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Achieving the BpTRUth: emergency department hypertension screening and the Centers for Medicare & Medicaid Services quality measure

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Abstract

In 2012, the Centers for Medicare & Medicaid Services (CMS) instituted a Physician Quality Reporting System measure for screening and referring patients with elevated blood pressure (BP). The aims of this study were to (1) assess the reliability of ED triage BP as a metric to establish when the CMS threshold (120/80 mm Hg), and other clinically relevant BP thresholds (140/90 and 160/100 mm Hg) have been met, using BP measured with a highly accurate device (BpTRU) in the emergency department as the gold standard; and (2) determine whether correct identification varies by gender, race, or triage acuity. Using the BpTRU, we calculated the proportion of patients whose triage BP accurately indicated a need for further referral and treatment for hypertension according to three suggested BP thresholds (120/80, 140/90, and 160/100 mm Hg). Of 354 patients, the median age was 39 years, 48.9% were women, and 66.4% were White. At the three suggested BP thresholds (120/80, 140/90, and 160/100 mm Hg), 66.1%, 74.0%, and 88.8% of patients were confirmed to meet the CMS threshold, respectively. There were no differences by gender, race, or triage acuity. Emergency department triage BP would reliably identify elevated BP using the CMS threshold in up to two-thirds of those without known hypertension.

Keywords

Blood pressure; emergency medicine; measurement; health policy

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Conflicts of interest: none.

Introduction

Approximately, 17% of the general United States population and roughly one-third of US emergency department (ED) patients are believed to have undiagnosed hypertension.^{1,2} Cardiovascular, neurological, and renal organ damage can be considerable when hypertension remains untreated.³ As blood pressure (BP) is measured during all visits, the ED is well positioned to screen patients for elevated BP and refer them for further evaluation and possible treatment.⁴ However, there is much debate over the appropriate threshold for screening and referral.

While hypertension itself (BP > 140/90 mm Hg) is widely recognized as an important contributing factor to cardiovascular disease development, prehypertension (systolic BP 120–139 mm Hg or diastolic BP between 80 and 89 mm Hg) is also associated with increased risk.⁵ In 2012, the Centers for Medicare & Medicaid Services (CMS) instituted a Physician Quality Reporting System measure for ED screening and referral of patients with elevated BP.⁶ This cross-cutting measure applies to all patients aged ≥ 18 years without known hypertension and an ED BP ≥ 120/80 mm Hg. The measure requires documentation in the medical record of the BP measurement as well as a written referral to a primary care or other provider. Failure to comply with these guidelines incurs EDs with up to a 6% penalty in Medicare payments.

The CMS measure has challenged the long-standing BP threshold used in the ED to initiate hypertension screening of ≥ 140/90 mm Hg.⁷ Our objectives were to (1) assess the reliability of ED triage BP for determination of a BP that truly exceeds the CMS threshold and other clinically relevant thresholds, using a validated measure of BP as the gold standard; and (2) determine whether correct identification varies by gender, race, or triage acuity. We hypothesized that the triage BP would correctly identify most ED patients who met the CMS threshold.

Materials and Methods

Study Design

This prospective observational cohort study was conducted between August 2014 and February 2016 among adult ED patients without a known diagnosis of hypertension with a triage BP that met the CMS threshold for outpatient referral. The hospital Institutional Review Board approved this study.

Study Setting and Population

The study was conducted in New England at a level I, tertiary referral academic ED with an annual volume of more than 100,000 adult patient visits. To be study eligible, patients had to be at least 18 years old, speak English, and have a triage BP ≥ 120 mm Hg systolic and/or ≥ 80 mm Hg diastolic. Patients were not eligible if they were known to be hypertensive, taking antihypertensives, receiving dialysis, or were pregnant, prisoners, intoxicated, admitted, or in infectious disease isolation. Patients were ineligible if they had atrial fibrillation, chest pain, shortness of breath, one-sided weakness or numbness, altered mental status, an acute psychiatric problem, or used cocaine in the previous 30 days. In addition,

patients were excluded from the study if they received any antihypertensive medication between the triage BP measurement and the BpTRU measurement.

Study Protocol

Research assistants (RAs) reviewed the electronic medical records of ED patients when they were available and then approached those who were potentially study eligible. Patients who met study criteria were consented to participate in the study.

Measurements

The BpTRU device is considered the “gold standard” for office-based BP measurement because of its superior accuracy to other automated devices.⁸ As suggested in the BpTRU user manual,⁹ the RA took measurements from the arm with the higher BP measurement. After the initial BP measurement, the RA left the room while the BpTRU device took five more readings at 1-minute intervals. The BpTRU device discounts the initial measurement and takes an average of the latter five. This average BP was used as the comparative standard for this study. The triage BP was collected by nurses or certified nursing assistants at patient arrival using an automated BP monitor. No attempt was made by the study personnel to standardize or alter the collection of this measurement.

Data Analysis

Characteristics of participants were reported using descriptive statistics. The proportion of ED patients whose triage BP met at least the CMS recommended BP threshold of 120/80 mm Hg were calculated, along with corresponding exact binomial confidence intervals (CIs). We stratified the proportions of those ED patients whose triage BP was verified by the BpTRU as meeting the CMS threshold by three triage BP levels: (1) the CMS recommended threshold for outpatient referral of 120 mm Hg systolic and/or 80 mm Hg diastolic, (2) the American College of Emergency Physicians threshold of 140 mm Hg systolic and/or 90 mm Hg diastolic, and (3) a severely elevated BP threshold as suggested by other emergency medicine researchers of 160 mm Hg systolic and/or 100 mm Hg diastolic.^{10,11} Two sample tests of binomial proportions were used for pair-wise comparisons of thresholds for all patients and by gender, race, and triage acuity. An $\alpha = 0.05$ level of significance was used for comparisons. Data were recorded into the REDCap application and analyzed using Stata/SE 13.0.

Results

Of the 354 patients in the study, the median age was 39 years (interquartile range 28–51), 48.9% were women, 66.4% were White, and 17.0% were Black (see Table 1). The mean difference between triage BP and BpTRU measurements was 20.6 mm Hg (95% CI: 18.8, 22.4) for the systolic measurement and 6.0 mm Hg (95% CI: 4.7, 7.4) for diastolic BP.

Table 2 indicates the proportions of the 354 ED patients whose triage BP met the CMS threshold of 120/80mm Hg as verified by the BpTRU according to their triage BP. As shown, participants with higher triage BPs were more likely to meet the CMS threshold.

There were no differences by gender, race, or triage acuity in correct classification of meeting the CMS threshold across triage BPs as measured by the BpTRU. Comparing correctly classified proportions between gender using the binomial proportions test resulted in the following *P* values for each cutoff value: 120/80 mm Hg (*P* = .099), 140/90 mm Hg (*P* = .214), 160/100 mm Hg (*P* = .269). In addition, there were no differences comparing races for each cutoff value: 120/80 mm Hg (*P* = .595), 140/90 mm Hg (*P* = .829),

160/100 mm Hg (*P* = .835). Comparing correctly classified proportions between triage acuities resulted in the following nonsignificant *P* values for each cutoff value: 120/80 mm Hg (*P* = .588), 140/90 mm Hg (*P* = .996), and 160/100 mm Hg (*P* = .506).

Discussion

Population-based screening is essential to decreasing rates of untreated hypertension, and as a health care safety net, EDs play a critical role in hypertension-related disease treatment and prevention. The results from this prospective study demonstrated that most patients whose triage BP met the CMS threshold for outpatient referral for a hypertension evaluation did in fact meet that recommended level according to a gold-standard device for BP measurement. Several findings from this study should be emphasized and considered for ED practice. First, triage BP overestimates BP when compared with the BpTRU. Second, using the triage BP and applying the CMS threshold, two-thirds of patients will be accurately referred. As such, although imperfect, this threshold would prompt referrals correctly for most ED patients with a BP 120/80 mm Hg. Prior research has shown that although there is some decrease in BPs during ED stays, many ED patients with elevated BPs are later confirmed to have hypertension.^{10,12,13} Third, higher triage BPs increase the likelihood that a patient will meet the CMS threshold for referral. Emergency physicians can be more assured that patients with higher triage BP levels do meet this need.

For any selected threshold, there is a balance between identifying as many ED patients with untreated hypertension as possible and incorrectly referring patients for an outpatient hypertension evaluation because of an erroneously high triage BP. Some proponents advocate referral for every patient with prehypertension range BP. The rationale for referring every patient with prehypertension range triage BP is that prehypertension increases the risk of cardiovascular disease. Others feel that setting a lower threshold unnecessarily alarms patients and results in higher health care costs and provider burden. Primary care-based screening for hypertension has been shown to improve health outcomes and represents good value for the money. Further research is necessary to evaluate the cost-effectiveness of hypertension screening in the ED setting and identify optimal methods of selecting those who need referrals.

Limitations

This study has several limitations. This study was from a single center and patients who were critically ill or injured, non-English speaking, or admitted were not included, so our findings might not be externally valid to the entire ED patient population. Because of RA availability, most patients were enrolled during daytime hours; and therefore, only a small fraction of patients potentially eligible each day were enrolled, which potentially limits the

generalizability of the study results. We did not standardize the timing between the triage BP and the subsequent BpTRU measurement. Therefore, some of the differences between the measurements could be due to passage of time. In addition, the triage BP may have been measured in a different arm than the BpTRU measurement; therefore, some of the difference between the triage and BpTRU BP may have been due to differences between BP in a patient's arms. In the BpTRU manual, it is recommended to first check which arm has a higher BP and uses this arm for the serial measurements. To make triage assessments as rapid as possible, triage personnel use the arm most easily accessible to them for vital sign measurement and it would not have been possible to change this practice for the purposes of the study. As with any study using screening techniques and comparing results to a gold standard, verification bias and measurement error are potential problems that we eliminated to the best of our ability. We excluded patients with known hypertension or those taking antihypertensive medications. Measurement error was minimized using the same BpTRU device on each participant in a standard, accepted protocol. Of course, other gold standards could be used for BP measurement, but the BpTRU has the advantage of being noninvasive and is the practice standard for the outpatient setting,^{8,14} which is where ED patients would be referred for further evaluation. Because of its costs and the time to perform the measurements (6 minutes), the BpTRU likely will not be used in the triage area of most EDs to verify BP measurements. This impediment, however, does not reduce the veracity of the study findings.

Conclusions

Two-thirds of ED patients with a triage BP $\geq 120/80$ mm Hg without a known diagnosis of hypertension had a BP above this threshold when measured using the BpTRU device. Applying the CMS suggested threshold for hypertension screening in the ED will help identify a significant number of patients at risk for hypertension and its associated complications.

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Table 1

Demographic and clinical characteristics of the participants

Characteristics	Included Patients, <i>n</i> = 354
Median age in years (IQR)	39 (28–51)
Sex, %	
Female	48.9
Male	51.1
Ethnicity/race, %	
White	66.4
Black	17.0
Other	16.6
Time of presentation, %	
First shift (8 AM–4 PM)	74.0
Second shift (4 PM–12 AM)	25.4
Third shift (12 AM–8 AM)	0.6
Triage acuity, %	
ESI 1	0.0
ESI 2	20.0
ESI 3	64.4
ESI 4	15.3
ESI 5	0.3
Triage SBP, mm Hg	
Mean (SD)	146.75 (18.42)
Median (IQR)	144 (134–155)
Triage DBP, mm Hg	
Mean (SD)	87.78 (12.28)
Median (IQR)	87 (80–95)

DBP, diastolic blood pressure; ESI, Emergency Severity Index; IQR, interquartile range; SBP, systolic blood pressure; SD, standard deviation.

Table 2

A comparison of triage and BpTRU measurement and the proportion of participants correctly classified when using triage blood pressure compared with BpTRU measurements

Triage BP (mm Hg)	BpTRU BP (mm Hg)		Correctly Classified
	120/80 (n)	<120/80 (n)	% (95% CI*)
All participants			
120/80	234	120	66.1 (60.9, 71.0)
140/90	191	67	74.0 (68.2, 79.3)
160/100	87	11	88.8 (80.8, 94.3)
Females			
120/80	107	66	61.8 (54.2, 69.1)
140/90	83	35	70.3 (61.2, 78.4)
160/100	47	4	92.2 (81.1, 97.8)
Males			
120/80	127	54	70.2 (62.9, 76.7)
140/90	108	32	77.1 (69.3, 83.8)
160/100	40	7	85.1 (71.7, 93.8)
Black			
120/80	42	18	70.0 (56.8, 81.2)
140/90	29	10	74.4 (57.9, 87.0)
160/100	17	2	89.5 (66.9, 98.7)
White			
120/80	156	79	66.4 (60.0, 72.4)
140/90	133	42	76.0 (69.0, 82.1)
160/100	61	6	91.0 (81.5, 96.6)
Other race/ethnicity			
120/80	36	23	61.0 (47.4, 73.5)
140/90	29	15	65.9 (50.1, 79.5)
160/100	9	3	75.0 (42.8, 94.5)
Low triage acuity [†]			
120/80	45	26	63.4 (51.1, 74.5)
140/90	37	13	74.0 (59.7, 85.4)
160/100	24	2	92.3 (74.9, 99.1)
High triage acuity [†]			
120/80	189	94	66.8 (61.0, 72.2)
140/90	154	54	74.0 (67.5, 79.9)
160/100	63	9	87.5 (77.6, 94.1)

CI, confidence interval.

* Note: all CIs are Clopper-Pearson (exact binomial).

[†] Low triage acuity is defined as Emergency Severity Index (ESI) 3, 4, or 5. High triage acuity is ESI 1 or 2.