**HYPERTENSION**  
*Screening, Evaluation, Treatment*  
LPCH Division of General Pediatrics, 2011

**SCREENING**

- All children ≥ 3 years at all medical visits
- Children < 3 years with risk factors or underlying conditions, e.g. premature birth, heart disease, recurrent UTIs, renal disease or family h/o renal disease, neurofibromatosis, tuberous sclerosis

<table>
<thead>
<tr>
<th>Systolic or Diastolic BP</th>
<th>Classification</th>
<th>Follow up after initial high reading</th>
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<tbody>
<tr>
<td>90&lt;sup&gt;th&lt;/sup&gt; to &lt;95&lt;sup&gt;th&lt;/sup&gt; %ile (or ≥120/80)</td>
<td>Prehypertension:</td>
<td>Recheck 6 months</td>
</tr>
<tr>
<td>BP &gt; 95&lt;sup&gt;th&lt;/sup&gt; %ile on 3 or more occasions:</td>
<td>Hypertension:</td>
<td></td>
</tr>
</tbody>
</table>
| 95<sup>th</sup> to 99<sup>th</sup> %ile + 5 mm Hg | Stage 1 | Repeat every 1-2 weeks x 3 in clinic  
Log Ambulatory Blood Pressure Monitoring (local drug store, home BP cuff if available) |
| >99<sup>th</sup> %ile + 5 mm Hg | Stage 2 | Refer to nephrology within 1 week or immediately if patient is symptomatic |

**Blood pressure percentile calculator** (Baylor College of Medicine)

**Blood pressure tables** (HTML)

**EVALUATION**

Identify underlying causes, complications of HTN

**MONSTER mnemonic** *(Feld and Corey, Pediatrics in Review, 2007)*

- Medications
- Obesity
- Neonatal history
- Symptoms and Signs
- Trends in the family
- Endocrine
- Renal
## Evaluation

<table>
<thead>
<tr>
<th>Condition</th>
<th>Suggested Evaluation</th>
<th>Notes</th>
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</table>
| All children with BP > 90\(^{th}\) %ile for age and height | BMI  
BP in both arms and one leg  
Thorough history, including sleep history, OSA  
Family history  
Risk factors: diet, smoking, alcohol  
Medications: NSAIDs, hormones (OCP), cough/cold products, CAM, anabolic steroids | If OSA – evaluate for RV hypertrophy |
| All children with Stage 1 HTN (BP > 95\(^{th}\) %ile)   | BUN, CR  
Electrolytes  
UA | If low K plasma renin, aldosterone  
Renal US and refer to nephrology for hematuria, proteinuria, casts |
| All children with Stage 2 HTN (BP > 99\(^{th}\) %ile + 5mm) | Refer to nephrology                                                                                       |                                                                      |
| Pre-school children with Stage 1 HTN          | Refer to nephrology                                                                                       |                                                                      |
| Adolescents                          | Uric Acid                                                                                                 | Uric acid > 5.5 mg/dL: Positive Predictive Value 89% for essential HTN  
Uric acid < 5: Negative Predictive Value 96% |
| Overweight/Obese                    | Fasting lipid panel (age 2+)  
Fasting lipids, glucose, AST, ALT (age 10+)                                                             |                                                                      |

Also consider: CBC (may suggest chronic renal disease); Renal US (if history, exam, or labs suggest renal disease); ECHO, retinal exam, drug screen, sleep study, evaluation for pheochromocytoma
TREATMENT

Non-pharmacologic approaches

- Weight Reduction
- Physical activity (Takata, 2003)
  - 90 minutes/week.
  - All at once or divided
  - Emphasize cardio/aerobic.
  - Get HR ↑, resp effort ↑. Get a little sweaty
  - NOTE: Weight training and Stage 2 hypertension: NO power lifting. If unable do 10 reps, the weight is too heavy

- Diet
  - Avoid excessive salt
  - Eat more fruits and vegetables
  - Whole grains
  - Fat-free, low fat dairy
  - Poultry, fish
  - Nuts, seeds, legumes
  - Stress reduction

- Avoid pressors (caffeine, pseudoephedrine)

Indications for Pharmacologic Therapy

<table>
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<tr>
<th>Prehypertension</th>
<th>Pharmacologic therapy indicated only in context of other conditions (e.g. DM, chronic renal disease, LVH, CHF)</th>
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</table>
| Stage 1 hypertension | Indicated for:  
  - Persistent BP > 95th%ile despite non-pharmacologic measures  
  - Symptomatic hypertension  
  - Secondary hypertension  
  - Hypertensive target-organ damage  
  - Diabetes (types 1 and 2)  |
| Stage 2 hypertension | All patients with Stage 2 hypertension  
Refer to nephrology |

Guidelines for Pharmacologic Therapy

- Goal: reduction of BP < 95th%ile.
  With concurrent conditions, reduction to < 90th%ile.
- Initiate with single drug
- May take 1-2 months to get BP under control
- Drug options:
  - Thiazides: consider in teens or obese children with hypertension
  - Chlorthalidone: given daily (25mg Q daily for teens)
  - β-blockers: consider in anxious or high catecholamine kids
    - Propranolol XL
    - Metoprolol XL
REFERENCES AND RESOURCES:


Annotated bibliography:

Solomon, Patient-, Provider-, and Clinic-Level Predictors of Unrecognized Elevated Blood Pressure in Children Pediatrics 2010;125;e1286-e1293; originally published online May 3, 2010; Brady, 2000 children screened. BP> 90% in 39% of cases. But only 17% were recognized. Absence of risk factors decreased likelihood of identifying elevated BP.

Daniel I. Feig; Richard J. Johnson , Hyperuricemia in Childhood Primary Hypertension Hypertension 2003;42:247-252
Among adolescents referred for evaluation of hypertension, a serum uric acid > 5.5 mg/dL had an 89% positive predictive value for essential hypertension, whereas a serum uric acid level of less than < 5.0 mg/dL had a negative predictive value for essential hypertension of 96%

Kapur, M. Ahmed, M, Secondary Hypertension in Overweight and Stage 1 Hypertensive Children The *Journal of Clinical Hypertension* Jan 2010 vol 12 no 1 G.
246 children with hypertension screened. 15 had 2° HTN (6%). Of those 8 patients with renal scarring, 5 patients with renal artery stenosis, 1 patient with pheochromocytoma, and 1 patient with juxtagranular cell tumor. Therefore 94% of patients did not have secondary HTN.

Crox & Feig, Childhood hypertension is not a silent disease *Ped. Nephr* 2006; 21: 527-532
Hypertension is more symptomatic than you think: 150 normal children administered quality of life questionnaire:26% symptomatic. 409 consecutive children seen in hypertension clinic - 64% symptomatic. Questionnaire repeated after blood pressure control: symptoms decreased to 28% (headache, difficulty initiating sleep, daytime tiredness)

Adams, Learning and Attention Problems Among Children With Pediatric Primary Hypertension *Pediatrics* Nov. 8, 2010 (doi:10.1542/peds.2010-1899)
201 children ages 10 to 18 . Those with high blood pressure were four times as likely to have learning disabilities, including ADHD, as children with normal blood pressure.

Paul C. Grimm, MD LPCH Grand Rounds 2010
Pediatric Hypertension. Selected Management Issues

Carrie Loutit, MD Hypertension Practice Guideline, Division of General Pediatrics 2011

ICD-9 Codes
- Hypertension 401.9
- Elevated blood pressure reading w/o hypertension 796.2
- Overweight 278.02
- Obesity 278.00
- Morbid obesity 278.01
- Obstructive sleep apnea 327.23