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Management of Inpatient Elevated Blood Pressures: A Systematic Review of Clinical Practice Guidelines

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Abstract

Background—Management of elevated BP during hospitalization varies widely, with many hospitalized adults experiencing blood pressures higher than those recommended for the outpatient setting.

Purpose—To systematically identify guidelines on elevated BP management in the hospital.

Data Sources—MEDLINE, Guideline International Network, and specialty society websites from 1 January 2010 to 29 January 2024.

Study Selection—Clinical practice guidelines pertaining to BP management for the adult and older adult populations for ambulatory, emergency department and inpatient settings.

Data Extraction—Two authors independently screened articles, assessed quality, and extracted data. Disagreements were resolved via consensus. Recommendations on treatment targets, preferred antihypertensive classes, and follow-up were collected for ambulatory and inpatient settings.

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Author Contributions: Ms. Wilson and Dr. Anderson had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Data Synthesis—Fourteen clinical practice guidelines met inclusion criteria (11 assessed as high quality per the AGREE II instrument), 11 provided broad BP management recommendations, 1 each was specific to emergency department, older adults, and hypertensive crises. No guidelines provided goals for inpatient BP or recommendations for managing asymptomatic moderately elevated BP in the hospital. Six guidelines defined hypertensive urgency as BP >180/120 mm Hg, with hypertensive emergencies requiring the addition of target organ damage. Hypertensive emergency recommendations consistently included use of intravenous antihypertensives in intensive care settings. Recommendations for managing hypertensive urgencies were inconsistent, from expert consensus, and focused on the emergency department, most often advising outpatient treatment with oral medications and follow-up in days to weeks. In contrast, outpatient BP goals were clearly defined, varying between 130/80 mm Hg and 140/90 mm Hg.

Limitations—Exclusion of non-English guidelines and guidelines specific to sub-populations.

Conclusions—Despite general consensus on outpatient BP management, guidance on inpatient BP management without symptoms is lacking, which may contribute to variable practice patterns.

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Introduction

Hypertension is the most common chronic condition of adults in the United States, with a prevalence near 50% for adults 40-59 years old and near 75% for adults over age 65 (1, 2). Given the high proportion of adults living with hypertension, as well as its importance as a risk factor for development of cardiovascular disease (3), there are widely accepted guidelines to approach the diagnosis and management of hypertension in the ambulatory setting. Yet, many patients admitted to the hospital are found to have elevated blood pressure (BP) by those same criteria. Whether this is due to pre-existing hypertension or transient factors related to acute illness or hospitalization, it is estimated that elevated BP is present in 50-72% of inpatients (4).

Management of elevated inpatient BP varies widely (5), with inconsistencies in medication routes, regimen intensification, and the prescription of new antihypertensives (4-8). Additionally, the benefits of intensive inpatient antihypertensive treatment have not been demonstrated and there are no randomized trials of inpatient BP management. Observational studies suggest 21-34% of medical inpatients receive intravenous BP medications and 9-14% of patients are discharged with intensified BP medications after non-cardiac hospitalizations (6-8). Risks of elevated BP in the inpatient setting are unknown as there are no published trials of asymptomatic inpatient BP treatment. Although at risk for confounding by indication, observational studies have found receipt of more intensive BP treatment to be associated with worse outcomes, including higher rates of acute kidney injury, stroke, and myocardial injury (6, 7, 9, 10).

Given the wide variation in practice patterns and potential harms of under or overtreatment of inpatient BP, we reviewed current BP management guidelines. We sought to identify

recommendations for inpatient BP goals, for management of elevated BPs in hospitalized adult and older adult populations, and for follow-up of elevated BP after hospitalization.

Methods

Steps for this systematic review included: 1) searching for relevant guidelines, 2) applying exclusion criteria, 3) assessing guideline quality, 4) synthesizing guidelines. Details of the protocol for this systematic review were registered on PROSPERO [CRD42023449250].

Search Strategy

To identify relevant guidelines, we searched MEDLINE via PubMed using medical subject heading of “hypertension” or “elevated blood pressure” and “management” or “therapy” and publication type of “guideline.” The same PubMed search was performed with the addition of the publication type of “systematic review” and limiting the journal search to 10 highly cited general medicine, cardiology, and hypertension journals: Annals of Internal Medicine, BMJ, Circulation, European Heart Journal, Hypertension, JAMA, JAMA Cardiology, JAMA Internal Medicine, Journal of the American College of Cardiology, Lancet, New England Journal of Medicine. Additionally, we searched the Guideline International Network library using the search terms hypertension and guidelines as well as pertinent domestic and international specialty societies. Specialty societies were decided upon through affiliation with the American Medical Association and consultation with experts. We initially ran the searches on August 01, 2023, and we updated all searches on January 29, 2024. See Supplemental Methods 1 for the full search strategy.

Eligibility Criteria

We defined guidelines as statements that include recommendations intended to optimize patient care that are informed by a review of evidence and an assessment of the benefits and harms of alternative care options (11). To be eligible, guidelines had to be published in English and include management guidelines for hypertension (Supplemental Figure 1). Guidelines that were entirely derived from an existing guideline or were published prior to 2010 were deemed ineligible. Only the most recent version of each guideline was included. We excluded guidelines specific to children or pregnant persons, and those that were specific to another care setting (e.g., long-term care facility). We included guidelines focused on ambulatory and emergency department management to assess if they included indications for hospitalizing patients for BP treatment. We excluded guidelines specific to perioperative BP management given prior reviews on this topic (12), guidelines that discussed management only in the context of other diagnoses (e.g., chronic kidney disease) or guidelines on only nonpharmacological treatment modalities (e.g., renal denervation, low-salt diets). The initial criteria and search strategy focused on recommendations tailored towards older adults given the burden of hypertension and medical complexity in this population, however given a lack of recommendations specific to older adults, the criteria and search was broadened to the general adult population. These criteria were applied to each record by two blinded reviewers (LW and TA) and any differences in screening were reconciled by consensus.

Guideline Quality Assessment

To assess the quality of included guidelines, we used the Appraisal of Guidelines for Research and Evaluation II (AGREE II) instrument (13-15). This instrument is comprised of 23 items categorized into 6 domains of Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity of Presentation, Applicability and Editorial Independence. Each item is scored from 1 (strongly disagree) to 7 (strongly agree). Each guideline was independently assessed by two reviewers (LW and TA). Scaled scores for each domain were calculated by summing the item scores for each domain, subtracting by the minimum possible score and scaling as a percentage of the maximum possible score minus the minimum possible score. Overall guideline quality was also scored from 1 (lowest possible quality) to 7 (highest possible quality) and averaged, and reviewers recorded if they would recommend the guideline for use. We classified a guideline as high quality based upon the Rigor of Development domain scaled score threshold of 60%, consistent with prior studies (16-20).

Guideline Synthesis and Analysis

Guideline recommendations were extracted if they were related to: 1) when treating inpatient BP is appropriate; 2) the circumstances that result in different recommendations – specifically symptoms, age, comorbidities, and geriatric syndromes; 3) preparation for a safe transition to a post-hospitalization setting. The data extracted for the first two categories included differing target BP levels and medications recommended for different populations, and the treatment location, where applicable. Preparing for a safe transition included data on outpatient follow-up. Data for all three categories was extracted from all included guidelines. The recommendations across the guidelines included in these three categories were then summarized into tables and compared.

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Results

We screened 147 unique records, 14 of which were included after full text review (Table 1) (21-34). Four of the guidelines were developed by US organizations, 2 from multinational organizations, and 8 from other countries (Australia, Brazil, Canada, England, Japan, Poland, Qatar, and the United Kingdom). Eleven guidelines provided broad BP management recommendations (21, 24, 26, 34) and one was specific to older adults (23). Two guidelines covered specific clinical situations, one was specific to management of asymptomatic elevated BP in the emergency department (22) and one was specific to hypertensive crises (25). The American College of Emergency Physicians (ACEP) guideline addressed two questions specific to patients with asymptomatic BP in the emergency department (does screening for target organ injury reduce rates of adverse outcome and does medical

intervention reduce rates of adverse outcomes) which were reviewed to be relevant to the inpatient setting (22).

Guideline Quality Assessment

Overall AGREE II scores ranged from 3.0-6.5 out of 7.0 (Supplemental Table 1). The ACC/AHA (21) and VA guidelines (33) had the highest overall scores of 6.5. Individual domain scaled score ranges were: scope and purpose 50-100%, stakeholder involvement 17-97%, rigor of development 28-98%, clarity of presentation 89-100%, applicability 4-81%, editorial independence 0-92%. Eleven guidelines were rated as high quality per the Rigor of Development domain scaled score quality threshold of 60%.

Eleven guidelines were based on systematic reviews and the remaining three did not clearly state what type of review was used. Nine of the guidelines specifically referenced at least one of the other guidelines included. No guidelines included systematic reviews focused on inpatient BP management decisions though three did systematically review hypertensive urgency or emergency management (22, 25, 30). Despite these methodological limitations, data from all guidelines were extracted to capture real-world practice recommendations.

Guideline Synthesis and Analysis

Guidelines generally had similar recommendations regarding outpatient elevated BP management and the treatment of hypertensive emergencies, while recommendations on the management of asymptomatic inpatient elevated BP recommendations were largely absent (Table 2). Details on all data extracted can be found in Supplemental Table 2.

Management of Hypertensive Emergency

Ten guidelines included recommendations for management of severely elevated BP causing clinical distress, categorized as hypertensive emergencies or crises, which are inclusive of, but not specific to, the inpatient setting. Hypertensive emergencies were consistently defined by end organ damage with a BP above a threshold, most commonly >180/120 mm Hg (n=6 guidelines). Guidelines consistently recommended treating hypertensive emergencies in the hospital, primarily in the intensive care unit, and with intravenous medications (Table 3). Detailed management was provided on specific hypertensive emergencies, though identified emergencies varied across the guidelines (Supplemental Table 3). BP targets and their immediacy varied by type of emergency, such as an immediate BP decrease for aortic dissection (n = 6) and a gradual BP decrease over days for malignant hypertension or acute renal failure (n =4). Only acute coronary syndrome and hypertensive encephalopathy were specified in all eleven guidelines. Amongst the guidelines mentioning hypertensive encephalopathy, four included recommendations on care, with three recommending a 20-25% reduction in BP or mean arterial pressure over a couple of hours.

Management of Asymptomatic Elevated Blood Pressure

No guidelines provided an inpatient BP target or guidance on antihypertensive classes to use in the inpatient setting. There were eleven guidelines with recommendations on hypertensive urgencies. These were consistently defined by severely elevated BP, above a threshold most often >180/120 mm Hg, without evidence of end organ damage (n=6 guidelines; Table 4).

Two guidelines specified hypertensive urgency presentation to the emergency department and four guidelines mentioned both the emergency department and clinic settings, without differential recommendations between the settings. The other five guidelines did not specify setting. Appropriate BP measurement to diagnose urgencies was included in four guidelines. Three stated that BP measurements should be repeated (24-26), two of which specified repeat measurements should be taken in both arms, and the other stated the single, severely elevated reading was sufficient (27). While three guidelines endorsed immediate BP treatment for urgencies, most guidelines (n = 8) recommended outpatient treatment using oral antihypertensive medications in the week following presentation. Five guidelines discussed diagnostics testing for end organ damage. One guideline stated no diagnostic testing was needed. The other four guidelines recommended diagnostic testing for end organ damage, including physical examination (n=4), fundi examination (n=4), a renal panel (n=4), and electrocardiogram (n=3). An echocardiogram (n=3), neuroimaging (n=3), and chest computed tomography (n=3) were recommended if indicated by symptoms. There was no indication that hypertensive emergencies required inpatient admission.

In the absence of inpatient-specific BP guidance for elevated BPs that do not constitute emergencies, some clinicians may turn to outpatient guidelines as a source for treatment goals or discharge prescribing decisions. In contrast to the lack of inpatient recommendations, outpatient recommendations were consistently present and largely consistent. Outpatient BP goals were defined across 12 guidelines, ranging from <130/80 mm Hg to <140/90 mm Hg (Supplemental Table 4). Thresholds for immediate pharmacological treatment, as opposed to recommending solely lifestyle modifications, was defined as a BP threshold of >160/100 mm Hg in six guidelines and >140/90 mm Hg in five guidelines. Monotherapy using angiotensin receptor blockers [ARBs], angiotensin converting enzyme inhibitors [ACE-Is], calcium channel blockers [CCBs], or thiazide diuretics were suggested for moderately elevated BPs by eight of the guidelines. Combination therapy using either an ACE inhibitor or ARB with a CCB or thiazide diuretic for stage 2 hypertension and a targeted decrease in BP of >=20/10 mm Hg was recommended by seven guidelines.

Patient characteristics that can influence BP management were discussed in an outpatient but not inpatient context (Supplemental Table 5). Comorbidities most commonly discussed by the guidelines include diabetes (n=11), cerebrovascular disease (n=11), chronic kidney disease (n=10), heart failure (n=10), and coronary artery disease (n=10). Recommendations specific to older adults were included in 11 guidelines (Supplemental Table 6). The age threshold to define older adult was inconsistent, ranging from >=60 to >=80 years old, but recommendations largely endorsed slightly higher (10 mm Hg on average) BP goals for older age groups. Consideration of specific geriatric syndromes were present less often than medical comorbidities, occurring in seven of the guidelines, most commonly relating to frailty (n=5), dementia (n=3) and multi-morbidity (n=3). For these conditions, recommendations largely advised individualizing BP care to reduce side effects and promote quality of life and did not recommend specific treatment targets.

Transitions of Care

Similar to the paucity of inpatient BP management guidance, there were no recommendations relating to the management of BP during transitions from hospital to home, even after hypertensive urgency or emergency. The recommendations on transition from emergency department to outpatient care for hypertensive urgencies were the only transitions of care recommendations present in the guidelines (n=8). Three guidelines recommended follow-up within 7 days, two within 1-3 days, and three did not specify the timing of follow-up. Follow-up for elevated BP was included in outpatient recommendations, specifically within 1 month (n=8) for moderately elevated BP and within a week for severely elevated BP.

Discussion

In this systematic review of clinical practice guidelines for BP management, no guidelines provided recommendations on the management of asymptomatic elevated BP in the inpatient setting, outside of the context of hypertensive urgency in the ED. Inpatient recommendations focused on management of hypertensive emergencies, and these did not discuss transitional management of BP upon discharge. In contrast to the paucity of inpatient recommendations, guidelines consistently specified outpatient BP goals, thresholds and preferred classes for pharmacological treatment, follow-up duration, and provided recommendations specific to patients with various comorbidities and geriatric conditions. This lack of guidance may contribute to wide variation in management (4-8).

In the absence of guidelines, observational studies on inpatient BP management have reported widely differing patterns of antihypertensive treatment, both during hospitalization and at hospital discharge, including frequent use of intravenous medications for moderately elevated BPs, intensification of home medications, and initiation of new long-term antihypertensives (4, 6-8). Multiple observational studies have indicated that more intensive inpatient BP management is not associated with a reduction in inpatient cardiovascular outcomes (6, 7) and that discharge with intensified antihypertensives is not associated with a reduction in subsequent cardiovascular outcomes (4, 6, 7). The same studies have suggested that both treatment practices may be associated with higher rates of medication-related adverse events (6, 7). While subject to selection bias and unmeasured confounding, these studies represent the current evidence-base, as randomized trials of inpatient BP management are nonexistent.

The recommendations on hypertensive emergencies, while detailed and important considering the potential for these conditions to be life-threatening, are not sufficient given their prevalence of only 0.3% of hospitalizations (35), whereas asymptomatic BP elevations occur in the majority of hospitalized patients. The BP threshold to determine a severely elevated BP varied, and was largely defined by expert consensus rather than clinical studies. Given they are both cases of severely elevated BPs, urgencies and emergencies are often grouped together in guidelines, which can be misleading. While emergencies require immediate treatment and when untreated can result in substantial morbidity and mortality, guidelines largely agreed that “hypertensive urgencies” are typically not urgent (36), with most guidelines recommending follow-up and treatment within days of presentation as

opposed to immediately. Additionally, guidelines disagreed on the necessity of end organ damage testing when presenting with a severely elevated BP, likely because BP levels alone do not predict the presence of end organ damage (35). Guidelines also largely did not provide guidance on measuring BP to confirm severe elevations. This gap in guidance for diagnostic management may contribute to both overuse of testing if some clinicians test all patients for end organ damage, as well as potentially harmful underuse of testing in populations who may not be able to clearly express symptoms of emergency. Further study of the yield of testing for end-organ damage in patients with severely inpatient elevated BP is warranted to inform guidelines, akin to advances made in understanding the yield of diagnostic testing for syncope, a similarly challenging and common clinical scenario which can portend an emergency but is most often transient and for which testing patterns vary widely (37, 38).

Given the absence of guidelines on inpatient BP goals, clinicians may turn to outpatient BP management guidelines. Outpatient recommendations are appealing as they are comprehensive and largely consistent, with guidance relating to BP targets, thresholds for pharmacological treatment, and medications selection. However, outpatient BP goals are set for long-term cardiovascular risk reduction in stable patients and during acute illness it is not clear whether more permissive BPs may be warranted. Much as heart rate and blood sugar rise as a physiologic response to acute stress, BP may be transiently elevated and thus treatment may risk inadvertent hypotension, either in the hospital or on return home to a physiologic steady state (39). Additionally, the frequent monitoring of BP in inpatient settings can result in management changes within a few hours if there is not an immediate BP reduction, despite the fact that achieving steady state for long-acting antihypertensives typically takes one to two weeks. This practice contrasts greatly with recommendations for outpatient follow-up of weeks to months to assess the impact of antihypertensive medication changes. Thus, there is a risk of overly rapid intensification of regimens in the hospital, increasing the risk for subsequent hypotension and other adverse events. Even in the absence of symptomatic hypotension, unnecessary overtreatment may expose patients to risks for medication-related harms without opportunity for benefits.

Transitions of care out of inpatient care is a third important area lacking in the reviewed guidelines. No guidelines provided recommendations on discharge education and support, including medication reconciliation or home BP monitoring. The proportion of patients advised to monitor their BP at home following hospitalization and the proportion provided equipment to do so is unknown. Growing use of home BP monitoring in the outpatient setting could suggest a role for monitoring following discharge. A subset of guidelines included recommended outpatient follow-up for hypertensive urgencies. Follow-up after a moderately elevated BP presentation was recommended within 1-2 months, and after a severely elevated BP presentation within 1 week. Primary care follow-up after a hospitalization is potentially beneficial for both patients discharged with new medications, to monitor effectiveness and safety, and patients whose home medications are not changes, to assess for sustained elevated BPs. However, most patients do not receive timely follow-up after hospitalization (40).

Given the limited observational evidence to support treatment recommendations, pragmatic clinical trials to clarify the risks and benefits of inpatient BP treatment approaches are urgently needed. One potential path, as has been studied for inpatient diabetes management, would be trials comparing different treatment thresholds for extremely elevated asymptomatic BP elevations, for example comparing treatment thresholds for SBP of greater than 160 mm Hg, greater than 180 mm Hg, or no threshold. Given that cardiovascular events are uncommon amongst patients hospitalized for non-cardiac conditions, the sample sizes required in these trials are likely to be quite large and thus quite expensive, however this investment is likely warranted for a condition affecting more than half of hospitalized adults. It remains unclear whether there is truly a goal inpatient BP given quickly shifting physiologic changes during acute illness. While inpatient BP is often compared to inpatient diabetes management, for which treatment thresholds have been established in randomized trials (41, 42), it is possible the better analogy is management of heart rate which is of alarm if too low, but is frequently elevated during hospitalization due to similar stressors as BP. Tachycardia is not routinely treated in the absence of symptoms, rather it is managed by controlling underlying stressors (e.g. pain, dehydration) and similar principles may apply to elevated BPs.

Interim guidance on inpatient BP management is needed, such as clinical decision-making frameworks that address the unique issues posed by hospitalizations and care transitions, until clinical trials are undertaken. Inpatient clinicians, including trainees, need an alternative to relying on outpatient guidelines which are designed for different populations and timelines (39).

There are limitations to this study. The search strategy was pre-registered but did not undergo peer review. The study evidence base was limited by a focus on English language guidelines published after 2010. Though we used pre-defined search criteria and multiple search strategies, given a focus on MeSH terms, it is possible that we missed relevant guidelines. We excluded certain inpatient scenarios with a different body of evidence, most notably management of elevated BP during pregnancy and perioperative BP management. This was a systematic review of guidelines and did not review the underlying evidence base supporting guideline recommendations. In the absence of guidelines, there are other sources of information that discuss inpatient hypertension management that may be used, such as clinical viewpoints or narrative reviews which were not included (39, 43, 44).

In sum, despite general consensus on outpatient BP management, there is little guidance on inpatient BP management, with existing recommendations focusing on hypertensive emergencies, which are far less commonly encountered than asymptomatic hypertension. There is an urgent need for pragmatic clinical trials to fill knowledge gaps for the management of elevated BP in hospitalized adults as well as a need for the development of inpatient BP clinical decision-making frameworks that address the unique issues posed by hospitalization and care transitions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Overview of included blood pressure management guidelines

Guideline Organizations (Abbreviation)	Guideline Title	Year	Setting	Hypertensive urgency	Hypertensive emergency	Quality level ‡
American College of Cardiology & American Heart Association **(ACC/AHA)** (21) *	Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults	2017	General †	X	X	High
American College of Emergency Physicians **(ACEP)** (22)	Clinical Policy: Critical Issues in the Evaluation and Management of Adult Patients in the Emergency Department with Asymptomatic Elevated Blood Pressure	2013	Emergency department	X		High
American College of Physicians & American Academy of Family Physicians **(ACP)** (23)	Pharmacologic Treatment of Hypertension in Adults Aged 60 Years or Older to Higher Versus Lower Blood Pressure Targets: A Clinical Practice Guideline	2017	Ambulatory			High
Brazilian Societies of Cardiology, Hypertension, and Nephrology **(SBC)** (24)	Brazilian Guidelines of Hypertension	2020	General †	X	X	Low
British and Irish Hypertension Society **(BIHS)** (25)	Management of hypertensive crisis	2022	General †	X	X	Low
European Society of Hypertension **(ESH)** (26)	Guidelines for the management of arterial hypertension	2023	General †	X	X	High
Hypertension Canada **(HC)** (27)	Comprehensive Guidelines for the Prevention, Diagnosis, Risk Assessment, and Treatment of Hypertension in Adults and Children	2020	General †	X	X	High
Japanese Society of Hypertension **(JSH)** (28)	Guidelines for the Management of Hypertension	2019	General †	X	X	High
National Heart Foundation of Australia **(NHFA)** (29)	Guideline for the diagnosis and management of hypertension in adults	2016	General †	X	X	High
National Institute for Health and Care Excellence **(NICE)** (30)	Hypertension in adults: diagnosis and management	2022	General †	X	X	High
Polish Society of Hypertension **(PSH)** (31)	Guidelines for the Management of Hypertension	2015	General †	X	X	Low
Qatari Ministry of Public Health **(QMoH)** (32)	The Diagnosis & Management Of Hypertension In Adults	2021	General †	X	X	High
Department of Veterans Affairs & Department of Defense **(VA)** (33)	Clinical Practice Guideline For The Diagnosis And Management Of Hypertension In The Primary Care Setting	2020	Ambulatory			High
World Health Organization **(WHO)** (34)	Guideline for the pharmacological treatment of hypertension in adults	2021	General †			High

* Full organizational list: American College of Cardiology, American Heart Association, American Academy of Physician Assistants, Association of Black Cardiologists, American College of Preventative Medicine, American Geriatrics Society, American Pharmacists Association, American Society of Hypertension, American Society for Preventive Cardiology, National Medical Association, Preventive Cardiovascular Nurses Association

† Guideline was non-specific to setting. The majority of the recommendations were directed at the outpatient setting, but hypertensive urgency recommendations included emergency department settings and hypertensive emergency recommendations were specific to the inpatient setting

‡ Full details on guideline quality assessment can be found in Supplemental Table 1

Table 2

Elevated blood pressure management recommendations across care settings

	Ambulatory Setting *	Inpatient Setting
Moderately elevated BP management		
No. of guidelines	12	0
Definition of elevated BP	>130/80 to >140/90 mm Hg	No guidance
Threshold to start pharmacologic treatment	>140/90 to >160/100 mm Hg	No guidance
Typical pharmacologic therapy	Monotherapy of ARB, ACE-I, CCB, or TZ	No guidance
Recommended follow up	1-2 months	No guidance
Hypertensive urgency management †		
No. of guidelines	11	0
Definition of severely elevated BP	>160/100 to >180/120 mm Hg	No guidance
Typical pharmacologic therapy	Combination therapy of ARB or ACE-I with CCB or thiazide diuretic	No guidance
Recommended follow up	Outpatient within a week	No guidance
Hypertensive emergency management		
No. of guidelines	10 ‡	
Definition of hypertensive emergency	>180/110 to >220/140 mm Hg with end organ damage	
Typical pharmacologic therapy	Intravenous medications §	
Appropriate location for treatment	Step-down or Intensive Care Unit	

Note: ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blockers; BP, blood pressure; CCB, calcium channel blocker, TZ, thiazide diuretic. Blue shading refers to consensus clinical practice recommendations, orange shading refers to no guidance

*Ambulatory includes clinic and emergency department settings

†Referred to by some guidelines as hypertensive urgency and others as markedly elevated blood pressure

‡Irrespective of presenting site of care

§Variable medication classes by type of emergency, see Supplemental Table 2

Table 3

Hypertensive emergency recommendations

	ACC/ AHA 2017	SBC 2020	BIHS 2022	ESH 2023	HC 2020	JSH 2019	NHFA 2016	NICE 2022	PSH 2015	QMoH 2021
Hypertensive emergency BP threshold (mm Hg)	180/120	180/120	180/120	180/110	DBP 130	180/120	220/140	180/120	190/120	180/110
Requires end organ damage	X	X	X	X	X	X	X	X	X	X
Location of treatment *	Intensive care unit	Intensive care unit	Stepdown unit or higher	Inpatient	-	Intensive care unit	Inpatient; usually intensive care unit	Same-day hospital specialist	Intensive care unit	Inpatient
Medication route	IV	IV	IV	IV	-	IV	IV	-	IV	-
Specific recommendations on emergency conditions †										
Acute coronary syndrome	X	X	X	X	X	X	X	X	X	X
Acute pulmonary edema	X	X	X	X	X	X	X	X	X	X
Acute renal failure / malignant hypertension	X	X	X	X	X	X	X	X		X
Aortic dissection	X	X	X	X	X	X	X		X	X
Hypertensive encephalopathy	X	X	X	X	X	X	X	X ‡	X	X
Intracranial hemorrhage	X	X	X	X	X	X	X		X	X
Ischemic stroke	X	X	X	X	X	X	X		X	X
Pheochromo-cytoma/ adrenergic crisis	X	X	X	X	X	X		X		X

Note: BP, blood pressure; DBP, diastolic blood pressure; IV, intravenous. Hypertensive emergency not discussed by: ACEP, ACP, VA, or WHO guidelines. "-" indicates topic not mentioned in guideline.

ACC/AHA = American College of Cardiology and American Heart Association; SBC = Brazilian Society of Cardiology; BIHS = British and Irish Hypertension Society; ESH = European Society of Hypertension; HC = Hypertension Canada; JSH = Japanese Society of Hypertension; NHFA = National Heart Foundation of Australia; PSH = Polish Society of Hypertension; QMoH = Qatari Ministry of Health

*All guidelines recommended immediate treatment

†Details on management recommendations for each type of hypertensive emergency can be found in Supplemental Table 3

‡Hypertensive encephalopathy was not specifically mentioned, but extrapolated from "new onset confusion"

Table 4

Hypertensive urgency recommendations

	ACC/ AHA 2017*	ACEP 2013*	SBC 2020*	BIHS 2022*	ESH 2023*	HC 2020	JSH 2019	NHFA 2016	NICE 2022	PSH 2015	QMoH 2021*
Threshold for urgency (mm Hg)	180/120	160/100†	180/120	180/120	180/110	DBP >130‡	180/120	180/110§	180/120	180/120	180/110
Location of treatment	Outpatient	Outpatient	Outpatient	Outpatient	Outpatient	-	Outpatient‖	-	Outpatient	Outpatient	Outpatient‖
Repeat BP measurement	-	-	Yes ¶	Yes	Yes	No	-	-	-	-	-
Diagnostics	-	None needed**	Exams, labs, imaging, ECG††	Exams, labs, imaging, ECG‡‡	-	-	Exams, labs§§	-	Exams, labs, ECG‖‖	-	-
Timing of treatment	Lower BP over 24-48 hours	None needed**	After observing	Variable¶¶	Lower BP over 24-48 hours	Immediate	Lower BP over 24-48 hours	Immediate	Reassess BP after 7 days	Immediate	Immediate if BP >220/120
Medication route	Oral	-	Oral	Oral	Oral	-	Oral	Oral	-	Oral	Oral
Medication classes	Not specified	-	Not specified	ACE-I, ARB, CCB	DHP-CCBs	-	CCBs, ACE-I, ARBs, BBs	Not specified	-	Not specified	Not specified
Outpatient follow-up	Timing not specified	Timing not specified	Within 7 days	Within 7 days	Timing not specified	-	Within 1-3 days	Within 1-3 days	Within 7 days	-	-

Note: ACE-I, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blockers; BB, beta blocker; BP, blood pressure; CCB, calcium channel blocker; DHP-CCBs, dihydropyridine calcium channel blockers; ECG, electrocardiogram. Hypertensive urgency not discussed by: ACP, VA, or WHO guidelines. "-" indicates topic not mentioned in guideline.

ACC/AHA = American College of Cardiology and American Heart Association; ACEP = American College of Emergency Physicians; SBC = Brazilian Society of Cardiology; BIHS = British and Irish Hypertension Society; ESH = European Society of Hypertension; HC = Hypertension Canada; JSH = Japanese Society of Hypertension; NHFA = National Heart Foundation of Australia; NICE = National Institute for Health and Care Excellence; PSH = Polish Society of Hypertension; QMoH = Qatari Ministry of Health

*Guideline includes discussion of patients presenting to emergency department or clinic. ACEP and ESH were specific to only the emergency department.

†Threshold for "markedly elevated BP", not hypertensive urgency

‡BP can be DBP>130 mm Hg or "severely elevated" which was not further defined

§Including symptoms/moderate organ damage

‖Observation care in addition was suggested

¶In both arms until measurement stabilizes; at least three times

** Diagnostic testing and treatment recommended at time of presentation in ED only for patients with "poor follow-up"

†† Physical and fundoscopic exams, electrolytes, creatinine, potassium and troponin, chest x-ray. If indicated, perform urinalysis, echocardiogram, BNP/NT, lactate dehydrogenase, neuroimaging, chest CT

‡‡ Physical and fundoscopic exams, renal function panel, urinalysis, chest x-ray. If indicated, perform echocardiogram, BNP/NT, neuroimaging, chest CT, troponin testing

§§ Physical and fundoscopic exams, renal function panel, urinalysis, lactate dehydrogenase, creatinine kinase, glucose. If indicated, perform chest x-ray, ECG, echocardiogram, neuroimaging, chest CT

/// Physical and fundoscopic exams, creatinine, electrolytes, cholesterol, urinalysis, estimated glomerular filtration rate.

¶¶ If previously diagnosed with hypertension, then treat immediately, if not then consider rechecking blood pressure within 7 days to confirm hypertension