Pediatric Hypertension: Diagnostic Challenges

MICHAEL L. RINKE, MD, PHD

Montefiore Einstein

Disclosures

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Dr. Rinke has no other financial disclosures or conflicts of interest

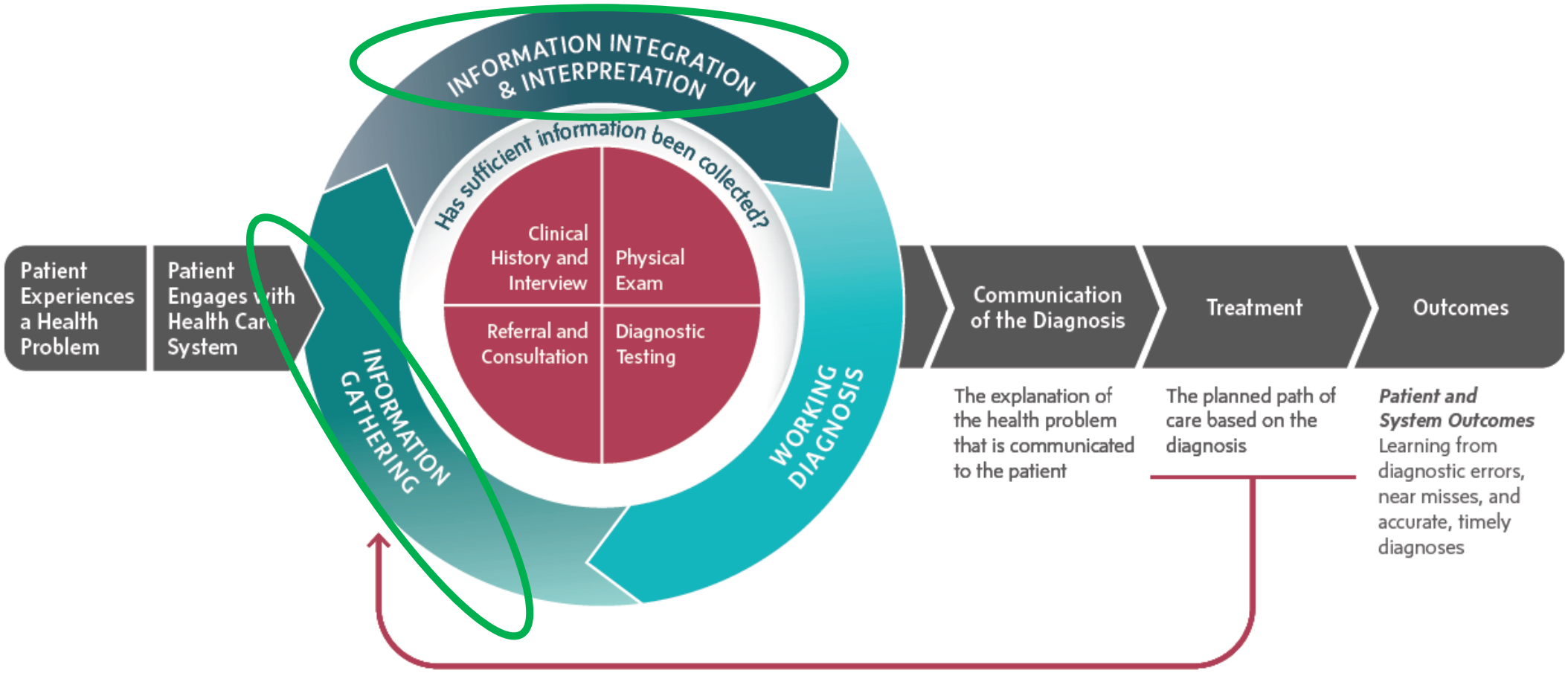
Disclosures (continued)

- Dr. Rinke is supported by, led by, in awe of, and owe everything to an amazing group of motivated, dedicated and energetic colleagues and patients who should all be up here presenting



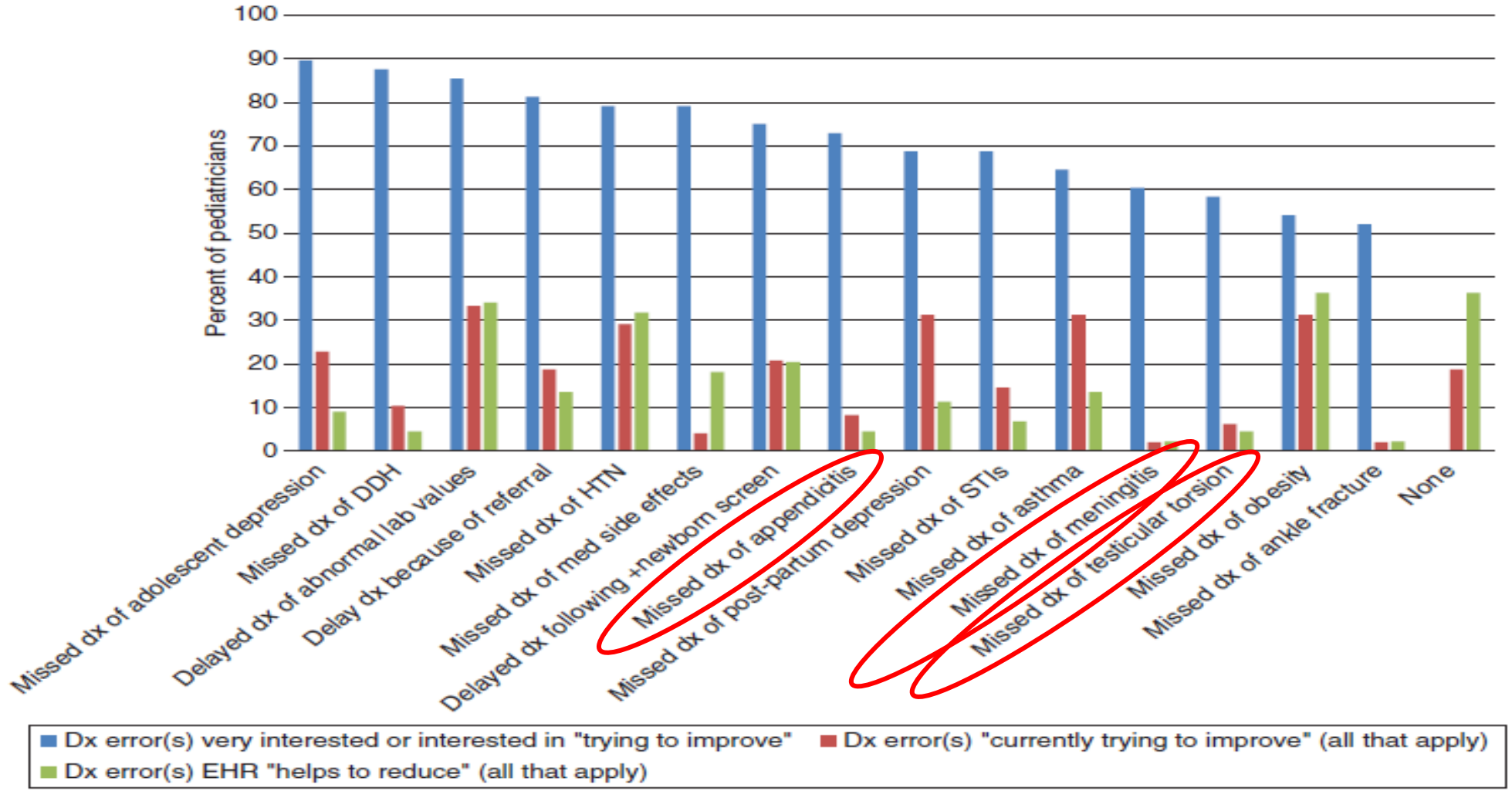
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The Diagnostic Process



IOM Report: Improving Diagnosis in Healthcare 2015

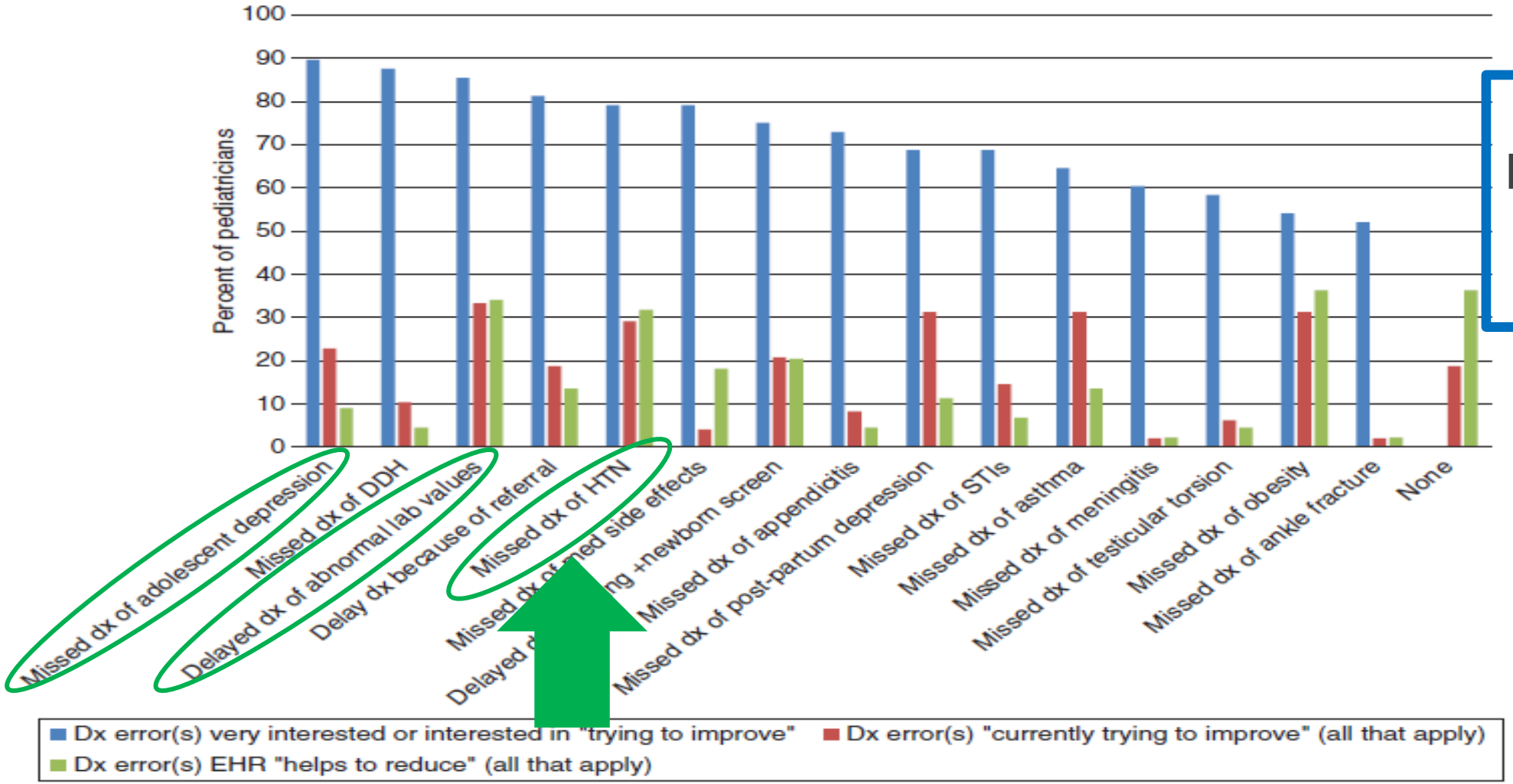
Lesson: Involve your subjects in designing your Diagnostic Error Studies



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Rinke, Bundy et. al 2016

Lesson: Involve your subjects in designing your Diagnostic Error Studies



High Frequency, Sub-acute Errors

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Rinke, Bundy et. al 2016

National QIC



Boosting
Primary
Care
Awareness and
Treatment for
Childhood
Hypertension

To determine whether a quality improvement collaborative without and with subspecialist involvement can improve pediatric hypertension guideline compliance

Hypertension is Common in Children

- 3-5% of children (over 3 million children) have pediatric hypertension
- 39% of children have elevated blood pressure readings at pediatric visits

Patients are Harmed by Missed Hypertension

- Up to 40% of children have left ventricular hypertrophy on diagnosis of hypertension

Cohort	PRE-WORK -3-0 Months	PHASE 1 0-6 Months	PHASE 2 7-12 Months	PHASE 3 13-18 Months	PHASE 4 19-24 Months
1	Pre-QIC data collection	QIC to Improve Local Hypertension Processes + Registry & BP Measurement	QIC with Subspecialist(s) to Improve Communication and Standardize Expectations	Hub and Spoke Co-Management QIC with Primary Care Hypertension Diagnosis and Management	Sustain Changes
2	Pre-QIC data collection	Usual Care + Registry & BP Measurement	QIC to Improve Local Hypertension Processes	QIC with Subspecialist(s) to Improve Communication and Standardize Expectations	Hub and Spoke Co-Management QIC with Primary Care Hypertension Diagnosis and Management

Figure 1: 28 month Collaborative Structure, Winter 2018 through Spring 2021

2017 AAP Guidelines:

FROM THE AMERICAN ACADEMY OF PEDIATRICS | CLINICAL PRACTICE GUIDELINE | SEPTEMBER 01 2017

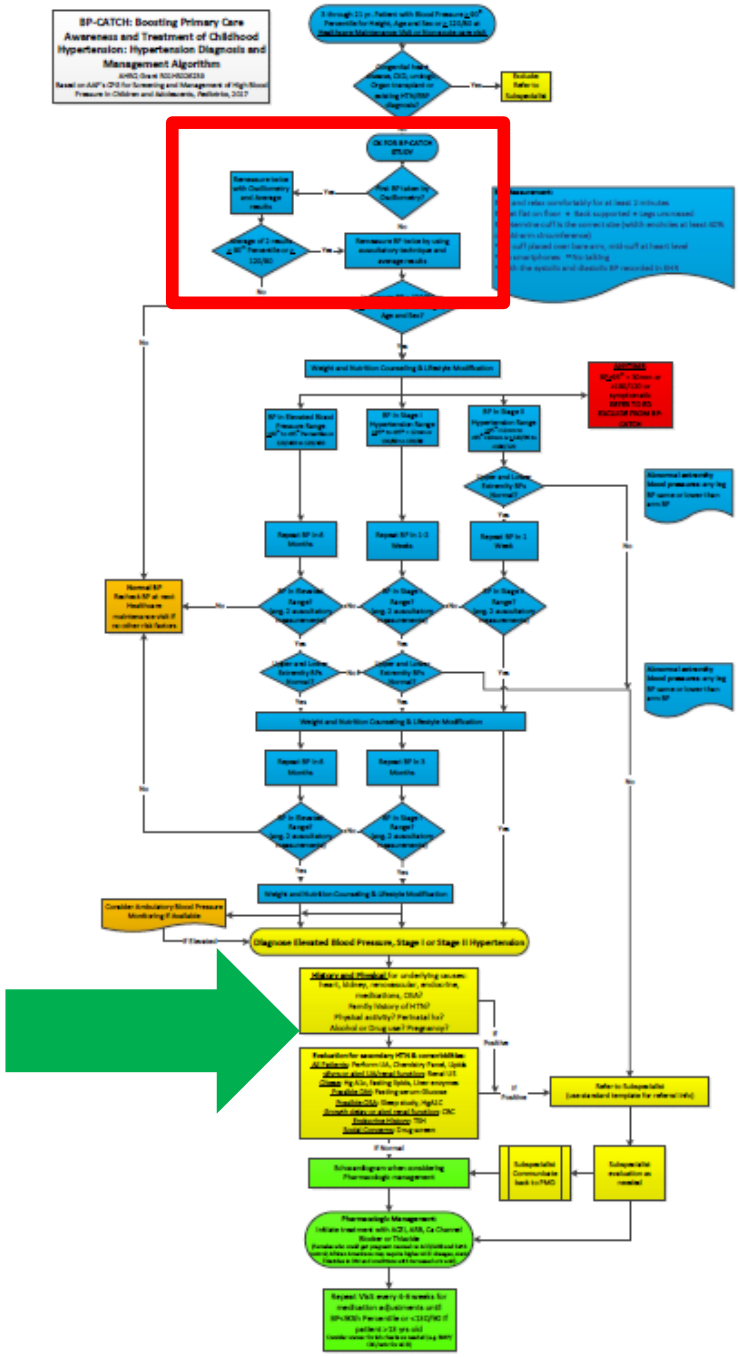
Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD ✉; David C. Kaelber, MD; Carissa M. Baker-Smith, MD; Douglas Blowey, MD; Aaron E. Carroll, MD; Stephen R. Daniels, MD; Sarah D. de Ferranti, MD; Janis M. Dionne, MD; Bonita Falkner, MD; Susan K. Flinn, MA; Samuel S. Gidding, MD; Celeste Goodwin; Michael G. Leu, MD; Makia E. Powers, MD; Corinna Rea, MD; Joshua Samuels, MD; Madeline Simasek, MD; Vidhu V. Thaker, MD; Elaine M. Urbina, MD;
SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

Address correspondence to Joseph T Flynn. Email: joseph.flynn@seattlechildrens.org

- 30 Key Action Steps
- 27 Additional Consensus Recommendations

- At least 30 specific actions needed to be taken to diagnose and treat most straightforward hypertension cases



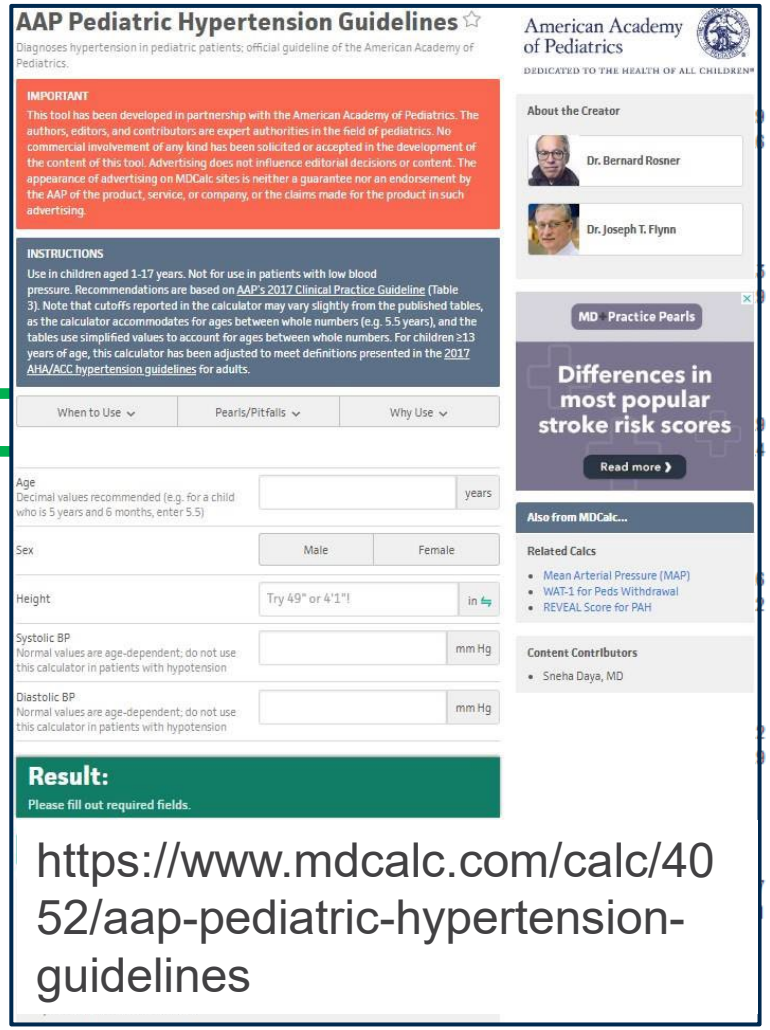
Nurse says, “patient’s blood pressure is high.” What do you say/do?

Is BP actually high?

Sex, Age, Height

TABLE 5 BP Levels for Girls by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)						
		Height Percentile of Measured Height							Height Percentile of 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									43	44	45	46
	90th	98	99									56	57	58	58
	95th	101	102									60	61	62	62
	95th + 12 mm Hg	113	114									72	73	74	74
2	Height (in)	33.4	34									35.9	36.9	37.8	38.4
	Height (cm)	84.9	86.3									91.1	93.7	96	97.4
	50th	87	87									48	49	50	51
	90th	101	101									60	61	62	62
	95th	104	105									64	65	66	66
	95th + 12 mm Hg	116	117									76	77	78	78
3	Height (in)	35.8	36.4									38.4	39.6	40.6	41.2
	Height (cm)	91	92.4									97.6	100.5	103.1	104.6
	50th	88	89									50	51	53	53
	90th	102	103									62	63	64	65
	95th	106	106									66	67	68	69
	95th + 12 mm Hg											78	79	80	81
4	Height (in)	38.3	38.9									41.1	42.4	43.5	44.2
	Height (cm)											104.5	107.6	110.5	112.2
	50th	89	90									53	54	55	55
	90th	103	104									65	66	67	67
	95th	107	108									69	70	70	71
	95th + 12 mm Hg	119	120									81	82	82	83
5	Height (in)	40.8	41.5									43.9	45.2	46.5	47.3
	Height (cm)	103.6	105.3									111.5	114.9	118.1	120
	50th	90	91									55	56	57	57
	90th	104	105									67	68	69	70
	95th	108	109									71	72	73	73
	95th + 12 mm Hg	120	121									83	84	85	85
6	Height (in)	43.3	44									46.6	48.1	49.4	50.3
	Height (cm)	110	111.8									118.4	122.1	125.6	127.7
	50th	92	92									56	57	58	59
	90th	105	106									69	70	71	71
	95th	109	109									72	73	74	74
	95th + 12 mm Hg	121	121									84	85	86	86
7	Height (in)	45.6	46.4									49.2	50.7	52.1	53
	Height (cm)	115.9	117.8									124.9	128.8	132.5	134.7
	50th	92	93									57	58	59	60
	90th	106	106									70	71	72	72
	95th	109	110									73	74	74	75
	95th + 12 mm Hg	121	122									85	86	86	87



https://www.mdcalc.com/calc/4052/aap-pediatric-hypertension-guidelines

Einstein

Nurse says, “patient’s blood pressure is high.” What do you say/do?

Is BP actually high? → Yes → **Is BP measured correctly?**

Sex, Age, Height

Rest for 3-5 Minutes





TABLE 5 BP Levels for Girls by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg) Height Percentile or Measured Height							DBP (mm Hg) Height Percentile or Measured Height						
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	
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	
	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	
	50th	84	85	86	86	87	88	88	41	42	42	43	44	45	
	90th	98	99	99	100	101	102	102	54	55	56	56	57	58	
	95th	101	102	102	103	104	105	105	59	59	60	60	61	62	
	95th + 12 mm Hg	113	114	114	115	116	117	117	71	71	72	72	73	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	
	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	
	50th	87	87	88	89	90	91	91	45	46	47	48	49	50	
	90th	101	101	102	103	104	105	106	58	58	59	60	61	62	
	95th	104	105	106	106	107	108	109	62	63	63	64	65	66	
	95th + 12 mm Hg	116	117	118	118	119	120	121	74	75	75	76	77	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	
	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	
	50th	88	89	89	90	91	92	93	48	48	49	50	51	53	
	90th	102	103	104	104	105	106	107	60	61	61	62	63	64	
	95th	106	106	107	108	109	110	110	64	65	65	66	67	68	
	95th + 12 mm Hg	118	118	119	120	121	122	122	76	77	77	78	79	80	
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	
	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	
	50th	89	90	91	92	93	94	94	50	51	51	53	54	55	
	90th	103	104	105	106	107	108	108	62	63	64	65	66	67	
	95th	107	108	109	109	110	111	112	66	67	68	69	70	70	
	95th + 12 mm Hg	119	120	121	121	122	123	124	78	79	80	81	82	82	
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	
	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	
	50th	90	91	92	93	94	95	96	52	52	53	55	56	57	
	90th	104	105	106	107	108	109	110	64	65	66	67	68	69	
	95th	108	109	109	110	111	112	113	68	69	70	71	72	73	
	95th + 12 mm Hg	120	121	121	122	123	124	125	80	81	82	83	84	85	
6	Height (in)	43.5	44	45.2	46.8	48.1	49.4	50.3	43.5	44	45.2	46.8	48.1	49.4	
	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	
	50th	92	92	93	94	96	97	97	54	54	55	56	57	58	
	90th	105	106	107	108	109	110	111	67	67	68	69	70	71	
	95th	109	109	110	111	112	113	114	70	71	72	72	73	74	
	95th + 12 mm Hg	121	121	122	123	124	125	126	82	83	84	84	85	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	
	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	
	50th	92	93	94	95	97	98	99	55	55	56	57	58	59	
	90th	106	106	107	109	110	111	112	68	68	69	70	71	72	
	95th	109	110	111	112	113	114	115	72	72	73	73	74	74	
	95th + 12 mm Hg	121	122	123	124	125	126	127	84	84	85	85	86	86	

Factor	Increase in Blood Pressure
Talking	7-10 mmHg
Listening	5 mmHg
Crossed Legs	2-8 mmHg
No back support	6-10 mmHg
Arm unsupported	Systolic:1-7 mmHg; Diastolic: 5-11 mmHg
Arm positioned with center of bladder at heart level	Each inch above this level decreases BP by ≥2 mm Hg, and vice versa*
Oscillometric Device	Systolic:10 mmHg; Diastolic:5 mmHg
Distended urinary bladder	10-15 mmHg
Recent caffeine intake	Systolic:10 mmHg; Diastolic:5 mmHg
Recent smoking	Systolic: 6 mmHg; Diastolic:5 mmHg
Cuff over clothing	Systolic: 5-50 mmHg
Cuff too small	Systolic:10 mmHg; Diastolic:2-8 mmHg

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Nurse says, “patient’s blood pressure is high.” What do you say/do?

Is BP actually high? → Yes → **Is BP measured correctly?** → Yes → **Auscultation or Oscillometric?**

Sex, Age, Height

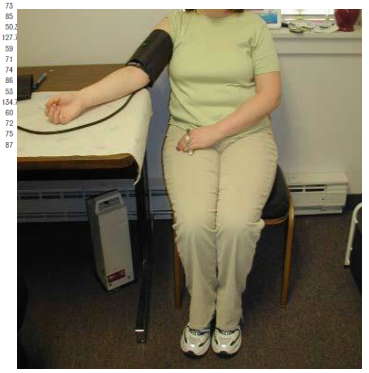
Rest for 3-5 Minutes

Oscillometric inflates 40mmHg above average of last 3 measurements

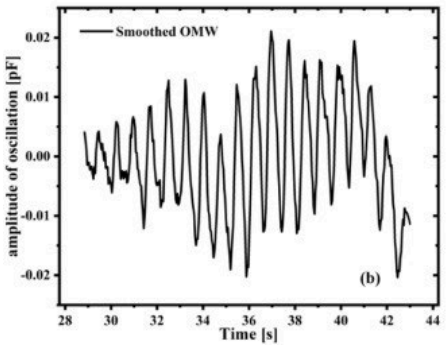
TABLE 5 BP Levels for Girls by Age and Height Percentile

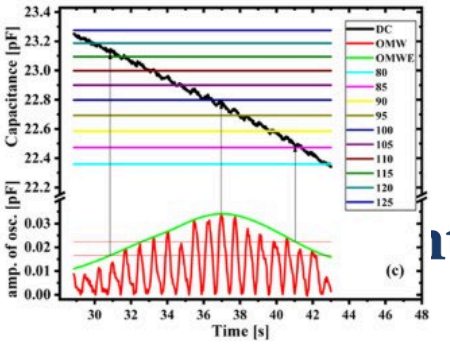
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		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%	75%	90%	95%
1	Height (in)	29.7	30.2	30.9	31.8	32.7	33.4	33.9	29.7	30.2	30.9	31.8			
	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8			
	50th	84	85	86	86	87	88	88	41	42	42	43			
	90th	98	99	99	100	101	102	102	54	55	56	56			
	95th	101	102	102	103	104	105	105	59	59	60	60			
	95th + 12 mm Hg	113	114	114	115	116	117	117	71	71	72	72			
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9			
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1			
	50th	87	87	88	89	90	91	91	45	46	47	48			
	90th	101	101	102	103	104	105	106	58	58	59	60			
	95th	104	105	106	106	107	108	109	62	63	63	64			
	95th + 12 mm Hg	116	117	118	118	119	120	121	74	75	75	76			
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			
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6			
	50th	88	89	89	90	91	92	93	48	48	49	50			
	90th	102	103	104	104	105	106	107	60	61	61	62			
	95th	106	106	107	108	109	110	110	64	65	65	66			
	95th + 12 mm Hg	118	118	119	120	121	122	122	76	77	77	78			
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			
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5			
	50th	89	90	91	92	93	94	94	50	51	51	53			
	90th	103	104	105	106	107	108	108	62	63	64	65			
	95th	107	108	109	109	110	111	112	66	67	68	69			
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	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5			
	50th	90	91	92	93	94	95	96	52	52	53	55			
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	95th	108	109	109	110	111	112	113	68	69	70	71	72	73	73
	95th + 12 mm Hg	120	121	121	122	123	124	125	80	81	82	83	84	85	85
6	Height (in)	43.5	44	45.2	46.6	48.1	49.4	50.3	43.5	44	45.2	46.6	48.1	49.4	50.2
	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 mm Hg	121	121	122	123	124	125	126	82	83	84	84	85	86	86
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	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 mm Hg	121	122	123	124	125	126	127	84	84	85	85	86	86	87

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Cuff over clothing	Systolic: 5-50 mmHg
Cuff too small	Systolic:10 mmHg; Diastolic:2-8 mmHg









Montefiore Einstein

Nurse says, “patient’s blood pressure is high.” What do you say/do?

Is BP actually high? → Yes → **Is BP measured correctly?** → Yes → **Auscultation or Oscillometric?** → Oscillo → **Repeat Twice More and Average**

Sex, Age, Height

Rest for 3-5 Minutes

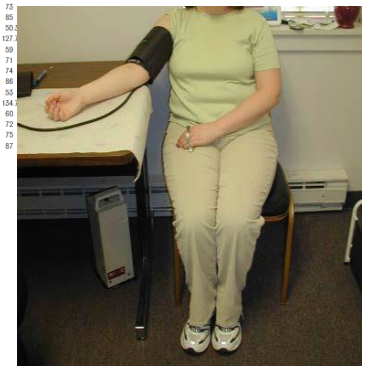
Oscillometric inflates 40mmHg above average of last 3 measurements

Rest for 3-5 Minutes between each one

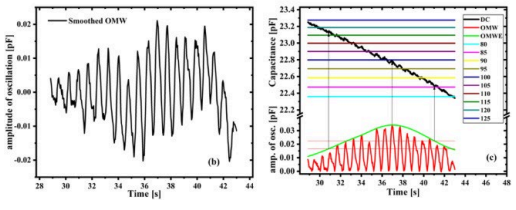
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	50th	84	85	86	86	87	88	88	41	42	42	43
	90th	98	99	99	100	101	102	102	54	55	56	56
	95th	101	102	102	103	104	105	105	59	59	60	60
	95th + 12 mm Hg	113	114	114	115	116	117	117	71	71	72	72
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1
	50th	87	87	88	89	90	91	91	45	46	47	48
	90th	101	101	102	103	104	105	106	58	58	59	60
	95th	104	105	106	106	107	108	109	62	63	63	64
	95th + 12 mm Hg	116	117	118	118	119	120	121	74	75	75	76
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
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6
	50th	88	89	89	90	91	92	93	48	48	49	50
	90th	102	103	104	104	105	106	107	60	61	61	62
	95th	106	106	107	108	109	110	110	64	65	65	66
	95th + 12 mm Hg	118	118	119	120	121	122	122	76	77	77	78
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
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5
	50th	89	90	91	92	93	94	94	50	51	51	53
	90th	103	104	105	106	107	108	108	62	63	64	65
	95th	107	108	109	109	110	111	112	66	67	68	69
	95th + 12 mm Hg	119	120	121	121	122	123	124	78	79	80	81
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
	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5
	50th	90	91	92	93	94	95	96	52	52	53	55
	90th	104	105	106	107	108	109	110	64	65	66	67
	95th	108	109	109	110	111	112	113	68	69	70	71
	95th + 12 mm Hg	120	121	121	122	123	124	125	80	81	82	83
6	Height (in)	43.5	44	45.2	46.6	48.1	49.4	50.5	43.5	44	45.2	46.6
	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4
	50th	92	92	93	94	96	97	97	54	54	55	56
	90th	105	106	107	108	109	110	111	67	67	68	69
	95th	109	109	110	111	112	113	114	70	71	72	72
	95th + 12 mm Hg	121	121	122	123	124	125	126	82	83	84	84
7	Height (in)	45.6	46.4	47.7	49.2	50.7	52.1	53	45.6	46.4	47.7	49.2
	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9
	50th	92	93	94	95	97	98	99	55	55	56	57
	90th	106	106	107	109	110	111	112	68	68	69	70
	95th	109	110	111	112	113	114	115	72	72	73	73
	95th + 12 mm Hg	121	122	123	124	125	126	127	84	84	85	85

Factor	Increase in Blood Pressure
Talking	7-10 mmHg
Listening	5 mmHg
Crossed Legs	2-8 mmHg
No back support	6-10 mmHg
Arm unsupported	Systolic:1-7 mmHg; Diastolic: 5-11 mmHg
Arm positioned with center of bladder at heart level	Each inch above this level decreases BP by ≥2 mm Hg, and vice versa*
Oscillometric Device	Systolic:10 mmHg; Diastolic:5 mmHg
Distended urinary bladder	10-15 mmHg
Recent caffeine intake	Systolic:10 mmHg; Diastolic:5 mmHg
Recent smoking	Systolic: 6 mmHg; Diastolic:5 mmHg
Cuff over clothing	Systolic: 5-50 mmHg
Cuff too small	Systolic:10 mmHg; Diastolic:2-8 mmHg







Montefiore Einstein

Nurse says, “patient’s blood pressure is high.” What do you say/do?

Is BP actually high? → Yes → **Is BP measured correctly?** → Yes → **Auscultation or Oscillometric?** → Oscillo → **Repeat Twice More and Average**

Sex, Age, Height

Rest for 3-5 Minutes

Oscillometric inflates 40mmHg above average of last 3 measurements

Rest for 3-5 Minutes between each one

Auscultation

Repeat Twice More and Average

Rest for 3-5 Minut… between each or…

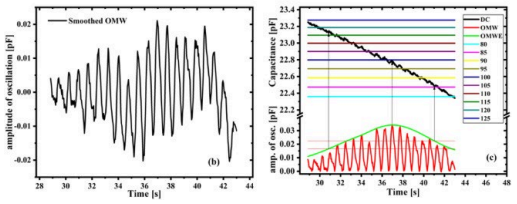
Return for repeat measur-ements in 1-12 weeks

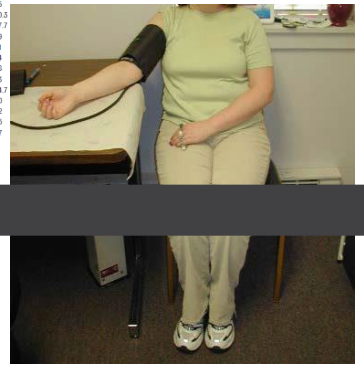
TABLE 5 BP Levels for Girls by Age and Height Percentile

Age (y)	BP Percentile	SBP (mm Hg)							DBP (mm Hg)			
		Height Percentile or Measured Height							Height Percentile or Measu			
		5%	10%	25%	50%	75%	90%	95%	5%	10%	25%	50%
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
	Height (cm)	75.4	76.6	78.6	80.8	83	84.9	86.1	75.4	76.6	78.6	80.8
	50th	84	85	86	86	87	88	88	41	42	42	43
	90th	98	99	99	100	101	102	102	54	55	56	56
	95th	101	102	102	103	104	105	105	59	59	60	60
	95th + 12 mm Hg	113	114	114	115	116	117	117	71	71	72	72
2	Height (in)	33.4	34	34.9	35.9	36.9	37.8	38.4	33.4	34	34.9	35.9
	Height (cm)	84.9	86.3	88.6	91.1	93.7	96	97.4	84.9	86.3	88.6	91.1
	50th	87	87	88	89	90	91	91	45	46	47	48
	90th	101	101	102	103	104	105	106	58	58	59	60
	95th	104	105	106	106	107	108	109	62	63	63	64
	95th + 12 mm Hg	116	117	118	118	119	120	121	74	75	75	76
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
	Height (cm)	91	92.4	94.9	97.6	100.5	103.1	104.6	91	92.4	94.9	97.6
	50th	88	89	89	90	91	92	93	48	48	49	50
	90th	102	103	104	104	105	106	107	60	61	61	62
	95th	106	106	107	108	109	110	110	64	65	65	66
	95th + 12 mm Hg	118	118	119	120	121	122	122	76	77	77	78
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
	Height (cm)	97.2	98.8	101.4	104.5	107.6	110.5	112.2	97.2	98.8	101.4	104.5
	50th	89	90	91	92	93	94	94	50	51	51	53
	90th	103	104	105	106	107	108	108	62	63	64	65
	95th	107	108	109	109	110	111	112	66	67	68	69
	95th + 12 mm Hg	119	120	121	121	122	123	124	78	79	80	81
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
	Height (cm)	103.6	105.3	108.2	111.5	114.9	118.1	120	103.6	105.3	108.2	111.5
	50th	90	91	92	93	94	95	96	52	52	53	55
	90th	104	105	106	107	108	109	110	64	65	66	67
	95th	108	109	109	110	111	112	113	68	69	70	71
	95th + 12 mm Hg	120	121	121	122	123	124	125	80	81	82	83
6	Height (in)	43.3	44	45.2	46.6	48.1	49.4	50.3	43.3	44	45.2	46.6
	Height (cm)	110	111.8	114.9	118.4	122.1	125.6	127.7	110	111.8	114.9	118.4
	50th	92	92	93	94	96	97	97	54	54	55	56
	90th	105	106	107	108	109	110	111	67	67	68	69
	95th	109	109	110	111	112	113	114	70	71	72	72
	95th + 12 mm Hg	121	121	122	123	124	125	126	82	83	84	84
7	Height (in)	45.6	46.4	47.7	49.2	50.7	52.1	53	45.6	46.4	47.7	49.2
	Height (cm)	115.9	117.8	121.1	124.9	128.8	132.5	134.7	115.9	117.8	121.1	124.9
	50th	92	[illegible]	94	95	97	98	99	55	55	56	57
	90th	106	[illegible]	108	109	110	111	112	68	68	69	70
	95th	109	[illegible]	111	112	113	114	115	72	72	73	73
	95th + 12 mm Hg	121	[illegible]	123	124	125	126	127	84	84	85	85

Factor	Increase in Blood Pressure
Talking	7-10 mmHg
Listening	5 mmHg
Crossed Legs	2-8 mmHg
No back support	6-10 mmHg
Arm unsupported	Systolic:1-7 mmHg; Diastolic: 5-11 mmHg
Arm positioned with center of bladder at heart level	Each inch above this level decreases BP by ≥2 mm Hg, and vice versa*
Oscillometric Device	Systolic:10 mmHg; Diastolic:5 mmHg
Distended urinary bladder	10-15 mmHg
Recent caffeine intake	Systolic:10 mmHg; Diastolic:5 mmHg
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Cuff over clothing	Systolic: 5-50 mmHg
Cuff too small	Systolic:10 mmHg; Diastolic:2-8 mmHg







Montefiore Einstein

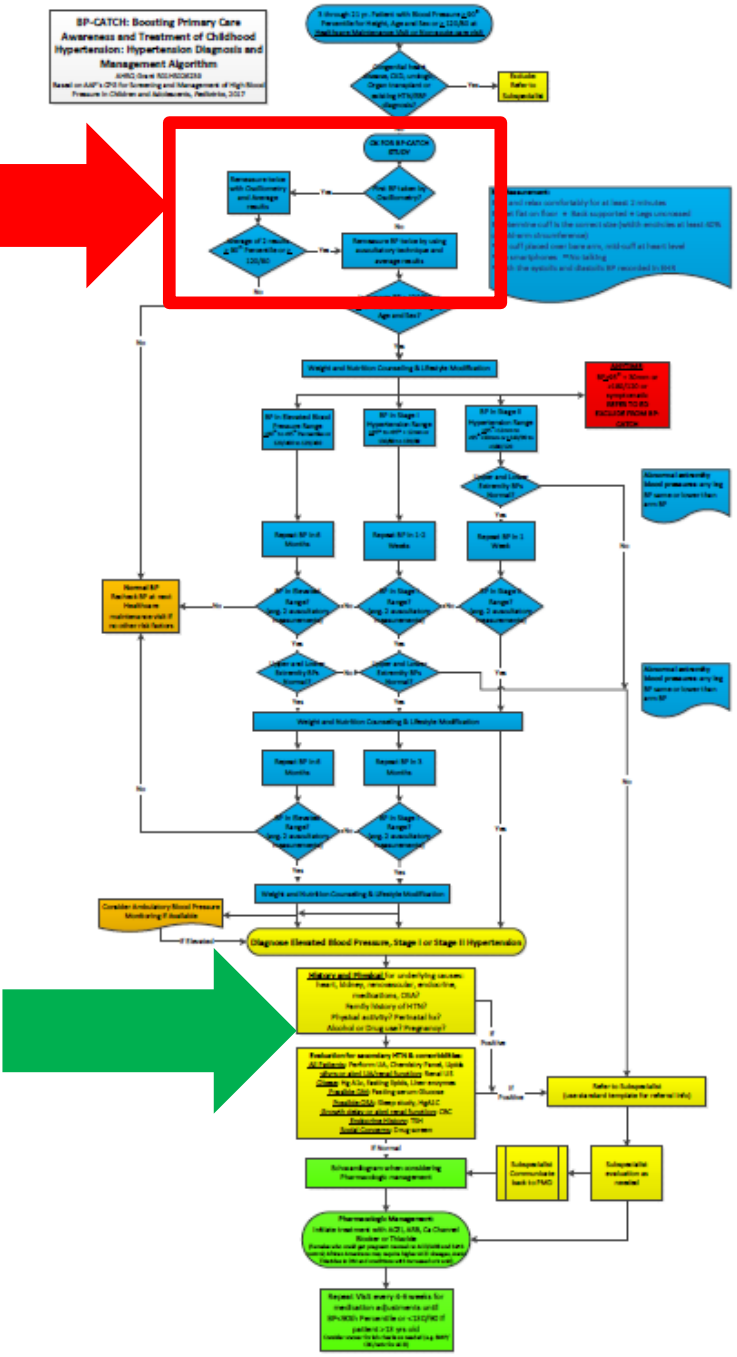
2017 AAP Guidelines:

FROM THE AMERICAN ACADEMY OF PEDIATRICS | CLINICAL PRACTICE GUIDELINE | SEPTEMBER 01 2017

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

Joseph T. Flynn, MD ✉; David C. Kaelber, MD; Carissa M. Baker-Smith, MD; Douglas Blowey, MD; Aaron E. Carroll, MD; Stephen R. Daniels, MD; Sarah D. de Ferranti, MD; Janis M. Dionne, MD; Bonita Falkner, MD; Susan K. Flinn, MA; Samuel S. Gidding, MD; Celeste Goodwin; Michael G. Leu, MD; Makia E. Powers, MD; Corinna Rea, MD; Joshua Samuels, MD; Madeline Simasek, MD; Vidhu V. Thaker, MD; Elaine M. Urbina, MD;
SUBCOMMITTEE ON SCREENING AND MANAGEMENT OF HIGH BLOOD PRESSURE IN CHILDREN

Address correspondence to Joseph T Flynn. Email: joseph.flynn@seattlechildrens.org

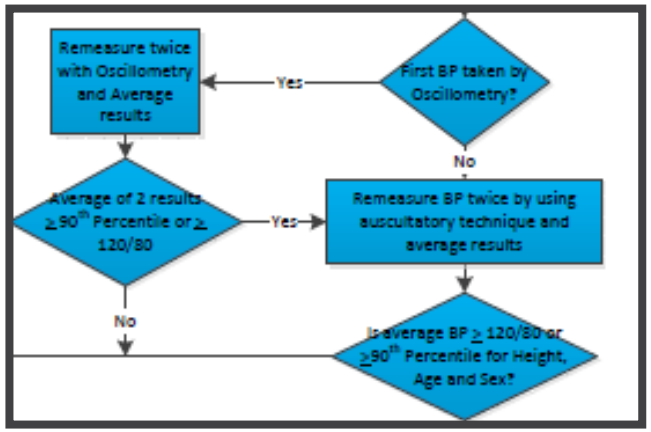


- 30 Key Action Steps
- 27 Additional Consensus Recommendations

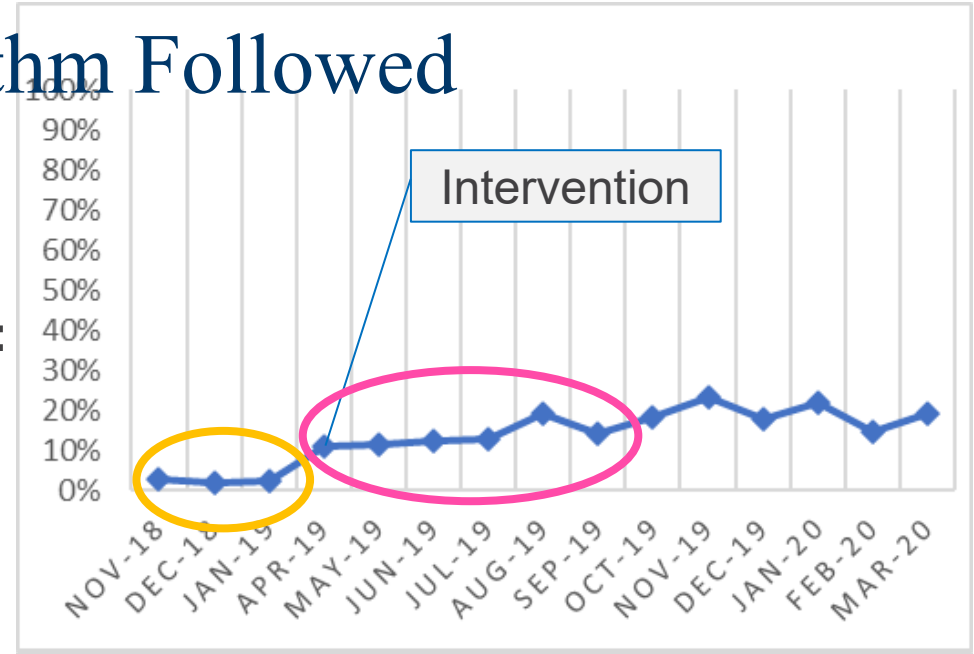
- At least 30 specific actions needed to be taken to diagnose and treat most straightforward hypertension cases

OUR BEST MEASURE:
12 Months Intervention:
BP Measurement Algorithm Followed

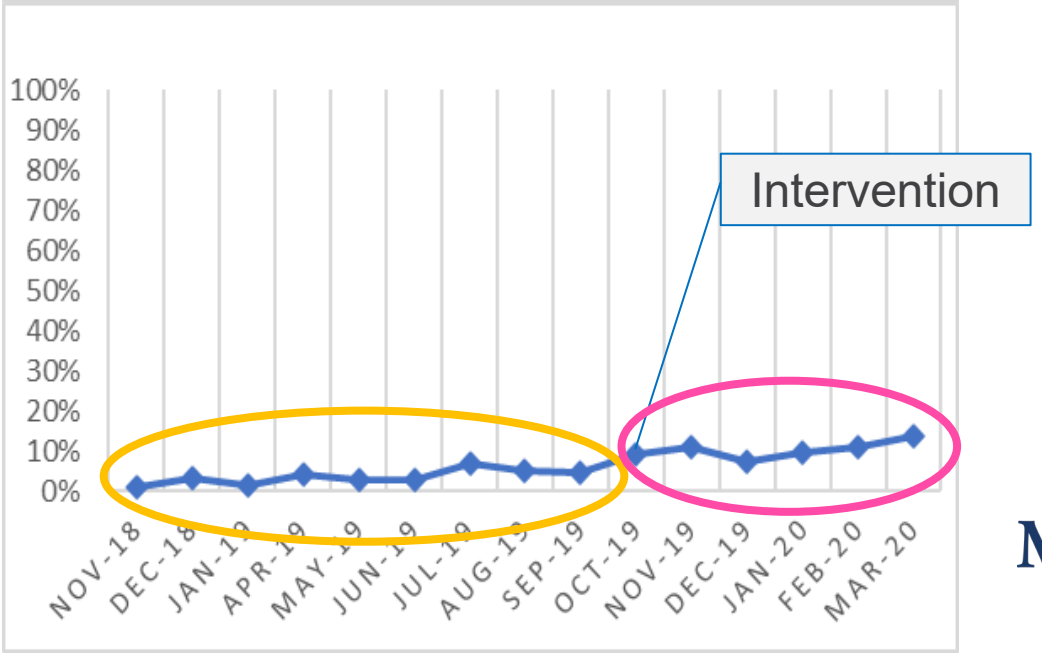
Boosting Primary Care Awareness and Treatment for Childhood Hypertension



Cohort 1: N=4424



Cohort 2: N=4679



Cohort	PRE-WORK -3-0 Months	PHASE 1 0-6 Months	PHASE 2 7-12 Months	PHASE 3 13-18 Months	PHASE 4 19-24 Months
1	Pre-QIC data collection	QIC to Improve Local Hypertension Processes + Registry & BP Measurement	QIC with Subspecialist(s) to Improve Communication and Standardize Expectations	Hub and Spoke Co-Management QIC with Primary Care Hypertension Diagnosis and Management	Sustain Changes
2	Pre-QIC data collection	Usual Care + Registry & BP Measurement	QIC to Improve Local Hypertension Processes	QIC with Subspecialist(s) to Improve Communication and Standardize Expectations	Hub and Spoke Co-Management QIC with Primary Care Hypertension Diagnosis and Management

Figure 1: 28 month Collaborative Structure, Winter 2018 through Spring 2021

Baseline 3%
Intervention 11.6%
RD 6.3
95% CI (4.5, 8)

Lesson: Statistical significance does not equal clinical significance

Montefiore Einstein

	Baseline			Intervention			Elevated Intervention			Estimated Percent Improvement/RD in Regression Model: Intervention vs. Baseline		Elevated Intervention vs. Baseline		Elevated Intervention vs. Intervention-	
	Criteria Met	N	%	Criteria Met	N	%	Criteria Met	N	%	RD	95%CI	RD	95%CI	RD	95%CI
BP Algorithm followed	141	4738	3	402	3475	11.6	260	1368	19	**6.3**	**(4.5,8.0)**	**12.2**	**(9.2,15.1)**	**5.9**	**(3.5,8.4)**
Recommended counseling	2142	4118	52	1561	2778	56.2	571	1094	52.2	0.01	(-4.1, 4.2)	-0.27	(-7.1,6.5)	-0.33	(-4.6,4.0)
3 Extremity BP Performed	1	844	0.1	3	605	0.5	3	219	1.4	0.4	(-0.23, 1.0)	1.2	(-0.3,2.8)	0.9	(-0.8,2.5)
PCP Follow Up Recommended	373	3758	9.9	338	2505	13.5	183	1009	18.1	1.4	(-1.4, 4.1)	3.5	(-1.1,8.1)	2.2	(-1.0,5.3)
Stage 2 PCP Follow up Scheduled	5	110	4.5	4	69	5.8	3	20	15	-0.5	(-6.7, 5.8)	11.7	(-5.2,28.5)	12.2	(-4.7, 29.0)
Stage 1/EBP Follow up Scheduled	144	2809	5.1	160	1847	8.7	106	768	13.8	1.2	(-1.2, 3.7)	4.7	(0.5,8.9)	3.5	(0.4,6.5)
Diagnosis of Stage 2 HTN Documented**	2	28	7.1	3	11	27.3	2	3	66.7	N/A*	N/A*	59.5	(1.5,117.6)	39.4	(-24.3, 103.1)
Diagnosis of Stage 1 HTN Documented**	12	111	10.8	17	87	19.5	5	24	20.8	N/A**	N/A**	26.3	(-3.6,56.2)	7.0	(-15.4, 29.5)
Diagnosis of EBP HTN	24	235	10.2	40	177	22.6	12	59	20.3	N/A**	N/A**	7.5	(-10.8, 25.7)	-2.9	(-16.5, 10.8)
			1.8	2	206	1	5	65	7.7	N/A**	N/A**	9.5	(1.1,17.8)	8.1	(11.9,15)

Risk Difference

Enough Data not available to compile data

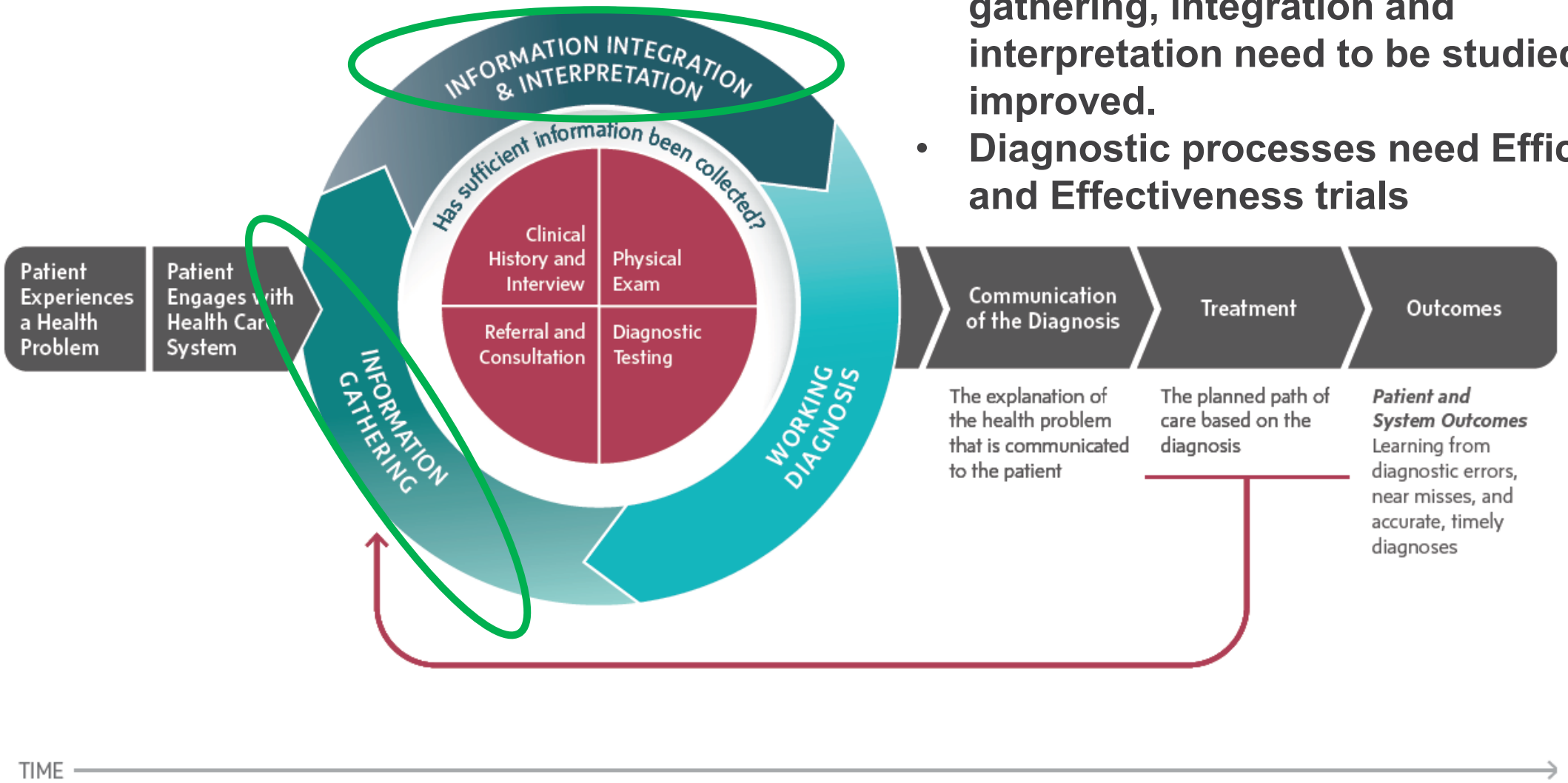
Lesson: Guidelines need to keep reality in mind

Boosting Primary Care Awareness and Treatment for Childhood Hypertension

Einstein

The Diagnostic Process

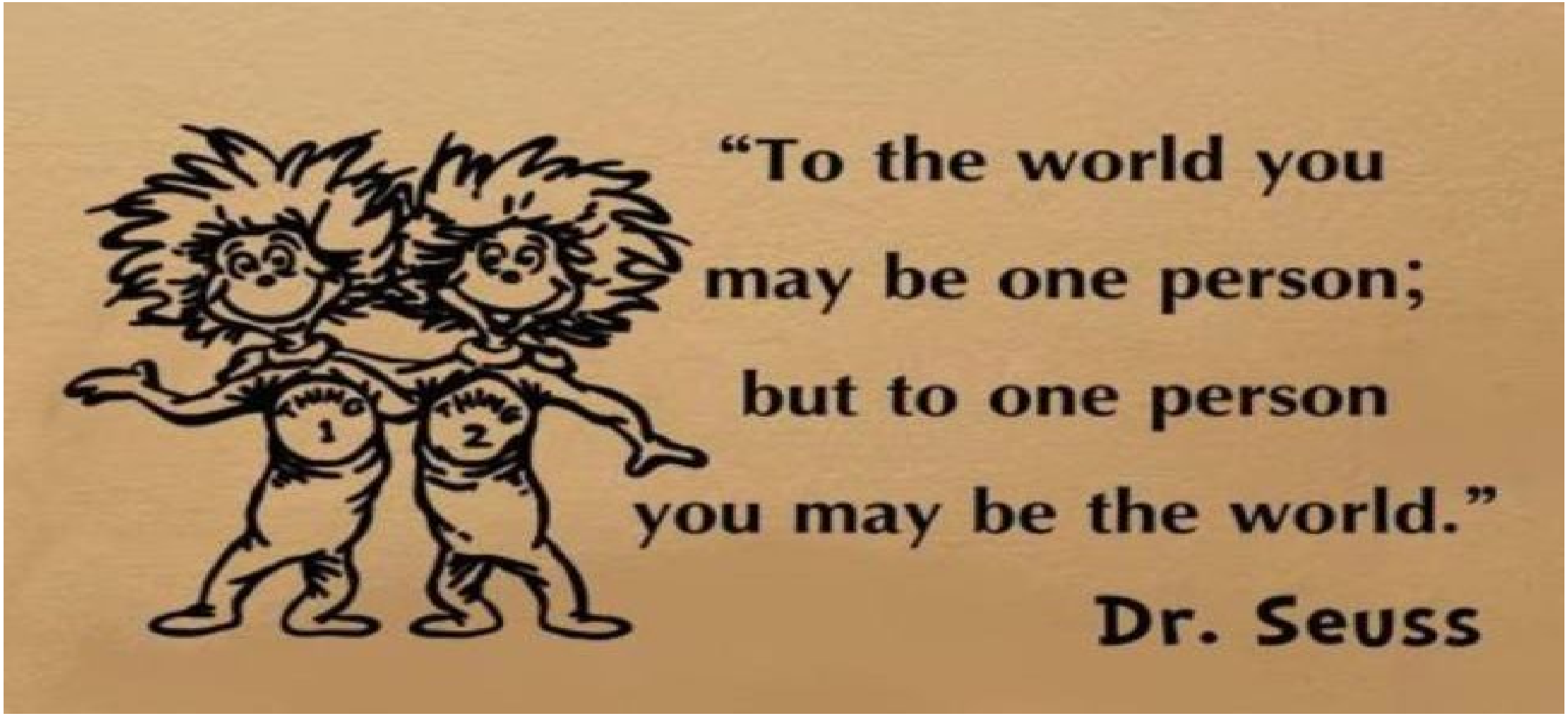
- **Diagnostic tools for information gathering, integration and interpretation need to be studied and improved.**
- **Diagnostic processes need Efficacy and Effectiveness trials**



IOM Report: Improving Diagnosis in Healthcare 2015

Thank you and Questions

Boosting Primary Care Awareness and Treatment for Childhood Hypertension



Montefiore Einstein