Hypertension

AHA SCIENTIFIC STATEMENT

The Management of Elevated Blood Pressure in the Acute Care Setting: A Scientific Statement From the American Heart Association

Adam P. Bress, PharmD, MS, Chair; Timothy S. Anderson, MD, MAS; John M. Flack, MD, MPH, FAHA; Lama Ghazi, MD, PhD; Michael E. Hall, MD, MS, FAHA; Cheryl L. Laffer, MD, PhD; Carolyn H. Still, PhD; Sandra J. Taler, MD, FAHA; Kori S. Zachrison, MD, MSc, FAHA; Tara I. Chang, MD, MS, Vice Chair; on behalf of the American Heart Association Council on Hypertension; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology

ABSTRACT: Over the past 3 decades, a substantial body of high-quality evidence has guided the diagnosis and management of elevated blood pressure (BP) in the outpatient setting. In contrast, there is a lack of comparable evidence for guiding the management of elevated BP in the acute care setting, resulting in significant practice variation. Throughout this scientific statement, we use the terms acute care and inpatient to refer to care received in the emergency department and after admission to the hospital. Elevated inpatient BP is common and can manifest either as asymptomatic or with signs of new or worsening target-organ damage, a condition referred to as hypertensive emergency. Hypertensive emergency involves acute target-organ damage and should be treated swiftly, usually with intravenous antihypertensive medications, in a closely monitored setting. However, the risk-benefit ratio of initiating or intensifying antihypertensive medications for asymptomatic elevated inpatient BP is less clear. Despite this ambiguity, clinicians prescribe oral or intravenous antihypertensive medications in approximately one-third of cases of asymptomatic elevated inpatient BP. Recent observational studies have suggested potential harms associated with treating asymptomatic elevated inpatient BP, which brings current practice into question. Despite the ubiquity of elevated inpatient BPs, few position papers, guidelines, or consensus statements have focused on improving BP management in the acute care setting. Therefore, this scientific statement aims to synthesize the available evidence, provide suggestions for best practice based on the available evidence, identify evidence-based gaps in managing elevated inpatient BP (asymptomatic and hypertensive emergency), and highlight areas requiring further research.

Key Words: AHA Scientific Statements ■ antihypertensive agents ■ blood pressure ■ hospitalization ■ hypertension ■ inpatients

High blood pressure (BP) remains the leading modifiable risk factor for cardiovascular disease (CVD) in the United States, and a large body of high-quality evidence guides the diagnosis and management of elevated BP in the outpatient setting. However, fewer data are available for the management of elevated BP in the acute care setting. Throughout this scientific statement, we use the terms acute care and inpatient to refer to care received in the emergency department (ED) and after admission to the hospital. The presence of elevated BP in the acute care setting in the United States is exceptionally common. One study found that elevated inpatient BP, with or without evidence of new or worsening target-organ damage, was present in up to 72% of hospital admissions.[1]

Elevated inpatient BP can be broadly categorized into 2 groups: asymptomatic elevated BP and elevated BP with signs of new or worsening target-organ damage, also known as hypertensive emergency. Although the recommendation to treat hypertensive emergency in a timely manner is well accepted, there is less clarity about the risks and benefits of treating asymptomatic elevated inpatient BP with antihypertensive medication. Despite its ubiquity, there are no randomized trials on the risks and benefits of treating asymptomatic elevated inpatient BP with antihypertensive medication, and recent observational studies suggest potential harms.

This scientific statement synthesizes the available evidence for treatment of elevated inpatient BP

Hypertension is available at www.ahajournals.org/journal/hyp

(asymptomatic and hypertensive emergency), outlines the evidence gaps for management of elevated inpatient BP, and sets forth potential hypotheses to be tested in future high-quality studies.

DEFINITIONS

Figure 1 presents the terminology used to define elevated inpatient BP (≥130 mm Hg systolic BP [SBP] or ≥80 mm Hg diastolic BP [DBP]) to be consistent with the 2017 Hypertension Clinical Practice Guidelines definition of hypertension.[2] Historical terms such as hypertensive crisis (markedly elevated BP, eg, SBP/DBP >180/110–120 mm Hg, with or without new or worsening target-organ damage) and hypertensive urgency (markedly elevated BP without evidence of new or worsening target-organ damage) fail to acknowledge the nuances of treatment decisions and, through the use of subjective emotive language such as crisis and urgency, may encourage unnecessary antihypertensive treatment. Therefore, we propose the following objective terminology: hypertensive emergency (SBP/DBP >180/110–120 mm Hg with evidence of new or worsening target-organ damage), asymptomatic markedly elevated inpatient BP (SBP/DBP >180/110–120 mm Hg without evidence of new or worsening target-organ damage), and asymptomatic elevated inpatient BP (SBP/DBP ≥130/80 mm Hg without evidence of new or worsening target-organ damage). It is imperative to underscore that BP-related target-organ damage might manifest even when BP is below the 180/110 to 120 mm Hg threshold in particular contexts, indicating that this benchmark should not be perceived as an unequivocal aspect of the definition criteria. BP-related target-organ damage refers to the acute harmful effects of elevated BP on vital organs. Specifically, it is defined by any symptom, sign, or diagnostic finding indicative of acute damage, including but not limited to injuries to the brain (eg, hypertensive encephalopathy, intracranial hemorrhage, and acute ischemic stroke), heart (eg, acute myocardial infarction, unstable angina, acute left ventricular failure with pulmonary edema), large vessels (dissecting aortic aneurysm), kidneys, and the microvasculature. Microvasculature manifestations may include conditions such as high-grade retinopathy, acute kidney injury, or microangiopathic hemolytic anemia and thrombocytopenia.

EPIDEMIOLOGY

In 2012, hypertension was the primary diagnosis for 1 040 000 ED visits, with ≈23% resulting in hospitalization.[3] Data from the Nationwide Emergency Department Sample for 2006 to 2013 indicate that hypertensive emergencies occurred in ≈2 in 1000 adult ED visits overall and 6 in 1000 for individuals with a previous diagnosis of hypertension.[4] Rates of hypertensive

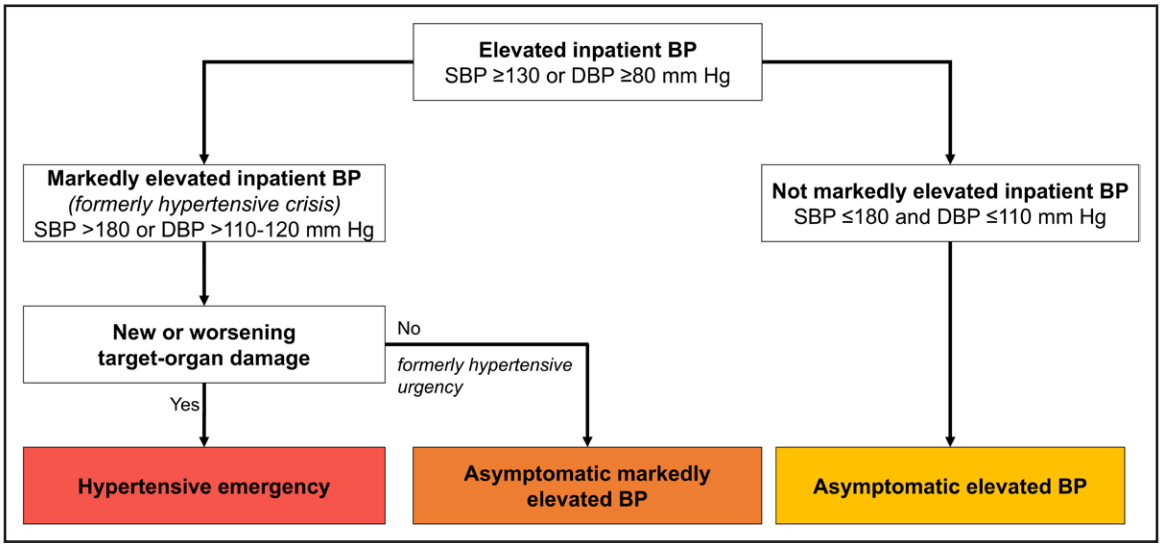

Figure 1. Terminology of elevated inpatient BP in the acute care setting.
The blood pressure (BP) classifications depicted in this figure are based on established thresholds from recent hypertension guidelines, including the 2017 Hypertension Clinical Practice Guidelines, the 2018 European Society of Cardiology/European Society of Hypertension (ESH) clinical practice guidelines for the management of arterial hypertension, and the 2023 ESH guidelines on arterial hypertension management. Markedly elevated BP is defined by the 2017 Hypertension Clinical Practice Guidelines as systolic BP (SBP) >180 mm Hg or diastolic BP (DBP) >120 mm Hg in scenarios without new or worsening target-organ damage. The 2023 ESH guidelines categorize hypertensive emergency or urgency as grade 3 hypertension (SBP ≥180 mm Hg or DBP ≥110 mm Hg) without differentiating severity based solely on BP values among those showing no signs of target-organ damage progression. The depicted ranges for inpatient elevated BP align with recommendations for outpatient high BP management as the definition of stage I hypertension. Readers are encouraged to consult individual guidelines for detailed definitions and clinical context.

emergencies have increased over the past 20 years; however, mortality rates have decreased and range from 0.2% to 11%.[4,5]

Asymptomatic elevated inpatient BP is more common than hypertensive emergency, although the prevalence varies. In a systematic review involving 9 studies, asymptomatic elevated inpatient BP was present in 50% to 72% of hospitalizations.[1] A multihospital study of 224 265 adults admitted for reasons other than hypertension found that 10% had asymptomatic markedly elevated inpatient BP.[6] In another study, the presence of at least 1 elevated BP, defined as SBP >140 mm Hg, was seen in 78% of 22 834 adults admitted to a medicine service for noncardiac diagnoses.[7] Certain patient populations appear to be more prone to hypertensive emergencies or asymptomatic elevated inpatient BP. These include older individuals, Black adults, and those with comorbidities such as diabetes, chronic kidney disease, and CVD.[4,6,8] In addition, socioeconomically disadvantaged individuals who are underinsured or who live in low-income areas and individuals who are nonadherent to antihypertensive medication also face an increased risk for being hospitalized for hypertension.[9–11] The prevalence of elevated inpatient BP likely varies by region as a result of challenges such as shortages of health care professionals in rural areas and other resource availability unique to specific geographies. Furthermore, sex and gender may also play a role. The prevalence of outpatient hypertension is lower in women until about the fifth decade of life and is higher later in life compared with men. However, there is no evidence suggesting that the threshold for initiating antihypertensive medication or indicating the type or combinations of antihypertensive medications to use should differ according to sex or gender. The management of hypertension in pregnancy in the inpatient setting has special requirements, and we refer the readers to recent guidelines and scientific statements on the management of hypertension in pregnancy.[12,13]

BP MEASUREMENT IN THE ACUTE CARE SETTING

The 2019 American Heart Association (AHA) scientific statement on BP measurement described best practices for outpatient BP measurement in and out of the office setting.[14] However, BP measurement in the acute care setting was not addressed in that statement, largely because of the limited data on this topic. Although the contexts are different, the general principles of proper BP measurement technique apply as outlined in the AHA scientific statement on measuring BP.[14] Most studies examining elevated inpatient BPs have relied on BP measurements taken during routine care and recorded in the electronic health record. However, BP recordings in the electronic health record typically omit critical contextual factors contributing to variability and inaccuracy (Figure 2). These factors may include the device type, validation and calibration status of the device, BP cuff placement, cuff size, patient position (eg, supine, seated), and situational factors (eg, anxiety, pain, patient woken up for BP measurement). The available data suggest significant variation in current BP measurement practices in

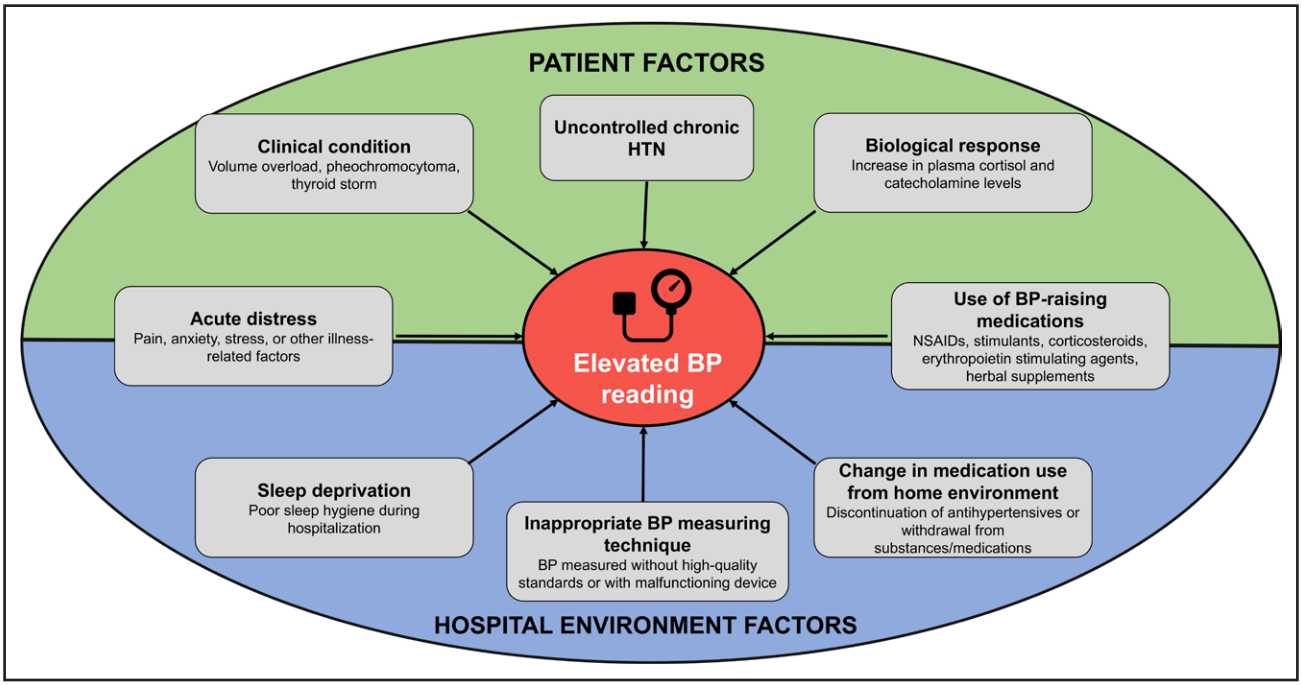

Figure 2. Mechanisms for elevated BP in the acute care setting.
BP indicates blood pressure; HTN, hypertension; and NSAID, nonsteroidal anti-inflammatory drug.

the acute care setting, including discrepancies in patient position, arm support, relative position to the heart, leg crossing, and incorrect cuff sizing.[14] For instance, 1 report found that 36 of 100 inpatient BP measurements in a UK hospital were performed with an inappropriately sized cuff.[15] In addition, the technique and variability of inpatient BP measurements may differ depending on the hospital unit where the BP is measured. In the intensive care unit, BP is often measured with an arterial line; however, erroneous readings can occur because of movement artifacts or calibration errors.[16] This variation in measurement practices can contribute to inaccurate BP readings and subsequent unnecessary treatment. However, arterial lines are preferred for hypertensive emergencies and for intravenous antihypertensives. Studies have found that when BPs are >180/100 mm Hg in critical care or surgical inpatient populations, oscillometric devices may underestimate BP by as much as 50/30 mm Hg compared with BP from an arterial line.[17,18] Even research-quality manual auscultatory methods with aneroid or mercury devices exhibit notable discrepancies compared with arterial line readings.[19,20] Thus, arterial lines are preferred for monitoring the rate of BP decline and the use of intravenous antihypertensive medications for hypertensive emergency. In asymptomatic elevated BP, when feasible, using standardized BP measurements in the acute care setting before making BP management decisions is reasonable and may help minimize variability and ensure appropriate treatment. Special populations, including pregnant individuals, older individuals, or patients with obesity, pseudohypertension, arrhythmias, pulseless syndromes, and left ventricular assist devices, require particular attention when BP is measured. For these special populations, we direct readers to the 2019 AHA scientific statement on the measurement of BP in humans.[14] Another special population for BP management in the inpatient setting is patients in the perioperative period. BP management in this setting is influenced by many factors such as pain, anxiety, anesthesia, and procedural variables. Although this topic is beyond the scope of our current statement, it merits attention and a dedicated review because of its distinct clinical challenges. Furthermore, the timing of BP measurements, relative to the time of day and proximity to stressors such as blood draws and diagnostic tests, along with geographic practices and staffing considerations, can influence BP measurement quality in the acute care setting.

MANAGEMENT OF ELEVATED INPATIENT BP

The management of elevated inpatient BP involves appropriate measurement technique, assessment of the severity of the reading, evaluation for new or worsening target-organ damage, addressing underlying causes of elevated BP, and judicious appraisal of the risks and benefits of initiating antihypertensive treatment (Figure 3). We found the inpatient A-I-M acronym (assess, identify, modify) appropriate to guide initial management (Figure 4) and the posthospitalization A-I-M acronym (arrange, inform, monitor) appropriate for discharge and transition-of-care planning.

Hypertensive Emergency

Distinguishing hypertensive emergencies from asymptomatic elevated inpatient BP is the critical first step

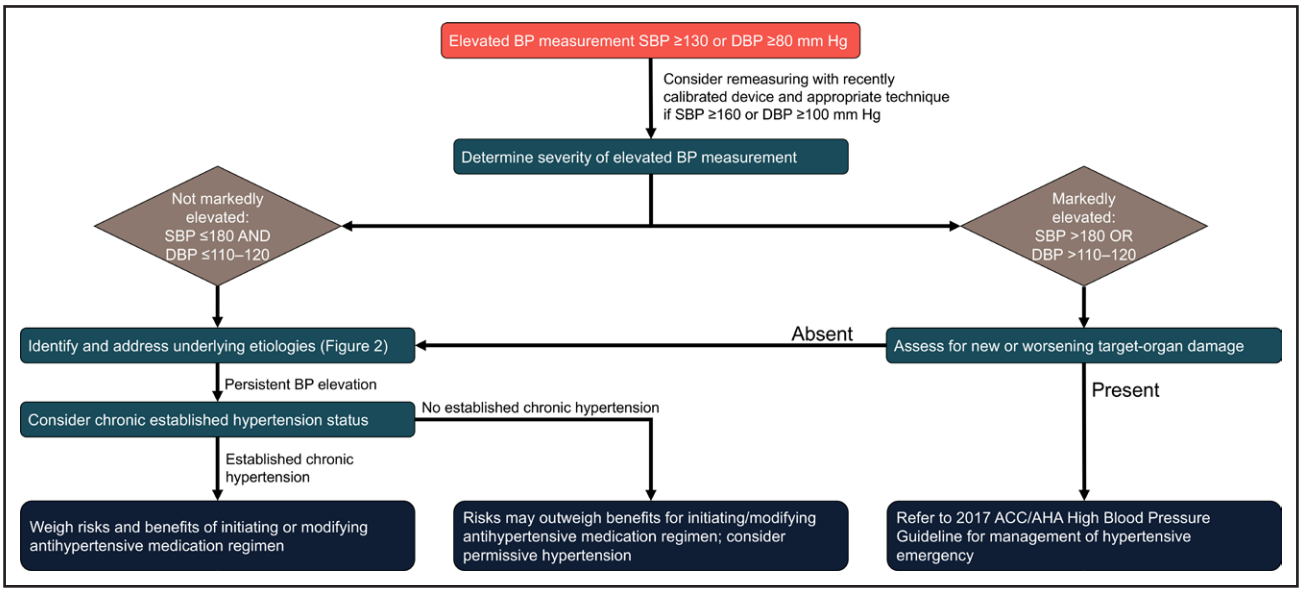

Figure 3. Approach to the acute management of elevated BP in the acute care setting.
ACC/AHA indicates American College of Cardiology/American Heart Association; BP, blood pressure; DBP, diastolic blood pressure; and SBP, systolic blood pressure.

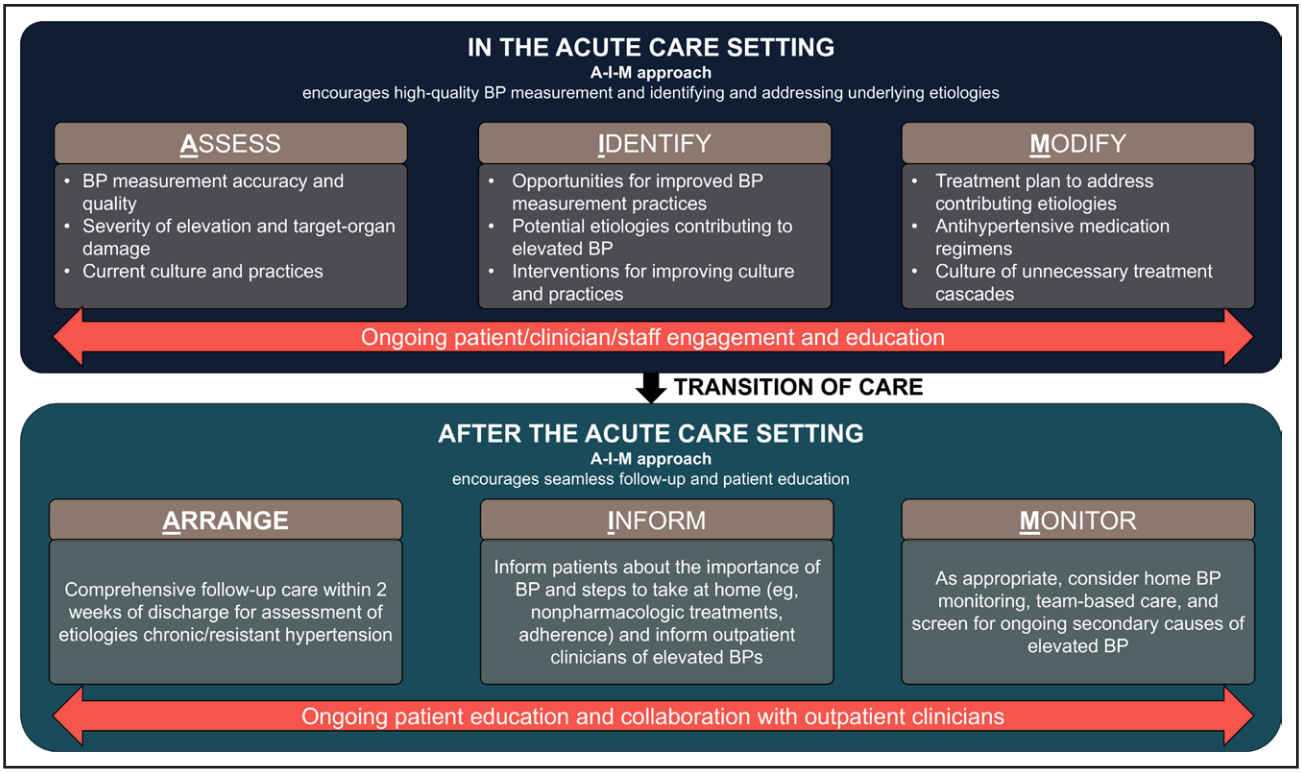

Figure 4. Care pathways for the management of BP in the acute care setting and transitions of care.
BP indicates blood pressure.

in management. After an accurate BP measurement is performed with the appropriate technique, the next step is to assess the severity of the reading and assess for evidence of new or worsening target-organ damage, the hallmark of hypertensive emergency. The BARKH acronym (brain, arteries, retina, kidney, heart) assists in quickly identifying potential target organs at risk (Table 1).[21] A comprehensive evaluation of markedly elevated BP includes a thorough history and physical examination. A comprehensive history includes information on chronic hypertension, the patient's current antihypertensive medications and adherence to the regimen, and ascertainment of any available outpatient BP readings. The physical examination includes a focus on comparing bilateral pulses, auscultating the heart and lungs, and performing a fundoscopic examination. Further diagnostic investigations include a basic metabolic panel, a complete blood count, a chest radiograph, a 12-lead ECG including heart rate, and an assessment of volume status and risk of orthostasis. If the BP reading is confirmed and evidence of new or worsening target-organ damage is present, then the treatment pathway for hypertensive emergency as outlined in the 2017 Hypertension Clinical Practice Guidelines should be promptly initiated.[2]

Asymptomatic Elevated Inpatient BP

Asymptomatic elevated inpatient BP is much more common than hypertensive emergency, yet the optimal strategies for managing BP in this setting remain unclear. Despite the lack of data, treatment in these circumstances is common. Treatment may be influenced by historical factors such as the emotive label of hypertensive crisis or hypertensive urgency and health-system factors such as vital sign alarms, automated clinical decision alerts, nursing notifications, and standardized pro re nata (PRN) order sets for BP measurements above a certain threshold. For example, PRN parenteral antihypertensive orders may be used to minimize disturbances from overnight calls or pages. This practice could lead to the administration of antihypertensive agents during the night, potentially lowering morning BP enough to withhold morning oral antihypertensive medications. Consequently, evening BP readings might run higher, contributing to a recurrent pattern of high BP at night and increased overall BP variability. In general, it is prudent to avoid PRN orders for antihypertensive medications to treat asymptomatic elevated inpatient BP. Admitting services can also ask that patients in the ED with markedly elevated BP first have the BPs be lowered to more "acceptable" levels before patient transfer, a practice that may be reinforced by institutional policies. Such policies, although well intended, may perpetuate a culture of routinely treating asymptomatic elevated inpatient BP, even in the absence of evidence of benefit. In this section, we first outline general best practices before presenting the current available observational evidence to inform the risks and benefits of treating asymptomatic elevated inpatient BP readings with antihypertensive medication.

Table 1. Hypertensive Emergencies by Organ and Initial Treatment Approach

	Organ				
	Brain	**Arteries**	**Retina**	**Kidney**	**Heart**
Acute conditions indicating hypertensive emergency	Stroke Hypertensive encephalopathy (PRES) Cerebral hemorrhage	Acute aortic dissection Preeclampsia, HELLP, eclampsia	Grade III–IV Keith-Wagener-Barker hypertensive retinopathy	Acute kidney injury Thrombotic microangiopathy	Acute heart failure Pulmonary edema Acute coronary syndrome
Initial BP target	130<SBP<180 mm Hg, MAP decline 15% in 1 h Immediate MAP decline 20%–25% Immediate MAP decline 15%	SBP <120 mm Hg immediate Immediate SBP <160 mm Hg and DBP <105 mm Hg if severe	SBP <180 mm Hg MAP decline of 15%	MAP decline 20%–25% over several hours	SBP <180 mm Hg or MAP decline 25% Immediate SBP <140 mm Hg Immediate SBP <140 mm Hg
Treatment agents	Labetalol Nicardipine	Esmolol and nitroprusside, nitroglycerin, or nicardipine Labetalol, nicardipine, magnesium sulfate, or hydralazine		Labetalol Nicardipine Clevidipine Fenoldopam	Nitroglycerin Nitroprusside Labetalol Clevidipine Esmolol

BP indicates blood pressure; DBP, diastolic blood pressure; HELLP, hemolysis, elevated liver enzymes, low platelets; MAP, mean arterial pressure; PRES, posterior reversible encephalopathy syndrome; and SBP, systolic blood pressure.

Data derived from Rossi et al[21] as part of the BARKH (brain, arteries, retina, kidney, heart) acronym designed for rapid identification of hypertensive emergencies requiring rapid parenteral treatment.

Careful Assessment of the BP Reading and Identifying Reversible Causes of Inpatient Elevated BP

The initial step in addressing asymptomatic elevated inpatient BP involves verifying the accuracy of the BP measurement and assessing for reversible causes.[2] A common sense approach involves first checking the BP measurement device to ensure that it is in optimal working condition and has been calibrated recently. However, because of current clinical demands, this may be impractical or unrealistic for busy clinical staff. Therefore, it is incumbent on hospital administration and medical engineering departments to ensure that all BP measurement devices are routinely calibrated and maintained in good working order. Next, it is prudent to repeat the BP measurement using proper technique as outlined in the AHA scientific statement for measuring BP[14] as closely as the clinical situation allows (eg, having the patient sit up in bed rather than being supine).

Next, the evidence supports identifying and addressing any reversible causes for the elevated BP (Figure 2). Acute stress, pain, anxiety, sleep deprivation, and other acute illness–related factors can raise BP. Home and inpatient medication lists should be thoroughly reviewed to identify medications that could potentially increase BP such as excessive intravenous fluids, nonsteroidal anti-inflammatory drugs, stimulants, corticosteroids, or illicit substances (eg, cocaine, methamphetamine). In addition, heart rate is important to monitor closely because it affects cardiac output and thus BP. In the inpatient setting, especially during acute illnesses or the administration of vasoactive or chronotropic medications, variations in heart rate, whether intrinsic or medication induced, can profoundly affect BP readings. This is evident in scenarios such as rebound hypertension after the abrupt cessation of β-blockers, when acute drops in BP trigger an increased heart rate to sustain cardiac output, or low BP in the setting of atrial fibrillation with rapid ventricular response. For patients with an existing hypertension diagnosis already taking antihypertensive medications at home, the evidence supports assessment of whether their home medications have been appropriately restarted during this admission. One study reported that 41% of patients prescribed PRN antihypertensives were not receiving their home regimen while in the hospital.[22] Another study of postsurgical inpatients receiving at least 1 dose of intravenous antihypertensive medication found that 25% were not started on their home antihypertensive medication regimen during hospitalization.[23] It is also important to consider that patients' home treatment regimens might be altered on hospital admission because of formulary limitations, which can inadvertently affect their BP control during their hospitalization. In managing asymptomatic elevated inpatient BP, it is important to assess the patient's volume status. Fluctuations in volume not only can affect BP readings but also can influence therapeutic strategies. Shifts in volume status, whether caused by fluid resuscitation, diuresis, or other interventions, can contribute to changes in BP. Equally important are the assessment and management of pain, factors often overlooked in the interpretation of elevated BP readings. Last, if available, the evidence supports evaluating the patient's measured BP levels outside of the hospital. These out-of-hospital BP readings and a diagnosis of established chronic hypertension are important to consider in the treatment algorithm because persistent BP elevations in inpatient and outpatient settings

might indicate the need for initiating or intensifying oral medications while the patient is in the hospital.

Outcomes of Treating Asymptomatic Elevated Inpatient BP

No randomized clinical trials have studied the treatment of asymptomatic elevated inpatient BP. However, multiple recent observational studies suggest that pharmacological treatment of asymptomatic elevated inpatient BP in the acute care setting, especially with intravenous medications, carries risks. One recent target trial emulation study by Anderson et al[24] examined intensive antihypertensive treatment strategies among adults ≥65 years of age who were hospitalized for noncardiac reasons in the national Veterans Affairs health system and had at least 2 elevated inpatient BP measurements in the first 48 hours of hospitalization. Patients who received ≥1 doses of new or intravenous antihypertensives medications in the first 48 hours of hospitalization were categorized as receiving intensive treatment. Patients not meeting this criterion were classified as receiving standard treatment. The primary outcome was a composite of mortality, acute kidney injury, stroke, troponin elevation, BNP (B-type natriuretic peptide) elevation, and transfer to the intensive care unit during the hospitalization. Intensive BP treatment occurred in 21% of eligible patients in the first 48 hours, and 18% of intensively treated patients received intravenous antihypertensives. Patients who received intensive BP treatment were more likely to experience the primary outcome (8.7% versus 6.9%; adjusted odds ratio, 1.28 [95% CI, 1.18–1.39]), and they were also more likely to experience a hypotensive episode (14.8% versus 14.0%; adjusted odds ratio, 1.22 [95% CI, 1.15–1.30]). Results were consistent across subgroups of age, frailty, home BP, and preexisting CVD.

In another study that included younger adults, Rastogi et al[7] examined patients hospitalized for noncardiac reasons who exhibited elevated inpatient BP in a 10-hospital health system. They compared patients whose highest BP during hospitalization was treated with new intravenous or oral antihypertensive medications with patients whose highest BP was not treated. Overall, 33% of the study population received intravenous or new oral antihypertensive medications, of which 26% included at least 1 intravenous medication. In the propensity score–matched analysis, patients who received ≥1 intravenous antihypertensive medications had significantly higher rates of the composite of acute kidney injury, myocardial infarction, or stroke (11% versus 8.2%).

Additional studies have focused on patients receiving PRN intravenous antihypertensives. Parenteral antihypertensive medications can lower BP abruptly, particularly in people with acute illness and impaired autoregulation. In a retrospective cohort health system study by Ghazi et al[6] of 22 000 hospitalized adults who developed markedly elevated asymptomatic BP, patients treated with intravenous antihypertensives were 40% more likely to have a ≥30% reduction in mean arterial pressure. In the same study population, intravenous antihypertensive treatment was associated with 60% greater risk of myocardial injury. In a single-center study, Mohandas et al[25] analyzed patients hospitalized for noncardiac indications, comparing patients who received PRN antihypertensives at any point during the hospitalization with patients who received scheduled antihypertensive medications. The investigators found that patients who received PRN antihypertensive medications (93% of which were intravenous) had a 2-fold higher risk of death, 24% higher risk of acute kidney injury, and 2-fold higher risk of abrupt BP lowering (defined as a >25% decrease in SBP within 1 hour of medication administration). However, the study had higher risk of confounding by indication because it did not consider the reason for admission, which included cardiovascular symptoms such as chest pain, heart failure, and shortness of breath. Another study in a large urban hospital found that 32.6% of patients receiving PRN intravenous antihypertensive medications experienced a drop in BP of >25% within 6 hours.[26] That same study found that administration of PRN intravenous antihypertensive medications was not routinely followed by intensification of oral medications and that PRN medications were often ordered for BP levels far below 180/100 mm Hg.[26] These data highlight the potential for serious adverse events attributable to large BP drops associated with intravenous antihypertensive medication administration.

Does The Evidence Support Any Situation to Treat Asymptomatic Elevated Inpatient BP?

Although most patients may not require treatment for asymptomatic elevated inpatient BP, it is plausible that benefit may outweigh risk in certain groups. Specifically, best practices for patients with persistent markedly elevated inpatient BP readings (ie, SBP/DBP >180/110–120 mm Hg) who have a history of high outpatient BPs may include initiating or intensifying antihypertensive medication during their admission. In addition, it may be reasonable to initiate or intensify antihypertensive medications in those with persistently high BP or persistently uncontrolled BP, as well as those at a high risk for or with a history of CVD. It is important to consider that a patient's BP may take several days to weeks to adjust to a medication change. Therefore, a typical inpatient stay is unlikely to be sufficient to fully assess the effect of a single medication change, and close outpatient follow-up is needed. In addition, the reason for hospitalization may affect decisions on treatment. For patients with resistant hypertension, a hospitalization for CVD might be an ideal time for a more comprehensive workup for secondary causes during their admission. However, for patients hospitalized for conditions unrelated to hypertension, a period of acute illness may be a less optimal time to intervene

because patient priorities may be focused on the acute illness and their physiology not at baseline. We acknowledge that although the 2017 Hypertension Clinical Practice Guidelines define treatment goals for hypertensive emergencies, treatment goals for asymptomatic elevated BP are not as straightforward. If the decision is made to initiate antihypertensive medication for asymptomatic elevated inpatient BP, it is prudent to use guidance from the current 2017 Hypertension Clinical Practice Guidelines.

In summary, the current state of evidence suggests that treating asymptomatic elevated inpatient BP should generally be the exception, not the rule. Future studies are needed to further clarify whether there is clinical benefit for patients with markedly elevated hypertension without evidence of new or worsening target organ damage. Until then, adopting a cautious and patient-centered approach might be the most prudent strategy. If the choice to begin antihypertensive medication is made, using the 2017 Hypertension Clinical Practice Guidelines to guide the initial regimen in the acute care setting is reasonable.

OPTIMIZING TRANSITIONS OF CARE

Disposition After an ED Encounter

A number of barriers to identification and appropriate initiation of treatment in the ED persist, including diagnostic uncertainty about the reliability of BP measurement in the ED setting and lack of coordination with outpatient primary care teams.[27,28] The 2013 American College of Emergency Physicians clinical policy discourages antihypertensive medication for asymptomatic elevated inpatient BP in the ED, but initiating oral therapy in the ED at discharge to home is supported by the evidence for some patients.[29] Although the structure of ED clinicians' workflow is not designed for the management of chronic disease, they do serve as a key—and sometimes primary—source of care for many patients who lack access to reliable outpatient care. Therefore, initiating antihypertensive treatment in the ED can help address health care disparities, particularly in disenfranchised groups who tend to experience poorer BP control[30] and disproportionate rates of severe cardiovascular consequences,[31] often lack primary medical care,[32] and are more likely to present to the ED for care.[33] The disposition after an ED encounter with hypertension as a focal concern encompasses a multitude of factors. For patients with asymptomatic elevated BP presenting to the ED, engaging community health workers, implementing specific care pathways, and providing referral strategies, including harnessing alternative care models to facilitate primary care follow-up and ongoing BP management, are critical to ensuring appropriate and equitable management after ED discharge.[34–40]

In addition to the immediate clinical needs, significant economic challenges, educational challenges, and geographic disparities play a pivotal role and disproportionally affect people of color. Particularly critical are equity issues related to inconsistent access to longitudinal primary care. For many patients presenting with high BP in the acute care setting, the challenge often is not the need for new medication but rather the absence of consistent, high-quality, affordable, and reliable outpatient health care and follow-up. To this end, the AHA-funded Health-Equity Research Network called RESTORE (Addressing Social Determinants to Prevent Hypertension) is pioneering significant strides in delineating equity-focused interventions to reduce hypertension burden in underresourced communities.[41]

Although beyond the scope of this scientific statement, we also recognize the importance of addressing the economic burden of ongoing hypertension management. Most antihypertensive medication regimens can be constructed with low-cost generic medications but still pose a financial burden for some patients. Strategies such as generic substitutions, patient assistance programs offered by pharmaceutical companies, community health initiatives, and advice from primary care clinicians on cost-effective therapeutic alternatives may be helpful. Understanding the patient's financial, personal, and social context and health insurance backdrop is pivotal to address health disparities in hypertension.

Disposition After Hospital Admission

For patients with elevated inpatient BP with or without a preadmission diagnosis of hypertension, there are 2 crucial steps at discharge: (1) careful review and adjustment of medication with adequate patient counseling and (2) planning for future care coordination. The best available evidence suggests maintaining the prehospitalization antihypertensive medication regimen and avoiding intensification at discharge.[7,24,25] Assessment of the entire medication regimen at discharge is essential, focusing on identifying guideline-discordant antihypertensive regimens because many patients receive antihypertensive medications that do not align with guideline-recommended classes.[42] Any new antihypertensive medication initiated during the admission should align with the 2017 Hypertension Clinical Practice Guidelines[2] and should account for factors that could affect treatment effectiveness and medication adherence such as health literacy, health insurance, affordability, social support, and self-management resources (eg, limited mobility, communication, digital technology, and transportation barriers).[43] Among US adults with hypertension, ≈18% take at least 1 medication that can increase inpatient BP,[44] and these medications should be discontinued when possible.

Recent data indicate that adherence to antihypertensive medications initiated at discharge is low. One study found that about one-third of antihypertensive medications prescribed at hospital discharge were never refilled, and half were discontinued by the end of the first year.[45]

 Hypertension. 2024;81:e00–e00. DOI: 10.1161/HYP.0000000000000238

Consideration should also be given to fixed-dose or combination therapy, which can improve adherence, help achieve adequate BP control sooner, and reduce medication burden.[2,46] Despite these advantages, the use of fixed-dose or combination therapy remains low, with only 27% of US adults on ≥2 antihypertensive medications using fixed-dose or combination therapy.[47] High-quality medication counseling on discharge is critical; 1 in 7 patients experiences confusion about their medication, leading to a higher risk of readmission.[48] Clear communication about any changes made during the admission, along with the need for outpatient monitoring, including out-of-office BP monitoring, is essential. In addition, some patients might prefer to delay any changes until they recover from their acute illness and can reassess with their primary care clinician. Patient education and family discussions about BP and antihypertensive medications may help ensure that all necessary follow-up appointments with the primary care clinicians or pharmacist are scheduled before discharge.[49]

High-quality postdischarge care for patients with hypertension involves patient education, promotion of self-management and lifestyle modifications, potential use of antihypertensive medications, and home BP monitoring (Figure 4).[2] We recognize the importance of accurate and consistent home BP monitoring. It is important to use validated home BP measurement devices. The website validatebp.com has a listing of validated home BP monitors. Successful transitions of care from the hospital to home include a focus on coordinating various levels of care and services across settings, including anticipating patients' short-term and long-term needs after discharge.[50] For discharge care coordination, establishing a follow-up appointment with the primary care clinicians is crucial. If a timely follow-up appointment is not feasible, scheduling the patient to see another clinical team member is reasonable. Ideally, this would involve a case manager within a team-based care model for hypertension, which has been shown to be more effective at controlled BP than usual care.[51] Current hypertension guidelines recommend a team-based approach that emphasizes shared decision-making, assessing and addressing social determinants of health, and consistent communication across settings.[2]

In summary, effective strategies for managing hypertension on discharge encompass various approaches. These include performing assessments to determine discharge readiness, educating patients and their families to encourage self-management, providing high-quality pharmaceutical care, and facilitating outpatient team-based care and home BP monitoring. Follow-up visits and referrals to subspecialty care for both primary and secondary reasons for hospitalization are also integral components of this strategy. Last, reconciling and managing medications plays a key role in ensuring effective hypertension management after discharge. Inadequate discharge planning can lead to costly and unnecessary ED visits, hospital readmissions, preventable CVD-related adverse events, and drug-related errors and medication nonadherence.[52]

RESEARCH PRIORITIES AND GAPS

Given the frequency with which asymptomatic elevated inpatient BPs are encountered and treated in clinical practice and data from observational studies suggesting potential harm, pragmatic randomized trials and implementation studies to guide treatment decisions are urgently needed (Table 2). High-quality observational studies using modern casual inference methods may be useful in settings where randomized trials are impractical or infeasible. Another important and unsettled question is the optimal treatment target if the decision is made to treat elevated inpatient BP. It may not be fitting to apply outpatient treatment targets, derived from data among stable ambulatory outpatients, to hospitalized patients. A potential pragmatic trial structure to identify optimal target BP ranges for hospitalized patients could be borrowed from similar trials of inpatient blood glucose control.[53] Such a trial might compare permissive with intensive BP targeting, for example, comparing a target

Table 2. Areas for Future Research

Aspect of inpatient FP elevation	Areas for future research
Epidemiology	The epidemiology of adverse events attributable to severely elevated inpatient BP remains poorly defined. Additional large cohort studies are needed to better understand the acute risks of asymptomatic elevated inpatient BP.
Measurement	For all patients, implementation science to support best practices for BP measurement in the acute care setting is needed. For patients without a prior diagnosis of hypertension, research is needed to identify whether elevated inpatient BP is associated with ambulatory hypertension.
Pathogenesis	Additional research to better understand triggers of severely elevated BP during hospitalization and to quantify the average effect of common triggers on BP may improve clinical decision-making.
Management	Clinical trials are needed to understand the benefits and harms of short-term BP management for asymptomatic hospitalized adults and to identify blood pressure treatment targets. Given the heterogeneity of reasons for hospitalization, trials focused on specific inpatient populations (eg, postoperative patients, medical patients, patients in the ICU) may be warranted.
Transitions of care	Research identifying optimal pathways for communication of findings of elevated BP to patients and their outpatient clinicians for short-term follow-up and to link patients without follow-up to primary care is needed.
Health equity	Research identifying equity-focused interventions to design, tailor, personalize, and test interventions to improve the management of BP in the inpatient setting among underresourced groups is needed.

BP indicates blood pressure; and ICU, intensive care unit.

SBP/DBP of <140/90 mm Hg with <180/110 to 120 mm Hg. Given the heterogeneity of inpatient populations, multiple trials will likely be needed.

Another research priority relates to improving the measurement of BP in the acute care setting. Best practices for outpatient BP measurement have been established, and efforts to translate these practices into the acute care setting are needed.[14] It is important to note that simply increasing the frequency of inpatient BP monitoring is unlikely to be a suitable substitute for higher-quality monitoring. This entails not only improving the current measurement techniques but also establishing standards for measuring supine BP in immobile patients, particularly those who are not in the intensive care unit. In addition, it is important to consider supine BPs in general because many patients are not transferred to a seated position for vital sign assessments and instead remain supine in their hospital beds.

Among patients without a prior diagnosis of hypertension, the acute care setting may reflect an opportunity to identify a modifiable cardiac risk factor and set patients on the path to long-term, durable BP control. Capitalizing on this opportunity requires an expanded understanding of the relationship between inpatient and outpatient BPs. Furthermore, measures of success need to move past the short-term focus on improvement of BP recordings at hospital discharge and toward continuity of BP care between the inpatient and outpatient settings. Many patients with elevated inpatient BP will require follow-up, typically with a primary care clinician. Pragmatic, patient-centered evaluations of strategies to increase postdischarge outpatient BP monitoring and follow-up after discharge will be needed, as have been performed to optimize other outpatient monitoring practices.

CONCLUSIONS

Although hypertensive emergency clearly warrants aggressive treatment with close monitoring, when and how to treat asymptomatic elevated inpatient BP, although frequently done with PRN medications given intravenously or orally, remain less certain. Future studies of management of elevated inpatient BP should focus on accurate BP measurement, differences among patients with and without a prior diagnosis of chronic hypertension, and treatment targets. In the meantime, the best available evidence suggests a practical, common sense approach to treatment of asymptomatic elevated inpatient BP, including repeating the BP measurement with a proper measurement technique and addressing all underlying conditions such as pain, anxiety, or other underlying illnesses, rather than focusing primarily on pharmacological interventions. Our 10 key implications for clinical practice are summarized in Table 3. Future studies must also address transitions of care from the ED to inpatient to home because each transition represents a potential opportunity to improve BP management and ultimately to improve patient outcomes.

Table 3. Ten Key Implications for Clinical Practice

1	It is important to use proper techniques with a recently calibrated device to measure BP
2	It is important to detect and correct reversible causes of elevated inpatient BP
3	In the ED setting, for asymptomatic elevated BP or asymptomatic markedly elevated BP, evidence supports avoiding intensifying hypertension medications, with a preference toward restarting home medications and planning for close outpatient follow-up care
4	Further research is needed to better define optimal inpatient BP measurement methods across different settings
5	Hypertensive emergencies require immediate and acute treatment usually with parenteral medications and often in the ICU setting
6	Elevated BP in the hospital without new or worsening target-organ damage may be best served by accurate remeasurement and attention to contributing circumstantial factors
7	Working with hospital administration to ensure regular validation of BP measurement devices may reduce erroneous elevated BP readings
8	The threshold to initiate or intensify antihypertensive medications in response to asymptomatic elevated inpatient BP should be high
9	Use of intravenous antihypertensives is not supported by the evidence in the absence of hypertensive emergency
10	Research is needed to determine the ideal inpatient candidate for intensification of the antihypertensive medication in response to asymptomatic elevated inpatient BP readings

BP indicates blood pressure; ED, emergency department; and ICU, intensive care unit.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

This statement was approved by the American Heart Association Science Advisory and Coordinating Committee on February 6, 2024, and the American Heart Association Executive Committee on April 30, 2024. A copy of the document is available at https://professional.heart.org/statements by using either "Search for Guidelines & Statements" or the "Browse by Topic" area. To purchase additional reprints, call 215-356-2721 or email Meredith.Edelman@wolterskluwer.com

The American Heart Association requests that this document be cited as follows: Bress AP, Anderson TS, Flack JM, Ghazi L, Hall ME, Laffer CL, Still CH, Taler SJ, Zachrison KS, Chang TI; on behalf of the American Heart Association Council on Hypertension; Council on Cardiovascular and Stroke Nursing; and Council on Clinical Cardiology. The management of elevated blood pressure in the acute care setting: a scientific statement from the American Heart Association. *Hypertension.* 2024;81:e•••–e•••. doi: 10.1161/HYP.0000000000000238

The expert peer review of AHA-commissioned documents (eg, scientific statements, clinical practice guidelines, systematic reviews) is conducted by the AHA Office of Science Operations. For more on AHA statements and guidelines development, visit https://professional.heart.org/statements. Select the "Guidelines & Statements" drop-down menu, then click "Publication Development."

Acknowledgments

The authors thank Joshua Jacobs, Alex Zheutlin, and Catherine Derington for their comments and editorial assistance on the manuscript, tables, and figures.

Disclosures

Writing Group Disclosures

Writing group member	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/ advisory board	Other
Adam P. Bress	University of Utah	None	None	None	None	None	None	None
Tara I. Chang	Stanford University	NIH/NHLBI (R01)†; CSL Behring (EAC committee chair work; paid to Stanford)†	None	None	None	None	Novo Nordisk†; ProKidney	None
Timothy S. Anderson	University of Pittsburgh; Center for Health Equity Research and Promotion, Veterans Affairs Pittsburgh Healthcare System	National Institute on Aging (grant funding for research related to inpatient blood pressure management)†	None	None	None	None	None	None
John M. Flack	Southern Illinois University	Astra Zeneca†; Cincor†; Mineralys†; ReCor Medical†; Quantam Genomics†; Indorsia†; GlaxoSmithKline†; Vascular Dynamics†	None	None	Teva†	Amphastar Pharmaceuticals†; Viking Therapeutics†; Orchard Biotechnology†	GlaxoSmithKline*; FibroGen†; Amgen*; Janssen*; ReCor†; Ardylex†; Astra Zeneca†	None
Lama Ghazi	University of Alabama at Birmingham	None	None	None	None	None	None	None
Michael E. Hall	University of Mississippi Medical Center	None	None	None	None	None	None	None
Cheryl L. Laffer	Vanderbilt University School of Medicine	None	None	None	None	None	None	None
Carolyn H. Still	Case Western Reserve University, Frances Payne Bolton School of Nursing	None	None	None	None	None	None	None
Sandra J. Taler	Mayo Clinic	None	None	None	None	None	None	None
Kori S. Zachrison	Massachusetts General Hospital and Harvard Medical School	None	None	None	None	None	None	None

This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Reviewer Disclosures

Reviewer	Employment	Research grant	Other research support	Speakers' bureau/ honoraria	Expert witness	Ownership interest	Consultant/advisory board	Other
Keith C. Ferdinand	Tulane University, School of Medicine	None	None	None	None	None	Novartis*; Boehringer Ingelheim*; Medtronic*; Janssen*; Eli Lilly*	None
Kristi Reynolds	Kaiser Permanente Southern California	National Heart, Lung, and Blood Institute†	None	None	None	None	None	None
Steven Shea	Columbia University	NHLBI (PI on contract NHLBI75N92020D00002)†	None	None	None	None	None	None
Domenic A. Sica	Virginia Commonwealth University	None	None	None	None	None	None	None
Howard S. Weintraub	New York University Medical Center	Novartis (HORIZON trial)†; Amgen (OCEAN trial)†	None	None	None	None	None	None

This table represents the relationships of reviewers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all reviewers are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $5000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $5000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

REFERENCES

1. Axon RN, Cousineau L, Egan BM. Prevalence and management of hypertension in the inpatient setting: a systematic review. *J Hosp Med*. 2011;6:417–422. doi: 10.1002/jhm.804
2. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, Collins KJ, Dennison Himmelfarb C, DePalma SM, Gidding S, Jamerson KA, Jones DW, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines [published correction appears in *Hypertension*. 2018;71:e140–e144]. *Hypertension*. 2018;71:e13–e115. doi: 10.1161/HYP.0000000000000065
3. Singh JA, Yu S. Emergency department and inpatient healthcare utilization due to hypertension. *BMC Health Serv Res*. 2016;16:1–11.
4. Janke AT, McNaughton CD, Brody AM, Welch RD, Levy PD. Trends in the incidence of hypertensive emergencies in US emergency departments from 2006 to 2013. *J Am Heart Assoc*. 2016;5:e004511. doi: 10.1161/JAHA.116.004511
5. Shah M, Patil S, Patel B, Arora S, Patel N, Garg L, Agrawal S, Jacobs L, Steigerwalt SP, Martinez MW. Trends in hospitalization for hypertensive emergency, and relationship of end-organ damage with in-hospital mortality. *Am J Hypertens*. 2017;30:700–706. doi: 10.1093/ajh/hpx048
6. Ghazi L, Li F, Chen X, Simonov M, Yamamoto Y, Biswas A, Hanna J, Shah T, Townsend R, Peixoto A, et al. Severe inpatient hypertension prevalence and blood pressure response to antihypertensive treatment. *J Clin Hypertens (Greenwich)*. 2022;24:339–349. doi: 10.1111/jch.14431
7. Rastogi R, Sheehan MM, Hu B, Shaker V, Kojima L, Rothberg MB. Treatment and outcomes of inpatient hypertension among adults with noncardiac admissions. *JAMA Intern Med*. 2021;181:345–352. doi: 10.1001/jamainternmed.2020.7501
8. Deshmukh A, Kumar G, Kumar N, Nanchal R, Gobal F, Sakhuja A, Mehta JL. Effect of Joint National Committee VII report on hospitalizations for hypertensive emergencies in the United States. *Am J Cardiol*. 2011;108:1277–1282. doi: 10.1016/j.amjcard.2011.06.046
9. Srivastava S, Vemulapalli B, Okoh AK, Kassotis J. Disparity in hospital admissions and length of stay based on income status for emergency department hypertensive crisis visits. *J Hypertens*. 2022;40:1607–1613. doi: 10.1097/HJH.0000000000003193
10. Lu Y, Wang Y, Spatz ES, Onuma O, Nasir K, Rodriguez F, Watson KE, Krumholz HM. National trends and disparities in hospitalization for acute hypertension among Medicare beneficiaries (1999-2019). *Circulation*. 2021;144:1683–1693. doi: 10.1161/CIRCULATIONAHA.121.057056
11. Wallbach M, Lach N, Stock J, Hiller H, Mavropoulou E, Chavanon ML, Neurath H, Blaschke S, Lowin E, Herrmann-Lingen C, et al. Direct assessment of adherence and drug interactions in patients with hypertensive crisis: a cross-sectional study in the emergency department. *J Clin Hypertens (Greenwich)*. 2019;21:55–63. doi: 10.1111/jch.13448
12. Garovic VD, Dechend R, Easterling T, Karumanchi SA, McMurtry Baird S, Magee LA, Rana S, Vermunt JV, August P; on behalf of the American Heart Association Council on Hypertension; Council on the Kidney in Cardiovascular Disease, Kidney in Heart Disease Science Committee; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Lifestyle and Cardiometabolic Health; Council on Peripheral Vascular Disease; and Stroke Council. Hypertension in pregnancy: diagnosis, blood pressure goals, and pharmacotherapy: a scientific statement from the American Heart Association [published correction appears in *Hypertension*. 2022;79:e70]. *Hypertension*. 2022;79:e21–e41. doi: 10.1161/HYP.0000000000000208
13. Gestational hypertension and preeclampsia: ACOG Practice Bulletin, Number 222. *Obstet Gynecol*. 2020;135:e237–e260. doi: 10.1097/aog.0000000000003891
14. Muntner P, Shimbo D, Carey RM, Charleston JB, Gaillard T, Misra S, Myers MG, Ogedegbe G, Schwartz JE, Townsend RR, et al; on behalf of the American Heart Association Council on Hypertension; Council on Cardiovascular Disease in the Young; Council on Cardiovascular and Stroke Nursing; Council on Cardiovascular Radiology and Intervention; Council on Clinical Cardiology; and Council on Quality of Care and Outcomes Research. Measurement of blood pressure in humans: a scientific statement from the American Heart Association. *Hypertension*. 2019;73:e35–e66. doi: 10.1161/HYP.0000000000000087
15. Holland M, Lewis PS. An audit and suggested guidelines for in-patient blood pressure measurement. *J Hypertens*. 2014;32:2166–2170. doi: 10.1097/HJH.0000000000000306
16. McGhee BH, Bridges EJ. Monitoring arterial blood pressure: what you may not know. *Crit Care Nurse*. 2002;22:60–64, 66–70, 73 passim.
17. Ribezzo S, Spina E, Di Bartolomeo S, Sanson G. Noninvasive techniques for blood pressure measurement are not a reliable alternative to direct measurement: a randomized crossover trial in ICU. *Sci World J*. 2014;2014:353628. doi: 10.1155/2014/353628
18. Wax DB, Lin H-M, Leibowitz AB. Invasive and concomitant noninvasive intraoperative blood pressure monitoring: observed differences in measurements and associated therapeutic interventions. *Anesthesiology*. 2011;115:973–978. doi: 10.1097/ALN.0b013e3182330286
19. Kallioinen N, Hill A, Horswill MS, Ward HE, Watson MO. Sources of inaccuracy in the measurement of adult patients' resting blood pressure in clinical settings: a systematic review. *J Hypertens*. 2017;35:421–441. doi: 10.1097/HJH.0000000000001197
20. Lehman L-WH, Saeed M, Talmor D, Mark R, Malhotra A. Methods of blood pressure measurement in the ICU. *Crit Care Med*. 2013;41:34–40. doi: 10.1097/CCM.0b013e318265ea46
21. Rossi GP, Rossitto G, Maifredini C, Barchitta A, Bettella A, Latella R, Ruzza L, Sabini B, Seccia TM. Management of hypertensive emergencies: a practical approach. *Blood Press*. 2021;30:208–219. doi: 10.1080/08037051.2021.1917983
22. Gaynor MF, Wright GC, Vondracek S. Retrospective review of the use of as-needed hydralazine and labetalol for the treatment of acute hypertension in hospitalized medicine patients. *Ther Adv Cardiovasc Dis*. 2018;12:7–15. doi: 10.1177/1753944717746613
23. Miller CP, Cook AM, Case CD, Bernard AC. As-needed antihypertensive therapy in surgical patients, why and how: challenging a paradigm. *Am Surg*. 2012;78:250–253.
24. Anderson TS, Herzig SJ, Jing B, Boscardin WJ, Fung K, Marcantonio ER, Steinman MA. Clinical outcomes of intensive inpatient blood pressure management in hospitalized older adults. *JAMA Intern Med*. 2023;183:715–723. doi: 10.1001/jamainternmed.2023.1667
25. Mohandas R, Chamarthi G, Bozorgmehri S, Carlson J, Ozrazgat-Baslanti T, Ruchi R, Shukla A, Kazory A, Bihorac A, Canales M, et al. Pro re nata antihypertensive medications and adverse outcomes in hospitalized patients: a propensity-matched cohort study. *Hypertension*. 2021;78:516–524. doi: 10.1161/HYPERTENSIONAHA.121.17279
26. Lipari M, Moser LR, Petrovitch EA, Farber M, Flack JM. As-needed intravenous antihypertensive therapy and blood pressure control. *J Hosp Med*. 2016;11:193–198. doi: 10.1002/jhm.2510
27. Tanabe P, Cline DM, Cienki JJ, Egging D, Lehrmann JF, Baumann BM. Barriers to screening and intervention for ED patients at risk for undiagnosed or uncontrolled hypertension. *J Emerg Nurs*. 2011;37:17–23. doi: 10.1016/j.jen.2009.11.017
28. Brody AM, Sharma VK, Singh A, Kumar VA, Goldberg EM, Millis SR, Levy PD. Barriers to emergency physician diagnosis and treatment of uncontrolled chronic hypertension. *Am J Emerg Med*. 2016;34:2241–2242. doi: 10.1016/j.ajem.2016.08.050
29. Wolf SJ, Lo B, Shih RD, Smith MD, Fesmire FM; American College of Emergency Physicians Clinical Policies Committee. Clinical policy: critical issues in the evaluation and management of adult patients in the emergency department with asymptomatic elevated blood pressure. *Ann Emerg Med*. 2013;62:59–68. doi: 10.1016/j.annemergmed.2013.05.012
30. Cutler JA, Sorlie PD, Wolz M, Thom T, Fields LE, Roccella EJ. Trends in hypertension prevalence, awareness, treatment, and control rates in United States adults between 1988–1994 and 1999–2004. *Hypertension*. 2008;52:818–827. doi: 10.1161/HYPERTENSIONAHA.108.113357
31. Graham G. Disparities in cardiovascular disease risk in the United States. *Curr Cardiol Rev*. 2015;11:238–245. doi: 10.2174/1573403x11666141122220003
32. Kirby JB, Kaneda T. Neighborhood socioeconomic disadvantage and access to health care. *J Health Soc Behav*. 2005;46:15–31. doi: 10.1177/002214650504600103
33. Tang N, Stein J, Hsia RY, Maselli JH, Gonzales R. Trends and characteristics of US emergency department visits, 1997-2007. *JAMA*. 2010;304:664–670. doi: 10.1001/jama.2010.1112
34. Stewart B, Brody A, Krishnan AC, Brown SK, Levy PD. An unmet need meets an untapped resource: pharmacist-led pathways for hypertension management for emergency department patients. *Curr Hypertens Rep*. 2019;21:61. doi: 10.1007/s11906-019-0965-4
35. Prendergast HM, Petzel-Gimbar R, Kitsiou S, Del Rios M, Lara B, Jackson M, Heinert S, Carter BL, Durazo-Arvizu RA, Daviglus M. Targeting of Uncontrolled Hypertension in the Emergency Department (TOUCHED): design of a randomized controlled trial. *Contemp Clin Trials*. 2021;102:106283. doi: 10.1016/j.cct.2021.106283
36. Meurer WJ, Dome M, Brown D, Delemos D, Oska S, Gorom V, Skolarus L. Feasibility of emergency department–initiated, mobile health blood pressure

intervention: an exploratory, randomized clinical trial. *Acad Emerg Med*. 2019;26:517–527. doi: 10.1111/acem.13691
37. Foster B, Dawood K, Pearson C, Manteuffel J, Levy P. Community health workers in the emergency department: can they help with chronic hypertension care. *Curr Hypertens Rep*. 2019;21:49. doi: 10.1007/s11906-019-0955-6
38. Gleason-Comstock J, Streater A, Ager J, Goodman A, Brody A, Kivell L, Paranjpe A, Vickers J, Mango L, Dawood R, et al. Patient education and follow-up as an intervention for hypertensive patients discharged from an emergency department: a randomized control trial study protocol. *BMC Emerg Med*. 2015;15:38. doi: 10.1186/s12873-015-0052-3
39. Giaimo AA, Kang AJ, Huot SJ. Hypertensive urgency: an emergency department pipeline to primary care pilot study. *Am J Hypertens*. 2021;34:291–295. doi: 10.1093/ajh/hpaa190
40. Brody AM, Miller J, Polevoy R, Nakhle A, Levy PD. Institutional pathways to improve care of patients with elevated blood pressure in the emergency department. *Curr Hypertens Rep*. 2018;20:30. doi: 10.1007/s11906-018-0831-9
41. Spruill TM, Muntner P, Popp CJ, Shimbo D, Cooper LA, Moran AE, Penko J, Bibbins-Domingo K, Ibe C, Nnodim Opara I, et al. AddREssing Social Determinants TO pRevent hypErtension (The RESTORE Network): overview of the Health Equity Research Network to Prevent Hypertension. *Am J Hypertens*. 2023;36:232–239. doi: 10.1093/ajh/hpad010
42. Anderson TS, Ayanian JZ, Zaslavsky AM, Souza J, Landon BE. National trends in antihypertensive treatment among older adults by race and presence of comorbidity, 2008 to 2017. *J Gen Intern Med*. 2022;37:4223–4232. doi: 10.1007/s11606-022-07612-3
43. Wilder ME, Zheng Z, Zeger SL, Elmi A, Katz RJ, Li Y, McCarthy ML. Relationship between social determinants of health and antihypertensive medication adherence in a Medicaid cohort. *Circ Cardiovasc Qual Outcomes*. 2022;15:e008150. doi: 10.1161/CIRCOUTCOMES.121.008150
44. Vitarello JA, Fitzgerald CJ, Cluett JL, Juraschek SP, Anderson TS. Prevalence of medications that may raise blood pressure among adults with hypertension in the United States. *JAMA Intern Med*. 2022;182:90–93. doi: 10.1001/jamainternmed.2021.6819
45. Anderson TS, Jing B, Fung K, Steinman MA. Older adults' persistence to antihypertensives prescribed at hospital discharge: a retrospective cohort study. *J Gen Intern Med*. 2021;36:3900–3902. doi: 10.1007/s11606-020-06401-0
46. Wald DS, Law M, Morris JK, Bestwick JP, Wald NJ. Combination therapy versus monotherapy in reducing blood pressure: meta-analysis on 11,000 participants from 42 trials. *Am J Med*. 2009;122:290–300. doi: 10.1016/j.amjmed.2008.09.038
47. Derington CG, Bress AP, Herrick JS, Jacobs JA, Zheutlin AR, Berchie RO, Conroy MB, Cushman WC, King JB. Antihypertensive medication regimens used by US adults with hypertension and the potential for fixed-dose combination products: the National Health and Nutrition Examination Surveys 2015 to 2020. *J Am Heart Assoc*. 2023;12:e028573. doi: 10.1161/JAHA.122.028573
48. Coleman EA, Smith JD, Raha D, Min S-J. Posthospital medication discrepancies: prevalence and contributing factors. *Arch Intern Med*. 2005;165:1842–1847. doi: 10.1001/archinte.165.16.1842
49. Franklin MM, McCoy MA. The transition of care from hospital to home for patients with hypertension. *Nurse Pract*. 2017;42:12–18. doi: 10.1097/01.NPR.0000511701.94615.4f
50. American Case Management Association. Transition of care standards: a new way forward. 2018. Accessed September 14, 2023. https://transitionsofcare.org › uploads › 2023/06
51. Mills KT, Obst KM, Shen W, Molina S, Zhang HJ, He H, Cooper LA, He J. Comparative effectiveness of implementation strategies for blood pressure control in hypertensive patients: a systematic review and meta-analysis. *Ann Intern Med*. 2018;168:110–120. doi: 10.7326/m17-1805
52. Morkisch N, Upegui-Arango LD, Cardona MI, van den Heuvel D, Rimmele M, Sieber CC, Freiberger E. Components of the transitional care model (TCM) to reduce readmission in geriatric patients: a systematic review. *BMC Geriatr*. 2020;20:345. doi: 10.1186/s12877-020-01747-w
53. Finfer S, Chittock DR, Su SY, Blair D, Foster D, Dhingra V, Bellomo R, Cook D, Dodek P, Henderson WR, et al. Intensive versus conventional glucose control in critically ill patients. *N Engl J Med*. 2009;360:1283–1297. doi: 10.1056/NEJMoa0810625