

Hypertension (PIP)

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The following guidance is taken from the Partners In Paediatrics (PIP)

Hypertension 2018–20

HYPERTENSION

RECOGNITION AND ASSESSMENT

Diagnosis is difficult because symptoms can be minimal and often go unrecognised

- Severe hypertension can cause:
 - loss of consciousness
 - [seizure](#)
 - hemiplegia
 - facial palsy

Definition

- Depends on age, sex and height of child
- Measure on ≥ 3 separate occasions with auscultatory method ([if possible](#))
- Normal: systolic and diastolic BP $< 90^{\text{th}}$ centile for age, sex and height
- High normal: systolic and diastolic BP between 90^{th} and 95^{th} centile for age, sex and height ($> 120/80$ even if below 90^{th} centile in adolescents)
- Stage 1 hypertension: 95^{th} – 99^{th} centile **plus** 5 mmHg
- Stage 2 hypertension: $> 99^{\text{th}}$ centile **plus** 5 mmHg **and** symptoms

Symptoms and signs

Hypertension

Listed in order of frequency with common presenting features first:

- Infants
 - congestive cardiac failure
 - respiratory distress
 - failure to thrive, vomiting
 - irritability
 - [seizures](#)
- Older children
 - headaches
 - nausea, vomiting
 - hypertensive encephalopathy (see below)
 - polydipsia, polyuria
 - visual problems
 - tiredness, irritability
 - cardiac failure
 - facial palsy
 - hemiplegia
 - epistaxis
 - poor growth, weight loss
 - cardiac murmur
 - abdominal pain

Hypertensive encephalopathy (accelerated hypertension)

- Any neurological sign associated with grossly elevated blood pressure, most commonly:
 - severe generalised headache
 - visual disturbance (+/- retinal changes)/blindness
 - seizure
 - posterior reversible encephalopathy syndrome (PRES)

Do not delay initiation of treatment pending investigations once diagnosis has been made

History

- Family history of hypertension, diabetes, cardiovascular and cerebrovascular disease, obesity, hereditary renal and endocrine disease
- Past history of renal, cardiac, endocrine or neurological problems
- Presenting complaints as listed above
- Drug intake such as corticosteroids, ciclosporin, tacrolimus, methylphenidate, antidepressants

Examination

- Detailed clinical examination of all systems
- **Do not** forget fundoscopy
- Height and weight
- Skin for neurocutaneous stigmata
- Check for cardiovascular causes
 - femoral pulses
 - right arm and leg blood pressure
- Thyroid status
- [Disorder of sexual differentiation](#)
- Cushingoid
- Abdominal bruit

Investigations

- Check for evidence of renal disease
 - serum creatinine, [U&E](#), calcium, chloride, [cholesterol](#), [bicarbonate](#)
 - urinalysis for blood and protein
 - if urine dipstick positive for protein send early morning urine for protein:creatinine ratio
 - renal ultrasound scan [+/- Doppler](#)
- plasma renin and aldosterone concentration (after strict recumbancy for 1–2 hr)
- DMSA scan may be required to exclude scarring
- ECG for left ventricular hypertrophy (LVH)
- echocardiogram
- Check for endocrine/[malignant](#) causes
 - fasting plasma glucose
 - 24 hr urinary free cortisol and/or discuss with [endocrinologist](#) for further investigations
 - urine metadrenalines (performed at Manchester Children's Hospital)
 - lipid profile

Differential diagnosis

- Incorrectly sized (too small) or placed BP cuff
- Transient hypertension secondary to pain, anxiety, distress

IMMEDIATE TREATMENT

Hypertensive encephalopathy (accelerated hypertension)

Urgent treatment necessary but bring BP under control slowly

Abrupt BP reduction can result in cerebral ischaemia with the risk of permanent neurological sequelae owing to failure of cerebral auto-regulation after sustained elevation of BP

- Excess BP = actual BP – acceptable BP (**Table 1** and **2**)
- 'acceptable BP' given by the 90th percentile according to height
- Reduce BP gradually. Aim to reduce 'excess BP' by $\frac{1}{3}$ in first 8 hr, another $\frac{1}{3}$ in next 12 hr, and final $\frac{1}{3}$ in next 48 hr
- Mark target BP ranges on chart so nurses know when to ask a doctor to review
- Monitor perfusion: may need volume expansion in first 12 hr if rapid BP drop
- Discuss choice of drug treatment with **consultant**
- Options comprise in following order: (**Table 3**)
 - **labetalol** infusion
 - starting dose 0.5–1 mg/kg/hr

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- increase by 1 mg/kg/hr every 15–30 min until effective
- maximum dose 3 mg/kg/hr (maximum 120 mg/hr)
- stop infusion when effective
- restart as BP starts to rise again
- normally lasts 4–6 hr
- **sodium nitroprusside** infusion
 - give in **high dependency or intensive care unit** as close BP monitoring (intra-arterial) required
 - starting dose 500 nanogram/kg/min
 - increase in increments of 200 nanogram/kg/min
 - maximum 8 microgram/kg/min for first 24 hr, reducing to 4 microgram/kg/min thereafter
 - only effective whilst infused as short half-life
 - **protect infusion** from **light**
 - stop infusion slowly over 15–30 min to avoid any rebound effects
- **hydralazine** infusion (or bolus as alternative)
- **nifedipine** oral (not 1st line for encephalopathy)
 - 200–300 microgram/kg 8-hrly (**maximum 3 mg/kg/day or 90 mg/day**)
 - avoid quick acting, use modified release to prevent large drop in BP
 - can be crushed but may have more rapid onset
 - may be used to clip peaks of BP
 - dose varies with product; check with pharmacy

SUBSEQUENT MANAGEMENT

Essential hypertension

- High normal BP
- non pharmacological measures such as weight loss, dietary modification (low salt diet), exercise
- medication (**Table 3**) only if compelling indications such as if symptomatic, diabetes mellitus, heart failure, left ventricular hypertrophy
- Stage 1 hypertension
 - non pharmacological measures
 - give medications (**Table 3**) if symptomatic, presence of end organ damage, diabetes, persistent hypertension despite non pharmacological measures
- Stage 2 hypertension
 - non pharmacological measures
 - start medications (**Table 3**)
 - add drug therapy only after discussion with a consultant

Renal hypertension

- In children with impaired renal function, keep BP within same target range as for children with normal renal function
- See **Table 1 and 2**

OUT-PATIENT MANAGEMENT

Table 1: Blood pressure (BP) for boys by age and height percentiles

Age (yrs)	BP percentile	Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of 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
	50 th	85	85	86	86	87	88	88	40	40	40	41	41	42	42
	90 th	98	99	99	100	100	101	101	52	52	53	53	54	54	54
	95 th	102	102	103	103	104	105	105	54	54	55	55	56	57	57
	95 th +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
	50 th	87	87	88	89	89	90	91	43	43	44	44	45	46	46
	90 th	100	100	101	102	103	103	104	55	55	56	56	57	58	58
	95 th	104	105	105	106	107	107	108	57	58	58	59	60	61	61
	95 th +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
	50 th	88	89	89	90	91	92	92	45	46	46	47	48	49	49
	90 th	101	102	102	103	104	105	105	58	58	59	59	60	61	61
	95 th	106	106	107	107	108	109	109	60	61	61	62	63	64	64
	95 th +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
	50 th	90	90	91	92	93	94	94	48	49	49	50	51	52	52
	90 th	102	103	104	105	105	106	107	60	61	62	62	63	64	64
	95 th	107	107	108	108	109	110	110	63	64	65	66	67	67	68
	95 th +12 mmHg	119	119	120	120	121	122	122	75	76	77	78	79	79	80
5	Height (in)	41.1	41.8	43	44.3	45.5	46.7	47.4	41.1	41.8	43	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
	50 th	91	92	93	94	95	96	96	51	51	52	53	54	55	55
	90 th	103	104	105	106	107	108	108	63	64	65	65	66	67	67
	95 th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95 th +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
	50 th	93	93	94	95	96	97	98	54	54	55	56	57	57	58
	90 th	105	105	106	107	109	110	110	66	66	67	68	68	69	69
	95 th	108	109	110	111	112	113	114	69	70	70	71	72	72	73
	95 th +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
	50 th	94	94	95	97	98	98	99	56	56	57	58	58	59	59
	90 th	106	107	108	109	110	111	111	68	68	69	70	70	71	71
	95 th	110	110	111	112	114	115	116	71	71	72	73	73	74	74
	95 th +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
	50 th	95	96	97	98	99	99	100	57	57	58	59	59	60	60
	90 th	107	108	109	110	111	112	112	69	70	70	71	72	72	73
	95 th	111	112	112	114	115	116	117	72	73	73	74	75	75	75
	95 th +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
	50 th	96	97	98	99	100	101	101	57	58	59	60	61	62	62
	90 th	107	108	109	110	112	113	114	70	71	72	73	74	74	74
	95 th	112	112	113	115	116	118	119	74	74	75	76	76	77	77
	95 th +12 mmHg	124	124	125	127	128	130	131	86	86	87	88	88	89	89
10															
Age (yrs)	BP percentile	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
	50 th	97	98	99	100	101	102	103	59	60	61	62	63	63	64

11	90 th	108	109	111	112	113	115	116	72	73	74	74	75	75	76
	95 th	112	113	114	116	118	120	121	76	76	77	77	78	78	78
	95 th +12 mmHg	124	125	126	128	130	132	133	88	88	89	89	90	90	90
	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
	50 th	99	99	101	102	103	104	106	61	61	62	63	63	63	63
	90 th	110	111	112	114	116	117	118	74	74	75	75	75	76	76
12	95 th	114	114	116	118	120	123	124	77	78	78	78	78	78	78
	95 th +12 mmHg	126	126	128	130	132	135	136	89	90	90	90	90	90	90
	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
	50 th	101	101	102	104	106	108	109	61	62	62	62	62	63	63
	90 th	113	114	115	117	119	121	122	75	75	75	75	75	76	76
	95 th	116	117	118	121	124	126	128	78	78	78	78	78	79	79
13	95 th +12 mmHg	128	129	130	133	136	138	140	90	90	90	90	90	91	91
	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
	50 th	103	104	105	108	110	111	112	61	60	61	62	63	64	65
	90 th	115	116	118	121	124	126	126	74	74	74	75	76	77	77
	95 th	119	120	122	125	128	130	131	78	78	78	78	80	81	81
	95 th +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	69.8	70.9	60.6	61.8	63.8	65.9	68	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
	50 th	105	106	109	111	112	113	113	60	60	62	64	65	66	67
	90 th	119	120	123	126	127	128	129	74	74	75	77	78	79	80
	95 th	123	125	127	130	132	133	134	77	78	79	81	82	83	84
	95 th +12 mmHg	135	137	139	142	144	145	146	89	90	91	93	94	95	96
	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
15	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
	50 th	108	110	112	113	114	114	114	61	62	64	65	66	67	68
	90 th	123	124	126	128	129	130	130	75	76	78	79	80	81	81
	95 th	127	129	131	132	134	135	135	78	79	81	83	84	85	85
	95 th +12 mmHg	139	141	143	144	146	147	147	90	91	93	95	96	97	97
	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
16	50 th	111	112	114	115	115	116	116	63	64	66	67	68	69	69
	90 th	126	127	128	129	131	131	132	77	78	79	80	81	82	82
	95 th	130	131	133	134	135	136	137	80	81	83	84	85	86	86
	95 th +12 mmHg	142	143	145	146	147	148	149	92	93	95	96	97	98	98
	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
	50 th	114	115	116	117	117	118	118	65	66	67	68	69	70	70
17	90 th	128	129	130	131	132	133	134	78	79	80	81	82	82	83
	95 th	132	133	134	135	137	138	138	81	82	84	85	86	86	87
	95 th +12 mmHg	144	145	146	147	149	150	150	93	94	96	97	98	98	99

Table 2: Blood pressure (BP) for girls by age and height percentiles

Age (yrs)	BP percentile	Systolic (mmHg) percentile of height							Diastolic (mmHg) percentile of 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
	50 th	84	85	86	86	87	88	88	41	42	42	43	44	45	46
	90 th	98	99	99	100	101	102	102	54	55	56	56	57	58	58
	95 th	101	102	102	103	104	105	105	59	59	60	60	61	62	62
	95 th +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
	50 th	87	87	88	89	90	91	91	45	46	47	48	49	50	51
	90 th	101	101	102	103	104	105	106	58	58	59	60	61	62	62
	95 th	104	105	106	106	107	108	109	62	63	63	64	65	66	66
	95 th +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
	50 th	88	89	89	90	91	92	93	48	48	49	50	51	53	53
	90 th	102	103	104	104	105	106	107	60	61	61	62	63	64	65
	95 th	106	106	107	108	109	110	110	64	65	65	66	67	68	69
	95 th +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
	50 th	89	90	91	92	93	94	94	50	51	51	53	54	55	55
	90 th	103	104	105	106	107	108	108	62	63	64	65	66	67	67
	95 th	107	108	109	109	110	111	112	66	67	68	69	70	70	71
	95 th +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
	50 th	90	91	92	93	94	95	96	52	52	53	55	56	57	57
	90 th	104	105	106	107	108	109	110	64	65	66	67	68	69	70
	95 th	108	109	109	110	111	112	113	68	69	70	71	72	73	73
	95 th +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
	50 th	92	92	93	94	96	97	97	54	54	55	56	57	58	59
	90 th	105	106	107	108	109	110	111	67	67	68	69	70	71	71
	95 th	109	109	110	111	112	113	114	70	71	72	72	73	74	74
	95 th +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
	50 th	92	93	94	95	97	98	99	55	55	56	57	58	59	60
	90 th	106	106	107	109	110	111	112	68	68	69	70	71	72	72
	95 th	109	110	111	112	113	114	115	72	72	73	73	74	74	75
	95 th +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
	50 th	93	94	95	97	98	99	100	56	56	57	59	60	61	61
	90 th	107	107	108	110	111	112	113	69	70	71	72	72	73	73
	95 th	110	111	112	113	115	116	117	72	73	74	74	75	75	75
	95 th +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
	50 th	95	95	97	98	99	100	101	57	58	59	60	60	61	61
	90 th	108	108	109	111	112	113	114	71	71	72	73	73	73	73
	95 th	112	112	113	114	116	117	118	74	74	75	75	75	75	75
	95 th +12 mmHg	124	124	125	126	128	129	130	86	86	87	87	87	87	87
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
	50 th	96	97	98	99	101	102	103	58	59	59	60	61	61	62
	90 th	109	110	111	112	113	115	116	72	73	73	73	73	73	73
	95 th	113	114	114	116	117	119	120	75	75	76	76	76	76	76
	95 th +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
	50 th	98	99	101	102	104	105	106	60	60	60	61	62	63	64
	90 th	111	112	113	114	116	118	120	74	74	74	74	74	75	75
	95 th	115	116	117	118	120	123	124	76	77	77	77	77	77	77
	95 th +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
	50 th	102	102	104	105	107	108	108	61	61	61	62	64	65	65
	90 th	114	115	116	118	120	122	122	75	75	75	75	76	76	76
	95 th	118	119	120	122	124	125	126	78	78	78	78	79	79	79
13	95 th +12 mmHg	130	131	132	134	136	137	138	90	90	90	90	91	91	91
	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
	50 th	104	105	106	107	108	108	109	62	62	63	64	65	65	66
	90 th	116	117	119	121	122	123	123	75	75	75	76	76	76	76
14	95 th	121	122	123	124	126	126	127	79	79	79	79	80	80	81
	95 th +12 mmHg	133	134	135	136	138	138	139	91	91	91	91	92	92	93
	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
	50 th	105	106	107	108	109	109	109	63	63	64	65	66	66	66
15	90 th	118	118	120	122	123	123	123	76	76	76	76	77	77	77
	95 th	123	123	124	125	126	127	127	80	80	80	80	81	81	82
	95 th +12 mmHg	135	135	136	137	138	139	139	92	92	92	92	93	93	94
	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
16	50 th	105	106	107	108	109	109	109	64	64	64	65	66	67	67
	90 th	118	119	121	122	123	123	124	76	76	76	77	77	78	78
	95 th	124	124	125	126	127	127	128	80	80	80	81	82	82	82
	95 th +12 mmHg	136	136	137	138	139	139	140	92	92	92	93	94	94	94
	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
17	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
	50 th	106	107	108	109	109	110	110	64	64	65	66	66	67	67
	90 th	119	120	122	123	124	124	124	76	76	76	77	78	78	78
	95 th	124	125	125	127	127	128	128	80	80	80	81	82	82	82
	95 th +12 mmHg	136	137	137	139	139	140	140	92	92	92	93	94	94	94
17	Height (in)	60	60.9	62.5	64.2	65.9	67.4	68.4	60	60.9	62.5	64.2	65.9	67.4	68.4
	Height (cm)	152.4	154.7	158.7	163	167.4	171.3	173.7	152.4	154.7	158.7	163	167.4	171.3	173.7
	50 th	107	108	109	110	110	110	111	64	64	65	66	66	66	67
	90 th	120	121	123	124	124	125	125	76	76	77	77	78	78	78
	95 th	125	125	126	127	128	128	128	80	80	80	81	82	82	82
95 th +12 mmHg	137	137	138	139	140	140	140	92	92	92	93	94	94	94	

Table 3: Drugs commonly used for management of hypertension in children

Drug	Mechanism of action	Advice
Atenolol	Beta-adrenoceptor blocker	<ul style="list-style-type: none"> Reduces heart contractility – contraindicated in early stages of hypertensive heart failure Avoid in confirmed asthmatics
Labetalol	Non-cardioselective beta-blocker with additional alpha-blocking properties	<ul style="list-style-type: none"> Combining alpha- and beta-blockade reduces tachycardia that can be a problem without beta-blockade Contraindicated in asthmatics and in heart failure Injection can be given orally
Nifedipine	Calcium channel blocker	<ul style="list-style-type: none"> Can be used in heart failure as any negative inotropic effect offset by a reduction in left ventricular work Side effects vasodilatation: flushing and headache, ankle swelling
Amlodipine	Calcium channel blocker	<ul style="list-style-type: none"> Does not reduce myocardial contractility or produce clinical deterioration in heart failure Side effects vasodilatation: flushing and headache, ankle swelling Tablets disperse in water
Enalapril or Captopril solution for younger children	Angiotensin-converting enzyme (ACE) inhibitor	<ul style="list-style-type: none"> Recommended in children with renal hypertension. First dose should be given at night to prevent transient hypotension In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen Contraindicated in bilateral renal artery stenosis Tablets can be crushed and dispersed in water
Losartan	Angiotensin II receptor blocker	<ul style="list-style-type: none"> In children with impaired renal function, check serum creatinine and potassium 2–3 days after starting treatment and consider withdrawal if they have risen Contraindicated in bilateral renal artery stenosis
Sodium nitro-prusside	Vasodilator	<ul style="list-style-type: none"> Use for hypertensive emergencies Avoid in hepatic or renal impairment Monitor blood cyanide if used >3 days Symptoms of cyanide poisoning (sweating, tachycardia, hyperventilation) see Toxbase