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Comparison of the 2017 ACC/AHA Hypertension Guideline with Earlier Guidelines on Estimated Reductions in Cardiovascular Disease

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Abstract

Purpose of Review To review the recommendations of the 2017 American College of Cardiology/American Heart Association hypertension guideline and to compare it with previous guidelines on potential cardiovascular disease (CVD) and mortality risk reductions.

Recent Findings Compared with previous guidelines, the 2017 hypertension guideline increased the prevalence of hypertension and the number of adults recommended for antihypertensive therapy in the US population. Based on data from recent analyses, the new guideline effectively directs antihypertensive therapy toward individuals at higher CVD risk. Two recent analyses using US national data estimated that implementation of the 2017 hypertension guideline could further reduce hundreds of thousands of CVD events and deaths compared with previous guidelines. However, the new guideline might increase the number of adverse events. The new guideline also improves the number of individuals needed to treat to prevent CVD events and deaths, suggesting implementation is cost-effective.

Summary Implementation of the 2017 hypertension guideline is projected to substantially reduce CVD events and deaths in the USA but might increase the number of adverse events. Future research is needed to implement and scale up effective, equitable, and sustainable strategies for applying the new guideline in daily clinical practice.

Keywords Cardiovascular disease · Mortality · Population · Epidemiology · Hypertension guidelines

Introduction

Hypertension is a leading risk factor for cardiovascular disease (CVD) in the USA and globally [1–3]. Decades of evidence derived from both observational epidemiologic studies [3, 4] and randomized controlled trials (RCTs) [5, 6] have informed the development of clinical guidelines for the prevention, detection, evaluation, and treatment of hypertension, beginning in 1977 with the report from the first Joint National Committee [7].

Over the past four decades, the hypertension guidelines have been revised and updated several times. The report from the Seventh Joint National Committee (JNC7) in 2003 defined hypertension in the general population as a systolic blood pressure (BP) or diastolic BP ≥ 140/90 mmHg, with a treatment goal of BP < 140/80 mmHg [8]. In 2014, a revision of the guidelines developed by the panel members appointed to the Eighth Joint National Committee relaxed the thresholds for initiation of antihypertensive pharmacologic treatment and BP treatment targets [9]. The change was met with controversy and spurred further interest in finding the best evidence-based definition of hypertension and optimal target for BP-lowering therapy [10].

In 2017, based on evidence from the Systolic Blood Pressure Intervention Trial (SPRINT) [11] and several meta-analyses [6, 12, 13], the American College of Cardiology (ACC) and American Heart Association (AHA) updated the clinical guidelines for the prevention, detection, and management of hypertension [14••]. The

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2017 ACC/AHA hypertension guideline redefined hypertension as BP ≥ 130/80 mmHg. Furthermore, the 2017 guideline recommends a BP treatment goal of < 130/80 among all adults with hypertension. However, debate continues concerning the new guideline, especially in terms of the feasibility of adoption and implementation, and its potential impact on the US population.

The aim of the current review is to discuss the major recommendations of the 2017 ACC/AHA hypertension guideline on the definition of hypertension and BP-lowering treatment goals, in the context of the two previous guidelines. Additionally, we comment on the potential for CVD and mortality risk reductions based on two recent comprehensive analyses of US national data [15••, 16••]. Finally, we provide a discussion of the implications of adoption of the new guideline and consider future directions and unanswered research questions in this topic area.

Comparison of Guideline Recommendations

Measurement and Detection of Hypertension

Accurate diagnosis and management of hypertension depends upon standardized and consistent measurement of BP, which has received more explicit attention in the 2017 hypertension guideline [14••] and a 2019 Scientific Statement from the AHA [17•]. Recommendations have been similar in previous guidelines [8, 9], most BP-lowering RCTs, and prospective research studies. Still, adherence in routine clinical practice is often poor, and there is potential disconnect between measurements obtained in rigorous RCTs, clinical practice, and out-of-office settings [17•, 18]. Regarding the latter, the 2017 guideline includes recommendations for use of ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM) to confirm and manage hypertension [14••]. For measurements obtained in an office setting, a standardized protocol is recommended, specifying use of a validated BP measurement device and appropriately sized cuff with the patient in a seated position with feet on the floor and back supported for > 5 min. Furthermore, clinicians should use an average of ≥ 2 measurements obtained on ≥ 2 occasions. Both traditional auscultatory methods and validated automated oscillometric devices are appropriate. The standardized protocol, while relatively simple, is prone to several errors that may lead to inaccurate BP measurement, often resulting in an overestimate of the patient's true BP [17•]. These errors lead to discrepancies between readings taken in rigorously conducted research studies and routine clinical practice settings [19], which also adds to uncertainty regarding the application of evidence from RCTs to the real world [20]. Thus, accurate BP measurement in the office setting is absolutely essential.

Table 1 provides a brief overview of the recommendations of the past 3 US national hypertension guidelines for defining hypertension, BP thresholds for initiation of pharmacologic treatment, and BP goals of pharmacologic treatment. Compared with JNC7 and the 2014 evidence-based guideline, the 2017 ACC/AHA guideline recommends a lower BP threshold for diagnosing hypertension, defining stage 1 as BP ≥ 130/80 mmHg and stage 2 as BP ≥ 140/90 mmHg [14••]. Additionally, elevated BP is defined as systolic BP 120–129 mmHg and diastolic BP < 80 mmHg. While this new classification scheme was met with some controversy, the guideline committee cited the supporting evidence of several large meta-analyses of observational cohort studies [3, 4, 21] and RCTs [6, 12]. Such studies consistently document a continuous association between BP and risks of CVD and mortality, finding that a usual BP level (correcting for day-to-day variation) of < 120/80 mmHg confers the lowest risk. Reclassification of hypertension reflects this risk gradient in an attempt to direct lifestyle and pharmacologic therapy to those at a higher risk.

Based on US nationally representative population prevalence estimates, more than 45% of US adults have hypertension under the 2017 guideline, which is substantially higher compared with estimates under the previous 2 guidelines (approximately 32%) [15••, 22•]. Sex differences in the prevalence of hypertension are apparent, with 48% of men having hypertension compared with 43% of women. Non-Hispanic black adults are also more likely (55%) to have hypertension compared with other race/ethnicity groups. As expected, the prevalence of hypertension increases substantially with increasing age. The greatest increase in prevalence resulting from the 2017 guideline definition of hypertension occurred in individuals aged 40–59 years (50% for the 2017 guideline compared with 32% for the 2014 guideline).

Management of Hypertension

Along with increases in the prevalence of hypertension, US national estimates suggest a large increase in the number of individuals recommended antihypertensive pharmacologic therapy under the new guideline (83 million compared with 72 million under the 2014 guideline) [15••]. In adults with hypertension, a large body of RCT evidence has established the effectiveness of BP-lowering therapy for reducing the risks of major CVD events and all-cause deaths, in the general population and various subgroups [5, 6, 23–25]. While treatment is effective, there has historically been uncertainty regarding the optimal target for BP reduction, with concerns regarding J-curve phenomena observed in post hoc analyses of some RCTs [26, 27]. This uncertainty was especially apparent, and remains a topic of debate, in various subgroups, including

Table 1 Blood pressure thresholds for hypertension, recommendations for pharmacologic treatment initiation, and goals of pharmacologic treatment according to the 2014 evidence-based guideline and 2017 ACC/AHA guideline

	2003 JNC7 guideline[a]	2014 evidence-based guideline[b]	2017 ACC/AHA guideline[c]
Blood pressure thresholds for definition of hypertension (mmHg)			
Systolic	≥ 140	≥ 140	≥ 130
Diastolic	≥ 90	≥ 90	≥ 80
Blood pressure thresholds for initiation of pharmacologic treatment (mmHg)			
Systolic	• ≥ 140 in the general population • ≥ 130 in individuals with diabetes or chronic kidney disease	• ≥ 140 in the general population < 60 years of age and in those ≥ 60 years with diabetes or chronic kidney disease • ≥ 150 in individuals ≥ 60 years of age without diabetes or chronic kidney disease	• ≥ 140 in the general population • ≥ 130 in individuals with high cardiovascular disease risk[d], diabetes, and chronic kidney disease, or age ≥ 65 years
Diastolic	• ≥ 90 in the general population • ≥ 80 in individuals with diabetes or chronic kidney disease	• ≥ 90 in all adults	• ≥ 90 in the general population < 65 years of age • ≥ 80 in individuals < 65 years of age with high cardiovascular disease risk[d], diabetes, or chronic kidney disease
Blood pressure goals of pharmacologic treatment (mmHg)			
Systolic	• < 140 in the general population • < 130 in individuals with diabetes or chronic kidney disease	• < 140 in the general population < 60 years of age and in those ≥ 60 years with diabetes or chronic kidney disease • < 150 in individuals ≥ 60 years of age without diabetes or chronic kidney disease	• < 130 in all adults
Diastolic	• < 90 in the general population • < 80 in individuals with diabetes or chronic kidney disease	• < 90 in all adults	• < 80 in all adults < 65 years of age

[a] 2003 Seventh Report of the Joint National Committee (JNC7) on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure

[b] 2014 Evidence-Based Guideline for the Management of High Blood Pressure In Adults report from the panel members appointed to the Eighth Joint National Committee

[c] 2017 American College of Cardiology/American Heart Association (ACC/AHA) Guideline for the Prevention, Detection, Evaluation and Management of High Blood Pressure in Adults

[d] High cardiovascular risk is defined as a history of cardiovascular disease (coronary heart disease, stroke or heart failure) or 10-year predicted cardiovascular disease risk ≥ 10% using the pooled cohort risk equations

those with chronic kidney disease (CKD) [28, 29] and diabetes [30–33], and older adults [34–37]. Accordingly, treatment targets have varied depending on guideline and subgroup, as detailed in Table 1. Based on JNC7, the target for systolic BP lowering was set at < 140 mmHg for the general population and < 130 mmHg for individuals with diabetes or CKD [8]. In the 2014 evidence-based guideline, the target for systolic BP lowering was set at < 140 mmHg for the general population < 60 years of age and in those ≥ 60 years with diabetes or CKD, but a higher target (< 150 mmHg) was recommended in those ≥ 60 years of age without diabetes and CKD [9]. These higher targets were not universally agreed upon, including by some panel members [10].

Based on RCT evidence from the SPRINT trial [11], its subgroup analyses [28, 37], several large meta-analyses of RCTs [6, 12, 13], and the guideline committee's systematic review [38], the 2017 guideline lowered the BP treatment target to < 130/80 mmHg in all adults. However, the approach for reaching the target differs based on baseline CVD risk. As detailed in Table 1, the 2017 guideline recommends pharmacologic therapy among all adults with stage 2 hypertension. Among those with stage 1 hypertension, pharmacologic therapy is recommended in those with diabetes and CKD, patients aged ≥ 65 years, and individuals with high CVD risk, defined as a history of CVD (coronary heart disease, stroke or heart failure) or 10-year predicted CVD risk ≥ 10% using the ACC/AHA pooled cohort equation [39]. Lifestyle modification is recommended for all adults with above-normal BP and is the first-line therapy in low-risk individuals. Furthermore, the 2017 guideline recommends individualized treatment and a comprehensive care approach to monitor potential adverse events and to titrate BP to treatment goals, as tolerated by individual patients. The guideline committee deemed this approach to be effective based on the preponderance of

evidence, and other research has suggested that, in general, intensive BP lowering is cost-effective [40].

Potential for Risk Reductions Under Recent Guidelines

In 2018, we published a modeling analysis using several US national data sources, including the National Health and Nutrition Examination Survey (NHANES), a network meta-analysis of antihypertensive clinical trials [13], and 4 population-based cohort studies, to estimate the risk reductions afforded by achieving and maintaining guideline-recommended BP-lowering treatment targets according to the 2014 and 2017 hypertension guidelines [15••]. Additionally, we estimated the potential increased number of adverse events related to BP lowering in the US population under the new guideline recommendations.

The methodologic details of this analysis have been described previously [15••]. In brief, the analyses included 4 components in the following sequence: (1) the proportion of US adults in systolic BP categories based on NHANES data was estimated; (2) the incidence rates of major CVD (non-fatal coronary heart disease, non-fatal stroke, heart failure, and CVD deaths) and all-cause mortality based on pooling of 4 cohort studies (the Atherosclerosis Risk in Communities Study [41], the Cardiovascular Health Study [42], the Framingham Offspring Study [43], and the Multi-Ethnic Study of Atherosclerosis [44]) were estimated; (3) the hazard ratios of major CVD and all-cause mortality associated with systolic BP treatment goals were estimated from a network meta-analysis of RCTs [13]; (4) the population attributable risks (PARs) related to systolic BP treatment goals were calculated, and the numbers of CVD events or deaths that could be reduced if the entire population achieved systolic BP treatment goals were computed by multiplying each outcome by the PAR for each age, sex, race/ethnicity, and hypertension guideline category. Uncertainty in population estimates, quantified as 95% confidence intervals (CIs), was estimated using Monte Carlo simulation [45].

We estimated that achieving the 2017 hypertension guideline systolic BP treatment goals may reduce 610,000 (95% CI, 496,000–734,000) CVD events and 334,000 (95% CI, 245,000–434,000) total deaths in US adults 40 years and older (Fig. 1). Conversely, achievement of the 2014 hypertension guideline systolic BP treatment goals was estimated to reduce 270,000 (95% CI, 202,000–349,000) CVD events and 177,000 (95% CI, 123,000–241,000) deaths. Potential CVD event and death reductions were also reported by age, sex, and race categories. In all categories, reductions in CVD events and deaths assuming achievement of the 2017 hypertension guideline were substantially higher compared with the 2014 guideline and were mostly similar among categories. However, the relative increase in events reduced among those < 60 years of age was quite large (> 3-fold increase in CVD events reduced for those < 60 years compared with a 2-fold increase in events reduced for those ≥ 60 years of age). Additionally, a sensitivity analysis suggested that even if 100% implementation of the 2017 guideline recommendations was not achieved, the CVD event and death reductions would still be significantly larger compared with the 2014 guideline recommendations.

Furthermore, the numbers needed to treat (NNT) were lower across almost all categories under the 2017 hypertension guideline recommendations (Table 2). The NNT is a useful measure of the cost-effectiveness of treatment and quantifies the number of participants that would need to undergo target-directed BP-lowering therapy to reduce one CVD event (or death) [46]. For CVD events, we estimated that NNT was significantly lower among women and those < 60 years of age under the 2017 guideline compared with the 2014 guideline. For deaths, we estimated that NNT was significantly lower for those < 60 years of age under the 2017 guideline compared with the 2014 guideline. These results supported earlier work finding that intensive BP control is cost-effective, despite potential increases in healthcare expenditures [40].

In 2019, Bress and colleagues published a complementary analysis estimating 10-year reductions in CVD events and deaths using similar analysis methods to our study [16••]. However, the analysis by Bress et al. used some different data inputs. Rather than using CVD incidence rate data from the four pooled US cohort studies as detailed above in our study, they used incidence data estimated from the Reasons for Geographic and Racial Differences in Stroke (REGARDS) Study, which includes a sample of 29,218 participants from across the USA [47]. While their estimates using REGARDS result in lower incidence rates of CVD and thus lower projected absolute risk reductions, conclusions were similar to our study. Namely, achieving the 2017 hypertension guideline could reduce twice as many CVD events and deaths over 10 years compared with the 2014 guideline. Additionally, Bress et al. compared results for event reductions under the 2017 hypertension guideline against JNC7, finding that the achievement of the lower targets recommended by the 2017 guideline would still reduce the absolute numbers of CVD events and deaths in the US population.

Regardless of method and data sources, the potential risk reductions afforded by achieving the 2017 hypertension guideline recommendations are substantial, even with less than 100% implementation. Still, the potential for additional adverse events must be considered. Both analyses by us [15••] and Bress et al. [16••] estimated a potentially large increase in the number of additional adverse events associated with the 2017 guideline's recommended treatment targets. For example, we estimated that

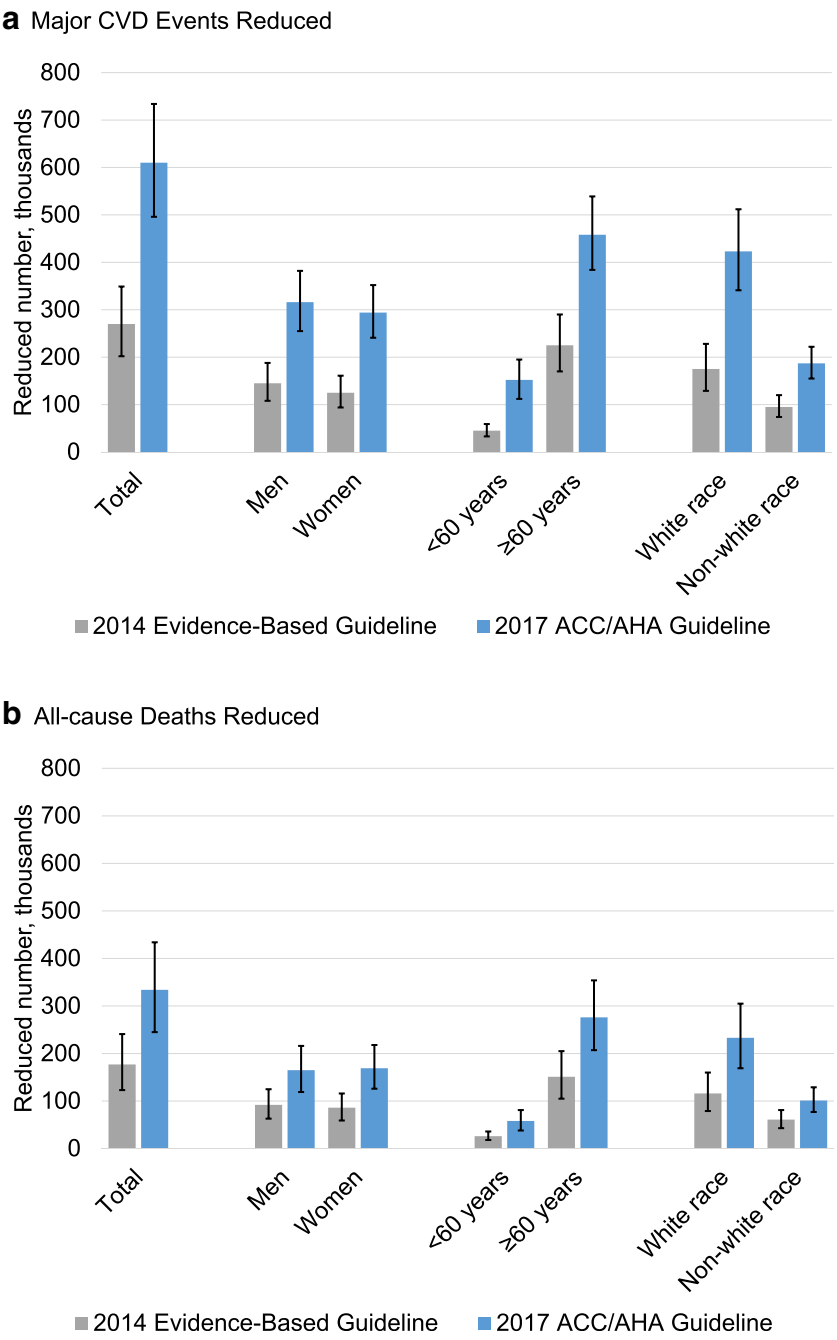

Fig. 1 Reduction of CVD events and total deaths in US adults 40 years and older. **a** Major CVD events reduced. **b** All-cause deaths reduced

implementing the 2017 hypertension guideline may increase 62,000 hypotension and 79,000 acute kidney injury or failure events. Bress et al. estimated that as many adverse events would occur as CVD event reductions. Importantly, as noted previously by several authors [15••, 16••, 48], reversible adverse events should not be weighted equally to CVD event and death risk reductions. Clinical decision-making should occur in the context of individualized patient care and consideration of patient treatment tolerance and careful surveillance for adverse events among patients with hypertension.

Discussion and Observations

The 2017 hypertension guideline recommendations significantly increase the prevalence of hypertension among US adults compared with the 2014 hypertension guideline and JNC7. Furthermore, these prevalence increases are greater among those 40–59 years of age and in populations with intermediate CVD risk. Along with increased prevalence of hypertension, there are also increases in the number of individuals recommended BP-lowering therapy and a lowering of the BP targets for therapy. While many more US adults are

Table 2 Estimated numbers needed to treat with systolic blood pressure lowering according to the 2014 evidence-based guideline and 2017 ACC/AHA guideline in the US general population

	Number needed to treat (95% CI)		
	2014 evidence-based guideline	2017 ACC/AHA guideline	*p* value for difference
Major cardiovascular disease			
Total	88 (68, 118)	70 (59, 87)	0.08
Sex			
Men	79 (61, 106)	67 (55, 83)	0.20
Women	99 (77, 131)	74 (62, 91)	0.03
Age (years)			
< 60	226 (172, 310)	91 (71, 125)	< 0.0001
≥ 60	61 (47, 80)	63 (54, 76)	0.72
Race/ethnicity			
White	87 (67, 118)	68 (56, 85)	0.07
Non-white	90 (71, 116)	75 (63, 91)	0.12
All-cause mortality			
Total	134 (99, 194)	129 (99, 175)	0.75
Sex			
Men	125 (91, 181)	128 (97, 176)	0.87
Women	145 (107, 209)	130 (100, 174)	0.38
Age (years)			
< 60	390 (284, 570)	240 (173, 368)	0.0005
≥ 60	90 (67, 130)	105 (82, 140)	0.21
Race/ethnicity			
White	131 (95, 193)	124 (95, 171)	0.71
Non-white	141 (106, 198)	139 (109, 184)	0.90

Adapted from Bundy JD, Mills KT, Chen J, Li C, Greenland P, He J. Estimating the Association of the 2017 and 2014 Hypertension Guidelines With Cardiovascular Events and Deaths in US Adults: An Analysis of National Data. *JAMA Cardiol*. 2018;3(7):572–581

recommended treatment, analyses conducted by us [15••] and others [16••] suggest adoption of the 2017 guideline recommendations could have a considerable impact in reducing the risk of CVD and mortality in US adults.

Under the 2017 ACC/AHA guideline, nearly half of US adults have hypertension [15••, 22•]. However, while the guideline lowered the threshold for hypertension, resulting in increased prevalence, the guideline did not create millions of individuals with disease [49]. Rather, the guideline sought to more appropriately direct lifestyle and pharmacologic therapy to individuals with higher-than-normal levels of an important risk factor and, thus, identified them as having higher risk for CVD and mortality based on substantial high-quality evidence. Recently, Colantonio et al. analyzed 29,218 participants from the REGARDS study and found that the 2017 hypertension guideline effectively directs antihypertensive therapy toward individuals at high risk for CVD, including those with BP 130–139/80–89 mmHg [50••]. More specifically, among participants not currently on antihypertensive therapy, CVD event rates were substantially higher among those now recommended treatment under the new guideline (20.5 per 1000 person-years; 95% CI, 18.5–22.6) compared with those not recommended treatment (3.4 per 1000 person-years; 95% CI, 2.4–4.4). A similar pattern was observed for participants who were recommended treatment intensification compared with those who were not. These results lend confirmatory evidence that the baseline risk–targeted approach in those with stage 1 hypertension is evidence-based. Another recent analysis of 21,441 Chinese adults with stage 1 hypertension by Qi et al. [51] noted that individuals < 60 years of age had significantly a higher risk of CVD compared with normotensive individuals. While this association was not observed in adults > 60 years of age, such a finding may be due to competing risks not directly attributable to BP [52]. Regardless of the cutoff points set by any given guideline, analyses have shown that risks of CVD and mortality increase in a dose-response, log-linear fashion, both for untreated BP [4] and for treated BP [13].

Despite the large potential benefits for risk reduction under the 2017 guideline, there are several challenges for full implementation. Several analyses have shown that hypertension awareness and control rates are low, even under the more relaxed guideline recommendations of the JNC7 and 2014 evidence-based guideline, both in the USA [53] and globally

[2]. Given that 31 million additional adults have hypertension and 11 million additional adults are recommended pharmacologic therapy under the 2017 guideline [15••], appropriate treatment and control of hypertension remains a monumental public health challenge. Indeed, regardless of guideline targets, a large population of patients with elevated BP remains unaware and untreated, leaving much to be done to address one of the most important known risk factors for CVD and mortality [54]. Research is ongoing to address the best practices for achieving better control, including the use of team-based, comprehensive care strategies, as recommended by the 2017 guideline [14••]. A recent systematic review and meta-analysis of 100 RCTs testing different BP management strategies identified that multilevel, multicomponent strategies were most effective [55•]. Future work should continue to evaluate the feasibility of widespread adoption of these strategies. Of course, the importance of standardized and accurate measurement of BP in improving awareness, management, and control of hypertension cannot be overstated [17•].

The possibility of adverse events should always be considered carefully, both in the contexts of population health and in routine clinical practice. There is concern over the feasibility of achieving the new guideline-recommended treatment targets, due to potential adverse events and increased costs related to combined treatment with multiple antihypertensive agents [20]. Importantly, the 2017 guideline recommends individualized management with careful consideration of the patient's tolerance to BP lowering and presence of comorbidities, such as diabetes and CKD. Based on a network meta-analysis that included more than 140,000 adults with hypertension belonging to various subgroups and patient populations, intensive systolic BP lowering reduced the risk of both CVD and death, providing evidence that intensive systolic BP lowering is beneficial in adults with hypertension at large [13]. Still, the trade-offs for the new guideline recommendations in terms of clinical events reduced versus adverse events increased must be weighed carefully based on public health and clinical impacts. Some analyses weight increased risk of adverse events equally to decreased risk of CVD [56]. However, we believe increases in adverse events should not be of equal importance to the risk reductions of major clinical events. The analyses by us [15••] and Bress et al. [16••] showed significant reductions in all-cause deaths, lending support to the idea that the benefits of treatment outweigh the harms.

Finally, it must be acknowledged that data are insufficient in several important subgroups, including in older adults and those with diabetes or CKD. Historically, hypertension guidelines have provided different recommendations for these important subgroups. For example, JNC7 provided lower targets for BP lowering in those with diabetes or CKD (< 130/80 mmHg) [8]. Similarly, while the 2014 hypertension guideline relaxed targets across all populations, they remained comparatively lower in these subgroups (< 140/90 mmHg compared with < 150/90 mmHg in the general population) [9]. Several pre-specified secondary analyses of SPRINT suggest treatment effects are similarly efficacious in older patients [37] and those with CKD [28]. However, conclusions from data outside the SPRINT population are more uncertain, especially among patients with diabetes [33, 57]. The Action to Control Cardiovascular Risk in Diabetes (ACCORD) BP trial did not demonstrate a statistically significant effect of intensive BP control among patients with diabetes due to lack of statistical power [30, 31]. In addition, interaction may exist between glycemic and BP controls, because a subgroup analysis revealed a statistically significant reduction in CVD risk for intensive BP lowering in people assigned to standard glycemic control, whereas no significant change was observed in people assigned to intensive glycemic control (p for interaction = 0.08). Regardless, owing to limitations in the network meta-analysis used for risk reduction data, we were unable to estimate CVD events and deaths reduced in these subgroups. Further study of these important patient populations is a major focus for further research, including effectiveness of RCTs.

Conclusions

The 2017 ACC/AHA hypertension guideline applied a lower threshold for defining hypertension and targets for lifestyle and pharmacologic interventions based on strong evidence from observational studies and RCTs. Recent analyses suggest that adoption of the new guideline could reduce CVD and mortality substantially in the US general population compared with older guidelines. The current challenge is to achieve the lower BP treatment goals (< 130/80 mmHg) in the general population among whom hypertension control is not optimal even at the previous, more relaxed goal (< 140/90 mmHg). Future research should focus on implementing and scaling up effective, equitable, and sustainable strategies for hypertension control in populations. Adoption of the new guideline should lead to future reductions in the risks of CVD and overall mortality among adults in the USA and worldwide.

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Compliance with Ethical Standards

Conflict of Interest The authors declare no conflicts of interest relevant to this manuscript.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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15.•• Bundy JD, Mills KT, Chen J, Li C, Greenland P, He J. Estimating the association of the 2017 and 2014 hypertension guidelines with cardiovascular events and deaths in US adults. JAMA Cardiol. 2018;3:572–81 **This is one of two separate, but complementary, modeling analyses that estimates the potential risk reductions of cardiovascular disease and all-cause deaths in the US population. Additionally, this paper provides the most updated nationally representative data on the prevalence of hypertension under the 2014 and 2017 hypertension guidelines.**
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