Recognition of Elevated Blood Pressure in an Outpatient Pediatric Tertiary Care Setting

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Objective To assess the prevalence of elevated blood pressure (BP) and its identification among outpatients at a pediatric tertiary care hospital and to assess clinician attitudes towards BP management.

Study design A retrospective review was undertaken of electronic medical record data of visits over the course of 1 year to 10 subspecialty divisions and 3 primary care services at an urban tertiary care hospital. Interviews of division/service representatives and a clinician survey on perceived role on BP care, practices, and protocols related to BP management were conducted. Elevated BP was defined as ≥90th percentile (using US references); identification of elevated BP was defined as the presence of appropriate codes in the problem list or visit diagnoses.

Results Among 29 000 patients (ages 2-17 years), 70% (those with ≥1 BP measurement) were analyzed. Patients were as follows: 50% male; 42% white, 31% Hispanic, 16% black, 5% Asian, and 5% other/missing; 52% had Medicaid insurance. A total of 64% had normal BPs, 33% had 1-2 elevated BP measurements, and 3% had ≥3 elevated BP measurements. Among those with ≥3 elevated BP measurements, the median frequency of identification by division/service was 17%; the greatest identification was for Kidney Diseases (67%), Wellness & Weight Management (60%), and Cardiology (33%). Among patients with ≥3 elevated BP measurements, 21% were identified vs 7% identified among those with 1-2 increased measurements ($P < .001$). All clinician survey respondents perceived self-responsibility for identification of elevated BP, but opinions varied for their role in the management of elevated BP.

Conclusions The identification of patients with elevated BP measurements was low. Strategies to increase the identification of elevated BPs in outpatient tertiary care settings are needed. *(J Pediatr 2015;166:1233-9)*.

The prevalence of elevated blood pressure (BP) among children has been increasing in conjunction with the increased prevalence of obesity epidemic.[1,2] The health risks associated with elevated BP in childhood include an increased risk of left ventricular hypertrophy,[3,4] reduced arterial compliance in childhood and early adulthood,[5,6] and impaired cognitive performance.[7,8] In addition, having sustained elevated BP in childhood represents an increased risk of hypertension[9] and atherosclerosis in adulthood.[10]

Comprehensive guidelines from a National Heart, Lung, and Blood Institute (NHLBI) Expert Panel outline the identification, evaluation, and management of elevated BP in children and reinforce previous recommendations.[11,12] These guidelines call for routine measurement and interpretation of BP in children age ≥3 years. In pediatric primary care, BP is measured at 67%-80% of visits.[13,14] There are few studies in which authors investigated the frequency of BP measurements in pediatric subspecialty care. A study of National Ambulatory Medical Care Survey data showed that, during preventive visits, pediatric subspecialists were less likely to screen for hypertension than primary care pediatricians.[14] Although BP frequently is measured in primary care, elevated measurements often are not recognized. In outpatient pediatric primary care, 17%-26% of children with elevated BP were recognized as having elevated BP.[13,15] In the inpatient setting, only 10% of inpatient children with a BP ≥95th percentile had a notation about elevated BP in the medical record.[16] We are not aware of any studies in which authors investigated the identification rates of elevated

BMI	Body mass index
BP	Blood pressure
EMR	Electronic medical record
ICD-9	*International Classification of Disease, 9th Revision*
NHLBI	National Heart, Lung, and Blood Institute

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BP in an outpatient pediatric subspecialty care setting. We conducted studies to determine the rates of identification of children with elevated BP. Study 1 assessed the prevalence and identification of elevated BP among outpatients presenting to subspecialty and primary care clinicians at sites of care owned by an urban tertiary referral hospital. This study also investigated clinician attitudes toward identifying and managing patients with elevated BP. Study 2 was conducted to provide a more in-depth look at the recognition of elevated BP in the primary care setting. Specifically, Study 2 assessed the prevalence and factors associated with identification of BP ≥95th percentile.

Methods

Study 1

Study 1 components were an anonymous data download from the electronic medical record (EMR), subspecialty divisions and primary care services physician representative interviews, and an online clinician survey. This study was approved by the Ann & Robert H. Lurie Children's Hospital of Chicago Institutional Review Board.

Pediatric divisions were recruited for participation by contacting a division member. All contacted divisions responded affirmatively, with gastroenterology division participation limited to the hepatology section. Although we did not invite surgical divisions to participate, one (otolaryngology) volunteered to participate because of shared research interests. Eight divisions participated: Allergy & Immunology; Cardiology; Endocrinology; Hematology/Oncology & Stem Cell Transplant; Kidney Diseases; Pulmonology; Rheumatology; and Otolaryngology/Head & Neck Surgery. Six services participated: Hepatology; Sports Medicine; Adolescent Medicine; Wellness & Weight Management Program; and 2 primary care locations (Site 1, a pediatric resident continuity clinic, and Site 2, a clinic providing resident continuity clinic experience and independent pediatrician-provided care, particularly for children with complex medical conditions).

Visits by outpatients (age 2-17 years) between November 1, 2010, and October 31, 2011, in participating divisions and services were included in the data download. Guidelines recommend annual screening of BP starting at age 3 years.[11] For this study, however, we have included 2-year-old children because they may have presented for care with conditions that prompted BP screening. The following data elements were obtained: patient demographics, height, weight, BP measurements, visit diagnosis codes, and problem list codes. The data download did not contain information about BP measurement technique (eg, automatic vs manual). If there were multiple BP measurements in the EMR for 1 visit, the first measurement was discarded and the average of subsequent measurements was interpreted.

The data download included 65 326 visits. Duplicate visits, incomplete visits, and visits in which a physician/advanced practice nurse was not seen (n = 2842) were omitted. Weight, height, and body mass index (BMI) percentiles were interpreted with Epi Info 3.5.3 (National Center for Health Statistics, Centers for Disease Control & Prevention, Atlanta, Georgia, 2011). Visits were excluded (n = 8655) if they were missing height or weight data, had an extreme height z-score (≥4 or ≤−4), or an extreme weight z-score (≤−4), or documentation of issues with measurement technique (eg, measurements taken with leg braces on), leaving 53 829 visits. Although some of these visits may have had a BP measurement, they were excluded to create a clean data set with less likelihood of the inclusion of visits with unreliable measurements. Visits missing a BP measurement or having an abnormally high systolic (>200 mm Hg) or low diastolic BP ≤25 mm Hg (n = 21 698) were considered not to include a valid BP. BP percentiles for visits with valid BPs were interpreted with the Health Indicators Analyzer software (2003, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois), which uses NHLBI references.[11]

We defined elevated BP measures as those in which BP is ≥90th percentile for age, sex, and height percentile or ≥120/80 mm Hg.[11] This definition was made because guidelines recommend repeated additional evaluations when measures are at or greater than the aforementioned cut points. We assigned patients to 1 of 13 division/service groups according to the division/service that had obtained the greatest BP percentile value for the subject during the study year to ensure that subjects with elevated measurements were assigned to a division/service in which one of the elevated measurements definitely occurred. Identification of elevated BP was defined as the presence of specific BP-related *International Classification of Disease, 9th Revision* (ICD-9) codes in the visit diagnosis or problem list (**Appendix**; available at www.jpeds.com) at any time during the study year.

Statistical Analyses of Study 1. Subjects were stratified into 3 groups on the basis of age: 2-5 years; 6-12 years; and 13-17 years. Race/ethnicity was categorized into 6 groups (white, black, Hispanic, Asian, American Indian/other, unknown). Subjects with ≥1 visit during which BP was measured and recorded (ie, BP measurement visit) in the study year were grouped on the basis of the number of elevated BP measurement visits: none; 1-2; or ≥3 elevated BP measurement visits. χ^2 analyses were conducted to determine factors significantly associated with elevated BP measurement by visit group. Factors evaluated included age group, sex, race/ethnicity, insurance, and BMI percentile group. The frequency of elevated BP and its identification by division/service was reported. Analyses were conducted with SAS (Version 9.3, SAS Institute, Cary, North Carolina) and IBM SPSS Statistics (Version 20.0.0, IBM Corp, Armonk, New York). Significance was set at $\alpha < 0.05$.

We conducted semistructured interviews, using a 31-question interview guide, with a representative from each division/service (n = 13) that focused on clinical practice, protocols for identifying and managing elevated BP, and philosophies of their role, and perceived barriers in