	32.7	33.4	33.9
	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8	83	84.9	86.1
	50th	84	85	86	86	87	88	88	41	42	42	43	44	45	46
	90th	98	99	99	100	101	102	102	54	55	56	56	57	58	58
	95th	101	102	102	103	104	105	105	59	59	60	60	61	62	62
	95th + 12 mmHg	113	114	114	115	116	117	117	71	71	72	72	73	74	74
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9	36.9	37.8	38.4
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1	93.7	96	97.4
	50th	87	87	88	89	90	91	91	45	46	47	48	49	50	51
	90th	101	101	102	103	104	105	106	58	58	59	60	61	62	62
	95th	104	105	106	106	107	108	109	62	63	63	64	65	66	66
	95th + 12 mmHg	116	117	118	118	119	120	121	74	75	75	76	77	78	78
3	Height (in)	35.8	36.4	37.3	38.4	39.6	40.6	41.2	35.8	36.4	37.3	38.4	39.6	40.6	41.2
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6	100.5	103.1	104.6
	50th	88	89	89	90	91	92	93	48	48	49	50	51	53	53
	90th	102	103	104	104	105	106	107	60	61	61	62	63	64	65
	95th	106	106	107	108	109	110	110	64	65	65	66	67	68	69
	95th + 12 mmHg	118	118	119	120	121	122	122	76	77	77	78	79	80	81
4	Height (in)	38.3	38.9	39.9	41.1	42.4	43.5	44.2	38.3	38.9	39.9	41.1	42.4	43.5	44.2
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5	107.6	110.5	112.2
	50th	89	90	91	92	93	94	94	50	51	51	53	54	55	55
	90th	103	104	105	106	107	108	108	62	63	64	65	66	67	67
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95th + 12 mmHg	119	120	121	121	122	123	124	78	79	80	81	82	82	83
5	Height (in)	40.8	41.5	42.6	43.9	45.2	46.5	47.3	40.8	41.5	42.6	43.9	45.2	46.5	47.3
	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5	114.9	118.1	120
	50th	90	91	92	93	94	95	96	52	52	53	55	56	57	57
	90th	104	105	106	107	108	109	110	64	65	66	67	68	69	70
	95th	108	109	109	110	111	112	113	68	69	70	71	72	73	73
	95th + 12 mmHg	120	121	121	122	123	124	125	80	81	82	83	84	85	85
6	Height (in)	43.3	44	45.2	46.6	48.1	49.4	50.3	43.3	44	45.2	46.6	48.1	49.4	50.3
	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4	122.1	125.6	127.7
	50th	92	92	93	94	96	97	97	54	54	55	56	57	58	59
	90th	105	106	107	108	109	110	111	67	67	68	69	70	71	71
	95th	109	109	110	111	112	113	114	70	71	72	72	73	74	74
	95th + 12 mmHg	121	121	122	123	124	125	126	82	83	84	84	85	86	86
7	Height (in)	45.6	46.4	47.7	49.2	50.7	52.1	53	45.6	46.4	47.7	49.2	50.7	52.1	53
	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9	128.8	132.5	134.7
	50th	92	93	94	95	97	98	99	55	55	56	57	58	59	60
	90th	106	106	107	109	110	111	112	68	68	69	70	71	72	72
	95th	109	110	111	112	113	114	115	72	72	73	73	74	74	75
	95th + 12 mmHg	121	122	123	124	125	126	127	84	84	85	85	86	86	87
8	Height (in)	47.6	48.4	49.8	51.4	53	54.5	55.5	47.6	48.4	49.8	51.4	53	54.5	55.5
	Height (cm)	121	123	126.5	130.6	134.7	138.5	140.9	121	123	126.5	130.6	134.7	138.5	140.9
	50th	93	94	95	97	98	99	100	56	56	57	59	60	61	61
	90th	107	107	108	110	111	112	113	69	70	71	72	72	73	73
	95th	110	111	112	113	115	116	117	72	73	74	74	75	75	75
	95th + 12 mmHg	122	123	124	125	127	128	129	84	85	86	86	87	87	87
9	Height (in)	49.3	50.2	51.7	53.4	55.1	56.7	57.7	49.3	50.2	51.7	53.4	55.1	56.7	57.7
	Height (cm)	125.3	127.6	131.3	135.6	140.1	144.1	146.6	125.3	127.6	131.3	135.6	140.1	144.1	146.6
	50th	95	95	97	98	99	100	101	57	58	59	60	60	61	61
	90th	108	108	109	111	112	113	114	71	71	72	73	73	73	73
	95th	112	112	113	114	116	117	118	74	74	75	75	75	75	75
	95th + 12 mmHg	124	124	125	126	128	129	130	86	86	87	87	87	87	87

Table 3 (continued)

Age (y)	Blood Pressure Percentile	Systolic Blood Pressure (mmHg) Height Percentile or Measured Height							Diastolic Blood Pressure (mmHg) Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
10	Height (in)	51.1	52	53.7	55.5	57.4	59.1	60.2	51.1	52	53.7	55.5	57.4	59.1	60.2
	Height (cm)	129.7	132.2	136.3	141	145.8	150.2	152.8	129.7	132.2	136.3	141	145.8	150.2	152.8
	50th	96	97	98	99	101	102	103	58	59	59	60	61	61	62
	90th	109	110	111	112	113	115	116	72	73	73	73	73	73	73
	95th	113	114	114	116	117	119	120	75	75	76	76	76	76	76
	95th + 12 mmHg	125	126	126	128	129	131	132	87	87	88	88	88	88	88
11	Height (in)	53.4	54.5	56.2	58.2	60.2	61.9	63	53.4	54.5	56.2	58.2	60.2	61.9	63
	Height (cm)	135.6	138.3	142.8	147.8	152.8	157.3	160	135.6	138.3	142.8	147.8	152.8	157.3	160
	50th	98	99	101	102	104	105	106	60	60	60	61	62	63	64
	90th	111	112	113	114	116	118	120	74	74	74	74	74	75	75
	95th	115	116	117	118	120	123	124	76	77	77	77	77	77	77
	95th + 12 mmHg	127	128	129	130	132	135	136	88	89	89	89	89	89	89
12	Height (in)	56.2	57.3	59	60.9	62.8	64.5	65.5	56.2	57.3	59	60.9	62.8	64.5	65.5
	Height (cm)	142.8	145.5	149.9	154.8	159.6	163.8	166.4	142.8	145.5	149.9	154.8	159.6	163.8	166.4
	50th	102	102	104	105	107	108	108	61	61	61	62	64	65	65
	90th	114	115	116	118	120	122	122	75	75	75	75	76	76	76
	95th	118	119	120	122	124	125	126	78	78	78	78	79	79	79
	95th + 12 mmHg	130	131	132	134	136	137	138	90	90	90	90	91	91	91
13	Height (in)	58.3	59.3	60.9	62.7	64.5	66.1	67	58.3	59.3	60.9	62.7	64.5	66.1	67
	Height (cm)	148.1	150.6	154.7	159.2	163.7	167.8	170.2	148.1	150.6	154.7	159.2	163.7	167.8	170.2
	50th	104	105	106	107	108	108	109	62	62	63	64	65	65	66
	90th	116	117	119	121	122	123	123	75	75	75	76	76	76	76
	95th	121	122	123	124	126	126	127	79	79	79	79	80	80	81
	95th + 12 mmHg	133	134	135	136	138	138	139	91	91	91	91	92	92	93
14	Height (in)	59.3	60.2	61.8	63.5	65.2	66.8	67.7	59.3	60.2	61.8	63.5	65.2	66.8	67.7
	Height (cm)	150.6	153	156.9	161.3	165.7	169.7	172.1	150.6	153	156.9	161.3	165.7	169.7	172.1
	50th	105	106	107	108	109	109	109	63	63	64	65	66	66	66
	90th	118	118	120	122	123	123	123	76	76	76	76	77	77	77
	95th	123	123	124	125	126	127	127	80	80	80	80	81	81	82
	95th + 12 mmHg	135	135	136	137	138	139	139	92	92	92	92	93	93	94
15	Height (in)	59.7	60.6	62.2	63.9	65.6	67.2	68.1	59.7	60.6	62.2	63.9	65.6	67.2	68.1
	Height (cm)	151.7	154	157.9	162.3	166.7	170.6	173	151.7	154	157.9	162.3	166.7	170.6	173
	50th	105	106	107	108	109	109	109	64	64	64	65	66	67	67
	90th	118	119	121	122	123	123	124	76	76	76	77	77	78	78
	95th	124	124	125	126	127	127	128	80	80	80	81	82	82	82
	95th + 12 mmHg	136	136	137	138	139	139	140	92	92	92	93	94	94	94
16	Height (in)	59.9	60.8	62.4	64.1	65.8	67.3	68.3	59.9	60.8	62.4	64.1	65.8	67.3	68.3
	Height (cm)	152.1	154.5	158.4	162.8	167.1	171.1	173.4	152.1	154.5	158.4	162.8	167.1	171.1	173.4
	50th	106	107	108	109	109	110	110	64	64	65	66	66	67	67
	90th	119	120	122	123	124	124	124	76	76	76	77	78	78	78
	95th	124	125	125	127	127	128	128	80	80	80	81	82	82	82
	95th + 12 mmHg	136	137	137	139	139	140	140	92	92	92	93	94	94	94
17	Height (in)	60.0	60.9	62.5	64.2	65.9	67.4	68.4	60.0	60.9	62.5	64.2	65.9	67.4	68.4
	Height (cm)	152.4	154.7	158.7	163.0	167.4	171.3	173.7	152.4	154.7	158.7	163.0	167.4	171.3	173.7
	50th	107	108	109	110	110	110	111	64	64	65	66	66	66	67
	90th	120	121	123	124	124	125	125	76	76	77	77	78	78	78
	95th	125	125	126	127	128	128	128	80	80	80	81	82	82	82
	95th + 12 mmHg	137	137	138	139	140	140	140	92	92	92	93	94	94	94

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have been uncomfortable with the 95th percentile cutoff definition for hypertension as it is a statistical measure, not based on hard outcomes. Several studies have demonstrated target organ damage in children with blood pressure between the 90th and 95th percentiles. Stabouli et al. found a 20% prevalence of left ventricular hypertrophy in both children with elevated blood pressure (prehypertension) and hypertension which was more than in normotensive children [35]. Urbina et al. showed that adolescents and young adults with elevated blood pressure (prehypertension) had increased left ventricular mass index, cIMT, arterial stiffness, and diastolic dysfunction compared to normotensive subjects [36]. Current research is aiming to better define blood pressures and percentiles associated with outcomes in children and adolescents to determine more appropriate thresholds for defining hypertension. Until these studies are complete, the recommendation is to continue to use blood pressure percentiles in children but with the slightly lower AAP blood pressure guideline normative data to potentially reduce target organ damage.

Classification of Hypertension

The updated AAP blood pressure guideline classification scheme for blood pressure in children and adolescents is presented in Table 4 [1••]. The revised classification distinguishes between children 1 to 13 years of age and adolescents ≥ 13 years of age. The childhood classification continues to be primarily percentile based while those for adolescents are absolute values consistent with the upcoming American College of Cardiology/American Heart Association (ACC/AHA) adult blood pressure guideline [37]. The definition of normal blood pressure remains unchanged as less than the 90th percentile in children and less than 120/80 mmHg in adolescents. The term prehypertension has been replaced with "elevated blood pressure" for consistency with the adult guideline and to more clearly distinguish it as abnormal blood pressure that needs attention and therapeutic lifestyle modifications [1••]. For children, elevated blood pressure continues to be defined as ≥ 90th percentile to < 95th percentile and in adolescents as 120–129/< 80 mmHg to correspond with adult definitions (Table 4). The tallest 12-year old children may have percentile values above the adolescent thresholds, so the lowest values should be used to avoid under-recognition of elevated blood pressure. Stage 1 hypertension in children continues to be defined as blood pressure ≥ 95th percentile to less than the 95th percentile + 12 mmHg (which is essentially the same as the 99th percentile + 5 mmHg from the 4th Report) [1••, 2•]. For adolescents, the new definition of stage 1 hypertension should be more easily recognized and is defined as blood pressure 130/80 to 139/89 mmHg. Stage 2 hypertension in children is now labeled as ≥ 95th percentile + 12 mmHg and in adolescents is ≥ 140/90 mmHg.

The AAP blood pressure guideline has modified the classification of abnormal blood pressure to create consistency with the upcoming ACC/AHA adult blood pressure guideline [37]. Likely, the Systolic Blood Pressure Intervention Trial (SPRINT) influenced the recommended adult blood pressure targets. This randomized controlled trial included non-diabetic adults > 50 years of age with systolic blood pressure > 130 mmHg and an increased risk of cardiovascular disease [38•]. They found that intensive treatment to a systolic blood pressure goal < 120 mmHg (achieved 121 mmHg) compared to < 140 mmHg (achieved 136 mmHg) was associated with a significantly lower rate of cardiovascular events and death [38•]. Although, more than half of participants in the intensive treatment group did not reach the target and there were more treatment related serious adverse events in the intensive treatment group. In light of the SPRINT results, Egan et al. evaluated NHANES data of treated hypertensive adults to assess current blood pressure control [39]. They found that in all adults ≥ 18 years of age, the mean systolic blood pressure achieved was 130 mmHg and in those with treated hypertension (< 140 mmHg), 75% had a systolic blood pressure less than 130 mmHg [39]. Rates were even better in adults ≥ 18 years of age excluding SPRINT-like participants, suggesting that lower targets than previous adult guidelines may actually be reasonable to achieve.

Table 4 Classification of blood pressure in children and adolescents

For Children Aged 1 to 13 Years	For Children Aged ≥13 Years
Normal BP: <90th percentile	Normal BP: <120/<80 mmHg
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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BP blood pressure, *HTN* hypertension

The development of the updated classification of hypertension, particularly for adolescents, was a balance between simplification of thresholds to improve the recognition of hypertension with limiting under-recognition or overdiagnosis of hypertension stage compared to the detailed blood pressure tables. Most of the discrepancies between the new threshold cutoff values and the complete blood pressure tables occur in the extremes of age and size [1••]. For example, defining stage 1 hypertension in adolescents starting at 130/80 could potentially miss systolic hypertension in 13 to 17-year-old females and shorter 13 to 15-year-old males compared to the detailed tables. In the youngest and smallest adolescents, the difference in definition compared to the 95th percentile can be around 10 mmHg, although most differences are much smaller and within measurement error. The criticism of the percentile tables in adolescents is that it does not make sense that older adolescents have one acceptable blood pressure by percentile in pediatric practice but different standards when they transition into adult care. Given that the adult blood pressure thresholds are based on clinical trials with hard cardiovascular outcomes and pediatric data is based on normative percentile data, it makes sense to adopt the adult thresholds in adolescents. Clinicians who are comfortable using the detailed tables may still consult the complete charts or may choose to do so in the extremes of age or size to decide on classification and management.

While the adolescent blood pressure classification has been simplified, the definitions for children are slightly more complex. In children, blood pressure percentiles linked with gender, age, and height continue to be the best comparison for classification given the significant growth and blood pressure changes occurring in early childhood and lack of hard outcome data related to blood pressure thresholds in children. The adolescent thresholds creep into the childhood blood pressure definitions to avoid percentile values in children to exceed those that are allowable in adolescents. This is really only an issue for the oldest and tallest children where thresholds differ by only a few millimeters mercury, so following the percentile recommendations for children continues to be a reasonable approach.

Importance of ABPM

There is increased emphasis on the use of 24-h ambulatory blood pressure monitoring (ABPM) in the 2017 AAP blood pressure guideline. The guideline contains seven key action statements related to the use of ABPM in the evaluation and management of pediatric hypertension (Table 5) [1••]. Since the 4th Report, there is increasing evidence supporting the utility and benefit of ABPM in general pediatric hypertension as well as in many high-risk conditions. ABPM has been shown to be more accurate, cost-effective, and reproducible than the clinic blood pressure to diagnose hypertension in children, especially as it identifies white coat hypertension [40•, 41–43]. Davis et al. found that, in patients referred for hypertension, 22% had white coat hypertension, 6.5% masked hypertension, and only 26% ambulatory hypertension with no

Table 5 ABPM related key action statements from the 2017 AAP Clinical Practice Guideline on Blood Pressure Management in Children [1••]

Statement type	Recommendation
Key action statement	ABPM should be performed for confirmation of hypertension in children and adolescents with office blood pressure measurements in the elevated blood pressure category for 1 year or more or with stage 1 hypertension over three clinic visits.
Key action statement	Routine performance of ABPM should be strongly considered in children and adolescents with high-risk conditions to assess hypertension severity and determine whether abnormal circadian blood pressure patterns are present, which may indicate increased risk for target organ damage.
Key action statement	ABPM should be performed using a standardized approach with monitors that have been validated in a pediatric population, and studies should be interpreted using pediatric normative data.
Key action statement	Children and adolescents with suspected white coat hypertension should undergo ABPM. Diagnosis is based on the presence of mean systolic and diastolic blood pressure < 95th percentile and systolic and diastolic blood pressure load < 25%.
Key action statement	Children and adolescents who have undergone coarctation repair should undergo ABPM for the detection of hypertension (including masked hypertension).
Key action statement	ABPM may be used to assess treatment effectiveness in children and adolescents with hypertension, especially when clinic and/or home blood pressure measurements indicate insufficient blood pressure response to treatment.
Key action statement	a. Children and adolescents with chronic kidney disease should be evaluated for hypertension at each medical encounter. b. Children or adolescents with both chronic kidney disease and hypertension should be treated to lower 24-h mean arterial pressure < 50th percentile by ABPM. c. Regardless of apparent control of blood pressure with office measures, children and adolescents with chronic kidney disease and a history of hypertension should have blood pressure assessed by ABPM at least yearly to screen for masked hypertension.

clinic blood pressure parameter associated with hypertension diagnosed by ABPM [40•]. Gimpel et al. analyzed the reproducibility of clinic and ABPM measurements from the ESCAPE trial and found that ABPM had a 24–30% smaller standard deviation for measurements with a 36–39% lower variation in longitudinal blood pressure changes compared to clinic blood pressure measures [44]. In a 15-year longitudinal study, Li et al. showed that ABPM had moderate long-term tracking stability from childhood to early adulthood [45]. In addition, several studies have demonstrated that target organ damage in the form of increased left ventricular mass index or left ventricular hypertrophy correlates with ABPM parameters and not casual blood pressure [46–48]. In a study by Richey et al., LVMI correlated incrementally with ABPM systolic blood pressure load, blood pressure index, and standard deviation score but not with casual blood pressure parameters [48]. ABPM is also useful to monitor and optimize treatment of pediatric hypertension, although control rates often remain less than ideal [49, 50].

ABPM is also the primary method to diagnose masked hypertension, nocturnal hypertension, and nocturnal non-dipping which are common blood pressure abnormalities in high-risk conditions. Patients with repaired aortic coarctation, chronic kidney disease, solid organ transplantation, diabetes mellitus, obstructive sleep apnea, and other secondary causes of hypertension are all at risk of blood pressure abnormalities found only with 24-h ABPM [1••, 51–53, 54•, 55]. In a cohort of children 8 years post aortic coarctation repair with normal clinic blood pressure, Di Salvo et al. found that 45% had masked hypertension on ABPM that was associated with abnormalities in left ventricular structure and function [51]. Samuels et al. reported on ABPM results from the Chronic Kidney Disease in Children Study where they found that 35% had masked hypertension and hypertension was more common during the nighttime than daytime [52]. Tainio et al. found significant rates of masked hypertension (26–46%) in pediatric kidney, heart, and liver transplant recipients with more nocturnal than daytime blood pressure abnormalities [53]. In children with diabetes mellitus, nocturnal blood pressure abnormalities also occur and in type 1 diabetes may precede the development of albuminuria [54•]. Nocturnal hypertension and non-dipping is not uncommon in children with obstructive sleep apnea, 16% in one study, with a higher prevalence in those with more apnea/hypoxia episodes during sleep [55]. Targeted use of ABPM in these high-risk populations, regardless of clinic blood pressure, is likely to be high yield for ambulatory blood pressure abnormalities.

In an ideal world, ABPM would be universally available to all pediatric populations to assess their blood pressure patterns but this is unfortunately not the case. To obtain an ABPM in many pediatric practices requires referral of patients to pediatric subspecialists. For those centers who do provide ABPM services, costs are often only partially reimbursed if at all, limiting the centers ability to expand their program. Interpretation of ABPM in children requires comparison to pediatric norms based on gender and height or age [56•]. Limited normal values exist for children less than 5 years of age or 120 cm of height or for non-Caucasian children. So while the strength of evidence indicates that ABPM is superior to clinic blood pressure in assessment of hypertension, a standard cannot be imposed using a technique that is not universally available and with limitations in the normative reference values.

Additional Updates

Since publication of the 4th Report, there have been significant advancements in health data systems and a shift from paper charts to electronic health records, although they are not universally used. There is increasing evidence that using electronic health records with a clinical decision support tool or flag for abnormal values can increase blood pressure screening and recognition of hypertension [57–59]. Brady et al. showed that the incorporation of a real-time electronic alert into the electronic health record used in a pediatric primary care practice increased the recognition of elevated blood pressure from 12 to 42% [57]. Use of electronic health records without prompts for blood pressure entry or flags for abnormalities does not seem to increase hypertension screening or diagnosis [13•, 15, 58]. The AAP Subcommittee recommends that "organizations with electronic health records used in an office setting should consider including flags for abnormal blood pressure values both when the values are being entered and when they are being viewed" [1••].

Investigation of pediatric hypertension for secondary causes according to the 4th Report recommendations has not been demonstrated in clinical practice by most pediatricians or pediatric nephrologists [60, 61]. The AAP blood pressure guideline has reduced the number of recommended investigations in children ≥ 6 years of age given that primary hypertension is the most common cause of hypertension in US children beginning at this age [1••, 24, 25]. The recommendation is primarily for children with overweight or obesity, or positive family history of hypertension, and no obvious secondary cause for hypertension on initial assessment. The AAP blood pressure guideline recommends that all patients have a urinalysis, electrolytes, urea, creatinine, and lipid profile and removes routine renal ultrasonography in children ≥ 6 years of age unless there is an abnormal urinalysis or renal function. This recommendation differs from recent pediatric guidelines from Hypertension Canada and the European Society of Hypertension that continue to recommend routine renal ultrasonography in all hypertensive children [62, 63]. The discrepancy may be related to different interpretation of the cost-benefit ratio of renal ultrasonography for detection of a

secondary or contributing cause for hypertension, as evidence is limited to small retrospective studies. Baracco et al. found that renal ultrasonography was abnormal more commonly in children ultimately diagnosed with secondary hypertension (34%) although was also abnormal in 10% with primary hypertension [24]. Even within a population of children with mostly essential hypertension, Wiesen et al. found contributory renal ultrasound abnormalities in 8% [64]. As not all children with obesity develop hypertension, there may be a second risk factor in some of these children that predispose them to the development of hypertension such as a solitary kidney or history of prematurity. Clinicians will need to decide within their own populations if the potential for identification of abnormalities on each investigation outweighs the additional costs and practice accordingly.

The blood pressure treatment goal in children without diabetes or chronic kidney disease was less than the 95th percentile in the 4th Report, but the AAP blood pressure guideline recommends a lower target at less than the 90th percentile [1••, 2•]. This lower treatment goal is consistent with what is practiced by the majority of pediatric nephrologists in North America [65]. There is increasing evidence that end organ damage is found in children with blood pressure > 90th percentile but less than the 95th percentile. Left ventricular hypertrophy, increased cIMT, increased arterial stiffness, and diastolic dysfunction have all been found in children with elevated blood pressure (formerly termed prehypertension) [35, 36]. In longitudinal studies, having blood pressure during childhood above the 90th percentile increases the risk of adulthood hypertension and cardiovascular disease [7, 8, 66•]. Based on this evidence, the AAP Subcommittee recommends using < 90th percentile blood pressure as a goal for nonpharmacologic and pharmacologic management of general pediatric hypertension. In adolescents, the treatment target is < 130/80 to be consistent with the upcoming ACC/AHA adult blood pressure guidelines and is likely influenced by the SPRINT trial and NHANES analysis (see "Classification of Hypertension") [37, 38•, 39].

Outstanding Issues

The updates within the 2017 AAP blood pressure guideline aim to clarify and simplify blood pressure assessment in children and adolescents. Unfortunately, several issues remain due to lack of strong evidence in the literature. For younger children, the definitions and classifications of hypertension continue to be based on normative blood pressure percentiles rather than on hard outcomes research. In adolescents, recommendations from the adult ACC/AHA guidelines have been adopted as they are based on more rigorous research studies but it is not known if it is correct to apply the adult standards to an adolescent population. As clinicians and researchers make use of the modified definitions and assess outcomes including target organ damage and longitudinal cardiovascular health, the utility of these definitions can be evaluated. As well, especially in pediatrics, there are inadequate markers of cardiovascular health using left ventricular changes as the primary evidence of target organ damage because other markers such as cIMT, pulse wave velocity, and flow-mediated dilation continue to be limited primarily to research and not clinical care. Yet despite these inadequacies, each updated version of the pediatric blood pressure clinical practice guideline expands upon the previous version and creates a comprehensive and current guideline. The AAP blood pressure guideline also improves upon the transparency of recommendations by clearly providing the level of evidence and strength of recommendation for each key action statement for a better practical understanding of the quality of evidence upon which the statements are based.

Conclusion

Hypertension in children and adolescents is under-recognized and under-diagnosed in clinical practice. The 2017 AAP blood pressure guideline recommendations and tools should improve the diagnosis of pediatric hypertension. Identification of potentially abnormal blood pressure values can start with frontline care providers with use of a simplified blood pressure screening table or use of flags or notifications in electronic health records. Reference normative data is now more representative of a healthy population with exclusion of data from overweight and obese children in the blood pressure tables. Classification of blood pressure in adolescents has been simplified with the use of single threshold values consistent with the adult ACC/AHA guideline for simpler diagnosis of hypertension and more consistency when transitioning adolescents to adult medical care. In addition, increasing use of ABPM will help to limit unnecessary investigation and treatment in those with white coat hypertension and better assess high-risk populations for masked and nocturnal hypertension. With an overall goal of managing the right patient with the right treatment at the right time, the updated AAP blood pressure guideline takes a step forward over previous versions to simplify and enhance recognition and management of pediatric hypertension.

Compliance with Ethical Standards

Conflict of Interest The author declares no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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