

# Attitudes and Practices of Resident Physicians Regarding Hypertension in the Inpatient Setting

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Hypertension is prevalent in the population at large and among hospitalized patients. Little has been reported regarding the attitudes and patterns of care of physicians managing nonemergent elevated blood pressure (BP) among inpatients. Resident physicians in internal medicine (IM), family medicine (FM), and surgery were surveyed regarding inpatient BP management. One hundred eighty-one questionnaires were completed across 3 sites. Respondents generally considered inpatient BP control a high priority. A majority of IM and FM residents indicated following the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) consensus guidelines for inpatients compared to 20% of surgery residents ( $P < .001$ ). While trainees did not appear to strictly follow JNC 7 guidelines for goal BP of 140/90 mm Hg, they did report making frequent BP medication changes (~51% reported changing regimens for >50% of

hypertensive patients). Overall ~90% indicated that discharging a hypertensive patient on a drug regimen established during hospitalization is preferable to reverting to the regimen in place at the time of admission. Resident physicians regard elevated BP inpatient management as important, but attitudes and practice vary between specialties. JNC 7 guidelines may not be appropriate for inpatient use. Future research should focus on developing functional diagnostic criteria for hypertension in the inpatient setting and determining best practices inpatient BP management. *J Clin Hypertens* (Greenwich). 2010;12:698–705. ©2010 Wiley Periodicals, Inc.

While guidelines for hypertension management and studies of control efforts over the past 30 years have fittingly concentrated on the outpatient setting, evidence suggests that the prevalence of hypertension in the inpatient setting is as high as 50%.<sup>1</sup> Hospitalization is common in the United States. In 2002, there were more than 38 million inpatient hospitalizations and roughly 33 million additional surgical procedures among adults.<sup>2,3</sup> Available studies indicate that recognition and control of hypertension in the inpatient setting are suboptimal, even in patients with high-risk conditions such as ischemic heart disease and stroke.<sup>4–10</sup> Thus, the inpatient setting might reasonably be a site to focus efforts to improve hypertension treatment.

While experts generally agree on principles for treatment of the range of hypertensive emergency

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syndromes,<sup>11–13</sup> there is no consensus recommendation regarding the management of nonemergent or asymptomatic elevated blood pressure (BP) in the inpatient setting. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) does not specifically address inpatient hypertension, and the utility of these guidelines in the hospital setting is not established.<sup>14</sup> In fact, very little published information is available about the knowledge and practices of inpatient physicians in the management of elevated BP.

In the present study, we have attempted to describe the approach of medical trainees in internal medicine (IM), family medicine (FM), and surgery regarding elevated BP in the inpatient setting. Survey questions focused on 2 primary dimensions of care: the general diagnosis and management of inpatient BP, and care transitions for inpatients with elevated BP.

## MATERIALS AND METHODS

### Study Design, Setting, and Participants

We conducted a cross-sectional survey of resident physicians in IM, FM, and surgery training programs at 3 sites: The University of Michigan, The Medical University of South Carolina, and the Spartanburg (South Carolina) Regional Medical Center. The former 2 sites are university-based medical centers, and the latter is a community-based hospital hosting training programs in FM and preliminary surgery. Trainees were approached by study personnel and invited to complete questionnaires in either pen/paper format or using an online survey form (<http://www.surveymonkey.com>). Survey items varied slightly by site and complete surveys are available in Supporting Information. Common survey items are presented in this report. Questionnaire items were varied in structure including rating scales, checklists, and case vignettes (these were administered only at the South Carolina sites). Surveys were reviewed and approved by institutional review boards at each site. All survey responses were anonymous. Of note, respondents at the Medical University of South Carolina were provided with coupons valued at \$5.00 for beverages at an in-hospital coffee kiosk independent of their decision to complete survey forms.

### Statistical Analysis

Upon completion, survey results from each site were combined and tabulated. The primary group comparisons were made based on training program (IM, FM, and surgery). Survey responses were

dichotomized and between-group differences were tested using chi-square or Fisher exact tests as appropriate. All analyses were performed using SAS statistical software package version 9.1 (SAS Institute Inc, Cary, NC).

## RESULTS

Demographic characteristics of survey respondents are shown in Table I below. Approximately two-thirds of trainee respondents were from IM, 18% from FM, and 17% from surgical specialties (general surgery, orthopedic surgery, and preliminary surgery). In general, respondents were evenly distributed based on sex and the number of years in training. IM residents self-reported a median of 7 to 8 inpatient months in the past 12 months, and FM resident's self-reported a median of 3 to 4 months.

Survey questions and responses dealing with the management of elevated BP among inpatients separated by specialty are listed in Table II below. Overall, 80% rated control of BP as 4 or 5 out of 5 in importance (5 = very important). As indicated in Figure 1 and Figure 2, there were no significant differences between specialties regarding the importance attributed to inpatient BP control, frequency of manually rechecking BP, correlation of elevated BP with medication timing, and frequency of changing BP medications. Similarly, a majority of respondents reported that they based their management on current JNC 7 guidelines. However, there was a notable difference between specialty training groups on this question (Figure 2). Ninety-seven percent of FM, and 70% of IM residents acknowledged use of these guidelines, but only 19% of surgery residents did so ( $P < .001$ ). In separate questions about the level of BP that would spur a medication change in a hospitalized patient, no group was likely to institute a BP medication change at  $<140/90$  mm Hg. However, the threshold for medication changes was higher for surgical residents than IM or FM residents (Figure 2). At a systolic BP  $\geq 160$  mm Hg, 63% of FM residents and 57% of IM residents would institute a medication change, but only 29% of surgical residents would do so ( $P < .001$ ). Similarly, at a diastolic BP  $\geq 100$  mm Hg 65% of FM and 64% of IM residents would implement a medication change, but only 23% of surgical residents would do so ( $P < .001$ ). In case vignettes, respondents were divided on how they chose to deal with an asymptomatic, moderately elevated BP observed in an inpatient. Overall, 44% indicated that they would treat with either an oral or intravenous agent, and

<b>Table I.</b> Characteristics of Survey Respondents				
	CHARLESTON N=69	SPARTANBURG N=22	ANN ARBOR N=90	TOTAL (%) N=181
Sex				
Female	24	10	NA <sup>b</sup>	
Male	45	12	NA <sup>b</sup>	
Years in training				
1	20	10	21	51 (28%)
2	23	7	28	58 (32%)
3	18	5	24	47 (26%)
3 or more	7	0	17	24 (14%)
Inpatient months <sup>a</sup>				
1-2	3	5	NA <sup>b</sup>	
3-4	10	12	NA <sup>b</sup>	
5-6	17	5	NA <sup>b</sup>	
7-8	25	0	NA <sup>b</sup>	
9-10	13	0	NA <sup>b</sup>	
11-12	1	0	NA <sup>b</sup>	
Specialty				
Internal medicine	69	0	50	119 (66%)
Family medicine	0	20	11	31 (18%)
Orthopedic surgery	0	0	20	20 (11%)
General surgery	0	0	9	9 (5%)
Transitional	0	2	0	2 (1%)

<sup>a</sup>Self-reported number of months spent on primarily inpatient rotations in the previous year. <sup>b</sup>Information on sex and number of inpatient months was not collected in the Michigan version of the survey.

56% indicated that they would not treat the hypothetical patient with antihypertensive medication. Regarding the use of hypertension specialists (Figure 2) 59% of FM and IM residents indicated that they would not consult a hypertension specialist, but only 14% of surgeons stated they would not do so ( $P < .001$ ).

Survey questions and responses dealing with care transitions for patients with elevated inpatient BP are listed by specialty in Table III below. Overall, 91% of respondents agreed that the final antihypertensive medication regimen arrived at during hospitalization should be the regimen at discharge, and there was no significant variation between IM and FM residents on this point. Also, 71% of respondents indicated that an appropriate follow-up interval for uncontrolled inpatient BP should be 1 to 2 weeks after discharge. IM trainees (16% of total) were more comfortable with longer follow-up intervals of greater than 2 weeks. In case vignettes, 66% of respondents claimed they would take multiple steps to document and treat BP including prescribing a new medication at discharge in a patient with newly diagnosed hypertension. However, only 7.8% surveyed would contact a primary care provider for input in titrating medications on a complex heart failure patient with uncontrolled BP.

Table IV lists the preferred oral and intravenous antihypertensive medications indicated by trainees. In general,  $\beta$ -blockers (84.5%), angiotensin-converting enzyme inhibitor/angiotensin receptor antagonists (70.7%), calcium channel blockers (56.9%), and diuretics (55.8%) were most favored for oral treatment of elevated BP among hospitalized patients. Interestingly, hydralazine was preferred by 50.8% of respondents overall, largely driven by IM and surgical trainees.  $\beta$ -Blockers (61.9%) and hydralazine (76.2%) were the most preferred parenteral agents.

## DISCUSSION

To our knowledge, this is the first report of resident physicians' attitudes and practices in the management of elevated BP in the inpatient setting. Survey respondents generally agreed that the management of inpatient hypertension was a high priority, and a majority indicated that they use current expert guidelines as a framework for delivering care, even though those guidelines do not specifically address the diagnosis and management of hypertension in the inpatient setting. However, respondents' answers to survey items indicate that they do not in fact use the standard JNC 7 outpatient treatment recommendations. A majority reported that patients

**Table II.** Survey Items Focusing on Inpatient Blood Pressure (BP) Control and Care Transitions

	INTERNAL MEDICINE N (%)	FAMILY MEDICINE N (%)	SURGERY N (%)	OVERALL N (%)
Controlling BP in the hospital is:				
(Not important) 1	0 (0)	0 (0)	0 (0)	0 (0)
2	5 (4.2)	1 (3.2)	2 (6.5)	8 (4.5)
3	23 (19.3)	3 (9.7)	3 (9.7)	29 (16.0)
4	53 (44.5)	15 (48.4)	18 (58.0)	86 (47.5)
(Very important) 5	38 (31.9)	12 (38.7)	8 (25.8)	58 (32.0)
I routinely retake the BPs myself in my hospitalized patients.				
(Never) 1	20 (16.8)	13 (43.3)	6 (19.4)	39 (21.7)
2	61 (51.3)	13 (43.3)	17 (54.8)	91 (50.6)
3	28 (23.5)	4 (13.4)	6 (19.4)	38 (21.1)
4	9 (7.6)	0 (0)	2 (6.4)	11 (6.1)
(All patients) 5	1 (0.8)	0 (0)	0 (0)	1 (0.5)
In evaluating BP, I routinely relate the timing of BP measurements to the time medications are given to my patients.				
(Never) 1	0 (0)	3 (10.0)	0 (0)	3 (1.8)
2	15 (13.6)	4 (13.3)	3 (11.5)	22 (13.2)
3	31 (28.2)	9 (30.0)	10 (38.5)	50 (30.1)
4	53 (48.2)	13 (43.3)	13 (50.0)	79 (47.6)
(All patients) 5	11 (10.0)	1 (3.4)	0 (0)	12 (7.3)
In what percentage of patients on your service do you adjust medications to reduce their BP while the patient is in the hospital?				
<20%	14 (11.8)	2 (6.5)	4 (12.9)	20 (11.0)
20%–50%	45 (37.8)	10 (32.2)	14 (45.2)	69 (38.1)
50%–80%	44 (37.0)	11 (35.5)	7 (22.6)	62 (34.3)
>80%	16 (13.4)	8 (25.8)	6 (19.3)	30 (16.6)
At what level of BP do you initiate medication changes while the patient is in the hospital? (mean, standard deviation)				
Systolic BP (mm Hg)				
140–149	34 (28.6)	11 (35.5)	2 (6.5)	47 (26.0)
150–159	20 (16.8)	6 (19.4)	6 (19.3)	32 (17.7)
160–169	21 (17.7)	8 (25.8)	14 (45.2)	43 (23.7)
170–179	13 (10.9)	1 (3.2)	5 (16.1)	19 (10.5)
180+	6 (5.0)	1 (3.2)	1 (3.2)	8 (4.4)
No specific number (% of respondents)	25 (21.0)	4 (12.9)	3 (9.7)	32 (17.7)
Diastolic BP (mm Hg)				
90–99	54 (45.4)	17 (54.8)	6 (19.4)	77 (42.5)
100–104	16 (13.5)	7 (22.6)	15 (48.4)	38 (21.0)
105–109	13 (10.9)	1 (3.2)	2 (6.5)	16 (8.8)
110–114	1 (0.8)	1 (3.2)	2 (6.5)	4 (2.2)
115+	0 (0)	0 (0)	1 (3.2)	1 (0.6)
No specific number (% of respondents)	35 (29.4)	5 (16.1)	5 (16.1)	45 (24.9)
I base my decisions regarding medications to reduce BP on the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) guideline recommendations.				
Yes	83 (69.8)	30 (96.8)	6 (19.3)	119 (65.8)
No	36 (30.2)	1 (3.2)	25 (80.7)	62 (34.2)
I would consult a hypertension specialist:				
I would not call a hypertension specialist	68 (59.1)	10 (58.8)	4 (13.8)	82 (51.0)
After adjusting the dose of 1 current medication if inadequate response	0 (0)	1 (5.9)	1 (3.4)	2 (1.2)
After adjusting the dose of 2 current medications if inadequate response	29 (25.2)	4 (23.5)	14 (48.3)	47 (29.2)
After adding on one additional anti-hypertensive medication	13 (11.3)	2 (11.8)	6 (20.7)	21 (13.0)
If a patient's BP was over ___/___ (mean, SD, number responding)	5 (4.4)	0 (0)	4 (13.8)	9 (5.6)

**Table II.** Survey Items Focusing on Inpatient Blood Pressure (BP) Control and Care Transitions (Continued)

	INTERNAL MEDICINE N (%)	FAMILY MEDICINE N (%)	SURGERY N (%)	OVERALL N (%)
How soon after discharge should patients in whom BP has required initiation or adjustment of drugs while in the hospital be seen?				
<1 week	15 (12.6)	10 (32.3)	10 (32.3)	35 (19.3)
1–2 weeks	85 (71.4)	20 (64.5)	21 (67.7)	126 (69.6)
3–4 weeks	16 (13.5)	1 (3.2)	0 (0)	17 (9.4)
>4 weeks	3 (2.5)	0 (0)	0 (0)	3 (1.7)
In general, for patients treated for hypertension prior to hospitalization, should they be discharged on:				
The final drug regimen established during the hospitalization	106 (91.4)	29 (93.6)	27 (87.1)	162 (91.0)
The drug regimen on which they were admitted	10 (8.6)	2 (6.4)	4 (12.9)	16 (9.0)

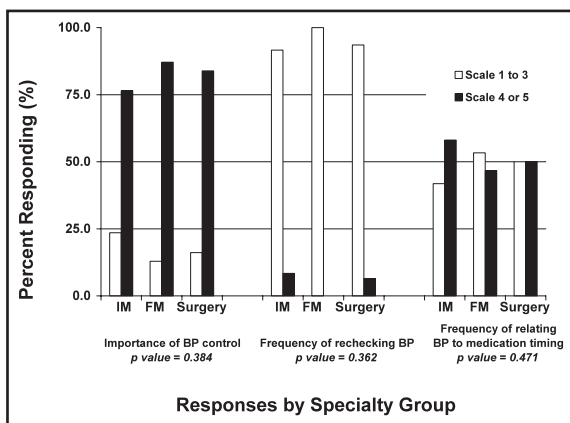


Figure 1. Between-group differences for selected survey items.

would need to have BP in excess of 160/100 mm Hg prior to instigating medication changes rather than the 140/90 mm Hg threshold outlined in JNC 7. Still, 51% stated that they frequently adjust antihypertensive regimens in hospitalized hypertensives. The efficacy and safety of such frequent changes in antihypertensive medications among stable inpatients is unclear.

There is also ambiguity regarding proper management of transiently elevated BP in the inpatient setting. In a case scenario, 44% of respondents indicated that they would treat acutely elevated BP in an asymptomatic patient. There is no evidence of benefit for administering antihypertensives in this setting, and the potential certainly exists for harm. One rationale for pharmacologic treatment of acutely elevated BP involves the concept of “triggering” whereby certain stressors acutely precipitate adverse cardiovascular events. Triggering of myocardial infarction has been causally linked to emotional upset, strenuous physical activity, lack of

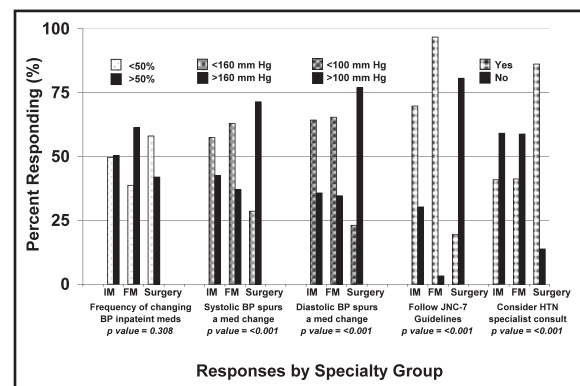


Figure 2. Between-group differences for selected survey items.

sleep, and overeating.<sup>15</sup> However, the question of whether acute, asymptomatic elevations in BP can precipitate adverse cardiovascular events among inpatients has never been formally studied. There is also an association between early morning surge in BP and a higher incidence of heart attacks and stroke in the early morning hours, but it is unclear whether this phenomenon is exaggerated in the inpatient setting.

A stronger case can be made that inpatient hospitalization represents an opportunity to recognize uncontrolled hypertension and improve postdischarge care transitions instead of intervening during the inpatient hospitalization. For patients with known, but uncontrolled hypertension, such recognition allows inpatient providers to alert outpatient treating physicians that there may be a problem with BP control. For patients without known hypertension, such recognition offers the chance to refer for treatment and to begin therapy in selected cases.

However, diagnostic uncertainty impairs inpatient physicians’ ability to make decisions about

**Table III.** Clinical Vignettes<sup>a</sup>

	INTERNAL MEDICINE	FAMILY MEDICINE	SURGERY	OVERALL
You are called by a nurse at 10 PM with an elevated BP of 182/100 mm Hg in a 74-y-old female with known HTN on her home medications who is not in any pain and has no other symptoms other than the cough caused by her pneumonia. How would you respond?				
Give 20 mg IV labetalol and recheck BP in 1 h.	10 (14.7)	1 (5.0)	0 (0)	11 (12.2)
Give 0.2 mg of oral clonidine and recheck BP in 1 h.	1 (1.5)	0 (0)	0 (0)	1 (1.1)
Do nothing acutely.	17 (25.0)	2 (10.0)	0 (0)	19 (21.1)
Give codeine for her cough.	40 (58.8)	17 (85.0)	2 (100.0)	59 (65.6)
Your 32-y-old male patient who was involved in a motor vehicle collision is being discharged today. You notice that he has had persistently, but mildly elevated BPs (140–159/90–100 mm Hg) over the past 3 days prior to discharge that are not clearly related to pain or nausea. He has no primary care physician, and he takes no medications for HTN at home. His kidney function was normal on admission, but he does have trace proteinuria on urinalysis, and ECG showed left ventricular hypertrophy. What actions are you likely to take in response to this elevated BP?				
1. No response is necessary. We are not sure these elevated BP measures represent true HTN.	11 (16.4)	7 (35.0)	0 (0)	18 (20.2)
2. Tell the patient he has stage 1 HTN and note this in his discharge summary.	17 (25.4)	4 (20.0)	0 (0)	21 (23.6)
3. # 2 above, and tell him to get primary care follow up.	27 (40.3)	5 (25.0)	2 (100)	34 (38.2)
4. # 3 above, and prescribe a medication for HTN.	12 (17.9)	4 (20.0)	0 (0)	16 (18.0)
You have a 65-y-old patient with known HTN, hyperlipidemia, and revascularized coronary artery disease, compensated ischemic cardiomyopathy with an ejection fraction of 30% who is seen after an elective procedure. During the 3 days of hospitalization, systolic BP has ranged from 150 to 170 mm Hg based on nurses' oscillometric BP measures. Current HTN medications include metoprolol tartrate 25 mg twice a day, lisinopril 40 mg/d, and furosemide 40 mg/d. She is followed for primary care by a family medicine physician in a neighboring town. Which of the following describes what you are most likely to have done if faced with a similar patient in the past year?				
Continue home medications as the patient is compensated and has good follow-up care.	6 (8.8)	3 (15.0)	1 (50.0)	10 (11.1)
Switch to metoprolol succinate at a titrated dose that has better "data" for use in patients with heart failure.	25 (36.8)	7 (35.0)	0 (0)	32 (35.6)
Add spironolactone 25 mg daily to the patient's regimen.	32 (47.1)	8 (40.0)	1 (50.0)	41 (45.5)
Call the primary care physician and ask what they suggest doing.	5 (7.3)	2 (10.0)	0 (0)	7 (7.8)
Abbreviations: BP, blood pressure; ECG, electrocardiogram; HTN, hypertension; IV, intravenous. <sup>a</sup> Clinical vignette items were completed at the Medical University of South Carolina and Spartanburg sites only.				

medication regimens at the time of discharge. Measurement techniques and diagnostic standards for outpatient hypertension are well established,<sup>16</sup> but numerous factors complicate hypertension diagnosis in the inpatient setting. Inpatients are a heterogeneous group with a variety of different primary inpatient diagnoses and medical comorbidities, as well as clinical factors such as acute illness, pain, nausea, and medication changes. Also, measurement of inpatient BP is often imprecise because of the use of poorly calibrated oscillometric devices and from lapses in proper measurement technique such as incorrect cuff size and lack of attention to the effects of posture and arm position. This is relevant given that 81% of respondents indicated that they never or rarely ever recheck BP themselves in hospitalized patients (Table II).

Discontinuity between the inpatient and outpatient settings represents another significant barrier. The proliferation of hospitalist physicians in the United States and several other factors have led to poorer continuity of care in recent decades,<sup>17</sup> especially because communication between inpatient physicians and primary care physicians can be poor. In one study, only 14.5% of discharge summaries arrived at patients' primary care physicians within 1 week of hospital discharge, and 25% never arrived.<sup>18</sup> Discontinuity has the dual effect of making appropriate medication changes less likely to persist and of introducing potential for adverse medication events. Such events after hospital discharge are common<sup>19,20</sup> and may be avoidable with improved communication and care coordination.<sup>21–23</sup>



**Table IV.** Preferred Oral and Intravenous Agents<sup>a</sup>

DRUG CLASS	INTERNAL MEDICINE (%)	FAMILY MEDICINE (%)	SURGERY (%)	TOTAL (%)
Oral agents				
ACE inhibitors/ARB	73.1	80.6	51.6	70.7
α-Blockers	6.7	22.6	12.9	10.5
α-β-Blockers	14.3	22.6	25.8	17.7
β-Blockers	80.7	90.3	93.5	84.5
Calcium channel blockers	54.6	74.2	48.4	56.9
Clonidine	16.8	25.8	35.5	21.5
Diuretics	54.6	64.5	51.6	55.8
Hydralazine	56.3	35.5	45.2	50.8
Other	4.2	3.2	0	3.3
Intravenous agents				
ACE inhibitors/ARB	5	12.9	6.5	6.6
α-β-Blockers	9.2	22.6	25.8	14.4
β-Blockers	55.5	77.4	71	61.9
Calcium channel blockers	15.1	25.8	32.3	19.9
Diuretics	13.4	16.1	35.5	17.7
Hydralazine	84	45.2	77.4	76.2
Other	3.4	0	9.7	3.9

Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker. <sup>a</sup>Respondents were allowed to select any oral or intravenous drug class/agent listed without limits on the number to be selected. Thus, percentages may total >100%.

The strong preference of trainees for hydralazine for hypertensive urgency in non-intensive-care-unit patients is curious given that there do not appear to be any randomized controlled clinical trials with this medication for this indication. However, separate data on the prescribing of hydralazine at the University of Michigan support the notion that hydralazine usage is common, concordant with residents' self-reported preferences.<sup>24</sup> Several recent review articles on the subject of hypertensive urgency/emergency discuss the use of hydralazine in this context.<sup>11,12,25</sup> Two authors suggest that this be restricted to use only in preeclampsia/eclampsia,<sup>11,12</sup> and the third states that hydralazine should be relatively contraindicated in hypertensive crisis.<sup>25</sup> It is possible that the medication choices in the non-intensive-care-unit setting are driven by other factors such as nursing-unit-specific restrictions on the use of intravenous antihypertensives rather than clinical trials or expert guidelines.

This study should be interpreted in light of its limitations. This survey study is comprised of a convenience sample of resident physicians, and results may not describe the knowledge and practices of all trainees. The study is strengthened, however, by featuring multiple sites spanning 2 geographic regions, by including both university-based and community-based training programs, and by the inclusion of multiple specialties. Simi-

larly, the knowledge and practices of attending physicians responsible for final disposition in each specialty may not mirror those of trainees. It is further possible that survey results were biased because respondents were invited by their attending physicians to participate. This seems unlikely, though, as the survey was anonymous, largely online, and because gifts (offered only at one site) were of nominal value (\$5.00) and not tied to participation. Finally and importantly, this survey relied on self-reported practices, and actual practice patterns may vary.

In closing, the present study provides new insight into the practice patterns of resident physicians in treating elevated BP in the inpatient setting. Respondents generally rated inpatient hypertension as a high priority, and they reported being fairly aggressive in titrating medications and treating acutely elevated, asymptomatic BP, but there were discrepancies between self-reported practices and expert guidelines. Also, there was significant variation in management between specialties. Future research in this area should focus on the development of functional diagnostic criteria for hypertension in the inpatient setting, determining what are the best practices for the management of nonemergent, elevated BP in the inpatient setting, minimizing training-specific variations in care that could affect patient outcomes, documenting the overall

risk associated with acute, asymptomatic elevations of BP as a possible trigger for adverse clinical events, and on best practices for care transitions in patients with sustained elevations of BP observed in the inpatient setting.

## REFERENCES

- 1 Conen D, Martina B, Perruchoud AP, et al. High prevalence of newly detected hypertension in hospitalized patients: the value of in-hospital 24-h blood pressure measurement. *J Hypertens*. 2006;24:301–306.
- 2 Merrill C, Elixhauser A. *Hospitalization in the United States, 2002*. Rockville, MD: Agency for Healthcare Research and Quality, 2005. HCUP Fact Book No. 6. AHRQ Publication No. 05-0056.
- 3 Mangano DT. Perioperative medicine: NHLBI working group deliberations and recommendations. *J Cardiothorac Vasc Anesth*. 2004;18:1–6.
- 4 Shankar BS, Russell RP, Southard JW, et al. Patterns of care for hypertension among hospitalized patients. *Public Health Rep*. 1982;97:521–527.
- 5 Onder G, Gambassi G, Sgadari A, et al. Impact of hospitalization on blood pressure control in Italy: results from the Italian Group of Pharmacoepidemiology in the Elderly (GIFA). *Pharmacotherapy*. 2003;23:240–247.
- 6 Voller H, Sonntag FJ, Thiery J, et al. Management of high-risk patients with hypertension and left ventricular hypertrophy in Germany: differences between cardiac specialists in the inpatient and outpatient setting. *BMC Public Health*. 2002;6:256–266.
- 7 Amar J, Chamontin B, Ferrieres J, et al. Hypertension control at hospital discharge after acute coronary event: influence on cardiovascular prognosis – the PREVENIR study. *Heart*. 2002;88:587–591.
- 8 Jankowski P, Kawecka-Jaszcz K, Bilo G, et al. Determinants of poor hypertension management in patients with ischaemic heart disease. *Blood Press*. 2005;14:284–292.
- 9 Ovbiagele B, Hills NK, Saver JL, et al. Antihypertensive medications prescribed at discharge after an acute ischemic cerebrovascular event. *Stroke*. 2005;36:1944–1947.
- 10 Ovbiagele B, Hills NK, Saver JL, et al. Secondary-prevention drug prescription in the very elderly after ischemic stroke or TIA. *Neurology*. 2006;66:313–318.
- 11 Elliott WJ. Clinical features in the management of selected hypertensive emergencies. *Prog Cardiovasc Dis*. 2006;48:316–325.
- 12 Feldstein C. Management of hypertensive crises. *Am J Ther*. 2007;14:135–139.
- 13 Marik PE, Varon J. Hypertensive crises: challenges and management. *Chest*. 2007;131:1949–1962 Erratum in *Chest*. 2007;(Nov)132:1721.
- 14 Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. National High Blood Pressure Education Program Coordinating Committee. *Hypertension*. 2003;42:1206–1252.
- 15 Culic V, Eterovic D, Miric D. Meta-analysis of possible external triggers of acute myocardial infarction. *Int J Cardiol*. 2005;99:1–8.
- 16 Pickering TG, Hall JE, Appel LJ, et al. Recommendations for blood pressure measurement in humans and experimental animals: part 1: blood pressure measurement in humans: a statement for professionals from the subcommittee of professional and public education of the American Heart Association Council on High Blood Pressure Research. *Hypertension*. 2005;45:142–161.
- 17 Sharma G, Fletcher KE, Zhang D, et al. Continuity of outpatient and inpatient care by primary care physicians for hospitalized older adults. *JAMA*. 2009;301:1671–1680.
- 18 Kripalani S, LeFevre F, Phillips CO, et al. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *JAMA*. 2007;297:831–841.
- 19 Kripalani S, Price M, Vigil V, et al. Frequency and predictors of prescription-related issues after hospital discharge. *J Hosp Med*. 2008;3:12–19.
- 20 Coleman EA, Smith JD, Raha D, et al. Posthospital medication discrepancies: prevalence and contributing factors. *Arch Intern Med*. 2005;165:1842–1847.
- 21 Coleman EA, Parry C, Chalmers S, et al. The care transitions intervention: results of a randomized controlled trial. *Arch Intern Med*. 2006;166:1822–1828.
- 22 Naylor M, Brooten D, Jones R, et al. Comprehensive discharge planning for the hospitalized elderly. A randomized clinical trial. *Ann Intern Med*. 1994;120:999–1006.
- 23 Dudas V, Bookwalter T, Kerr KM, et al. The impact of follow-up telephone calls to patients after hospitalization. *Am J Med*. 2001;111:265–305.
- 24 Weder AB, Erickson S. Treatment of hypertension in the inpatient setting: use of intravenous labetalol and hydralazine. *J Clin Hypertens (Greenwich)*. 2010;12:29–33.
- 25 Marik PE, Varon J. Hypertensive crises: challenges and management. *Chest*. 2007;131:1949–1962.

## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**Data S1.** Evaluation and treatment of inpatient blood pressure.

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