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STATE-OF-THE-ART REVIEW

# Hypertension in the Oldest Old

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## ABSTRACT

Hypertension affects 80% of adults 80 years of age or older and is a leading cause of morbidity and mortality through its fundamental role as a risk factor for cardiovascular disease, stroke, kidney disease, and cognitive impairment. Antihypertensive therapy reduces the risk of coronary artery disease, heart failure, atrial fibrillation, stroke, and cognitive decline among patients in this age group, but older patients with advanced frailty, cognitive impairment, complex comorbidities, or nursing home residence have largely been excluded from clinical trials. This article reviews the epidemiology, pathophysiology, diagnosis, and management of hypertension in the oldest old, herein defined as age ≥80 years. We propose the geriatrics 4 Ms model as a framework for providing individualized patient-centered care for the oldest patients with hypertension. Additional research is needed in patients who have been under-represented in clinical trials and to assess the role of deprescribing in the care of older patients with hypertension. (JACC Adv. 2025;4:102306) © 2025 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Higher-income countries around the world, including the United States, are undergoing a marked demographic shift toward a progressively aging population. In the United States, the fastest growing segment of the population is the 85 years and older subgroup, which is projected to more than double in size to 13.7 million by 2040.[1] Hypertension is one of the most common chronic medical conditions among older adults and is a leading cause of morbidity and mortality. Although numerous clinical trials have tested various treatments for hypertension in older adults, patients at very advanced age, especially those with complex comorbidity, geriatric syndromes, or residence in a chronic care facility have been markedly underrepresented. The objectives of this review are to summarize the epidemiology, clinical impact, diagnosis, and management of hypertension in the oldest old and to provide a framework for managing this highly diverse and often complex population.

## KEY CONCEPTS

1. A consensus definition for the "oldest old" population has not been established.[2] In this review, we focus on adults age 80 years and older. However, in some instances, for example where evidence from randomized clinical trials is lacking, a lower threshold of 75 years is used.
2. Beyond chronological age (ie, years since birth), the extreme heterogeneity that characterizes the oldest old mandates that functional and cognitive status be incorporated into hypertensive management considerations.[3] To that end, where available, recommendations based on frailty status, functional status, and remaining life expectancy are presented.
3. Striking a balance between the risks and benefits of blood pressure (BP) control presents a special challenge in the oldest old. Although the rates of some adverse treatment-related events are

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**ABBREVIATIONS AND ACRONYMS**

**BP** = blood pressure

**CV** = cardiovascular

**CVD** = cardiovascular disease

**MCI** = mild cognitive impairment

**SBP** = systolic blood pressure

indisputably higher in the oldest old, their concomitant higher incidence and prevalence of cardiovascular disease (CVD), stroke, and cognitive impairment means that the potential benefits of antihypertensive therapy may be greater than in younger patients.[4] In this context, a risk-based approach to BP control that attempts to integrate these factors into a net benefit assessment is presented. The inherent complexities that arise at the end of life are also discussed, and an individualized, patient-centric approach to care that aligns with what matters most to patients in the oldest old cohort is recommended.

**HIGHLIGHTS**

- Hypertension is a potent risk factor for cardiovascular disease, kidney disease, and cognitive impairment in older adults.
- Treatment of hypertension in older patients reduces risk for cardiovascular disease, stroke, and cognitive dysfunction.
- Hypertension management in older patients must consider prevalent comorbidities, geriatric syndromes, and individual care preferences.
- The 4 Ms model provides a personalized framework for optimizing hypertension management in complex older adults.

## EPIDEMIOLOGY AND PATHOPHYSIOLOGY

Aging is associated with progressive stiffening of the large arteries due to increasing collagen deposition and crosslinking in the arterial walls in conjunction with degeneration of elastin fibers.[5] This leads to a gradual increase in systolic BP (SBP) with age, a concomitant plateauing and decline in diastolic BP, and widening of the pulse pressure.[6] As a result, the prevalence of hypertension increases with age and 80% of men and women 75 years of age or older in the United States have elevated BP (**Figure 1**).[7]

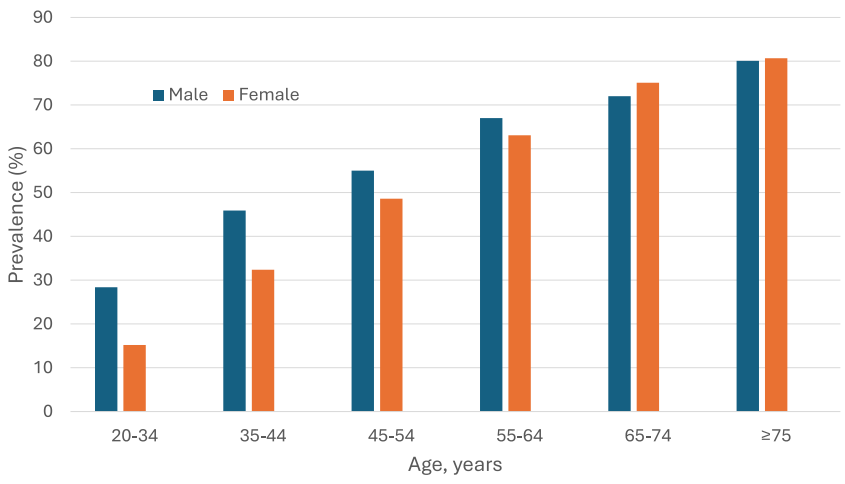
In the Global Burden of Disease study, hypertension was the strongest risk factor for attributable mortality, accounting for 10.8 million deaths worldwide in 2019 (19.2% of all deaths), with substantially greater impact at older age. In addition, systolic hypertension was the leading risk factor for disability-adjusted life years for adults age 75 years or older and accounted for 15.8% of the population attributable risk for dementia.[8]

Despite the clear association of hypertension with adverse clinical outcomes at a population level, uncertainty persists regarding the impact of hypertension and its treatment in the oldest old, particularly for individuals with advanced frailty, severe cognitive impairment, and nursing home residence. For example, in a study of 4071 U.S. veterans ≥80 years of age, the SBP and diastolic BP ranges associated with longest survival were 130-139 mm Hg and 80-89 mm Hg, respectively, and there was no apparent association between BP and survival among individuals with uncontrolled hypertension (≥140/90).[9] Similarly, in the PARTAGE (Predictive Values of Blood Pressure and Arterial Stiffness in Institutionalized Very Aged Population) study of 1,126 nursing home residents age ≥80 years, each 10 mm Hg increase in SBP was associated with a significant 9% lower mortality risk.[10] However, the inverse association between high BP and mortality among older adults in observational studies may in part be explained by reverse causality (ie, lower BP in this age group may be a marker for less robust health and reduced life expectancy).[11] Notably, several randomized trials have demonstrated mortality and morbidity benefits with intensive SBP control in older adults (**Table 1**).[12-16] With the exception of the ACCORD study, the smallest and oldest of the trials, these studies have consistently shown improved outcomes with SBP treatment targets <120 mm Hg or 110-130 mm Hg compared to standard care. Nevertheless, management of hypertension in the oldest old must be undertaken in the context of the patient's overall health and disease burden in conjunction with their goals of care and health care preferences.

## BENEFITS AND RISKS OF ANTIHYPERTENSIVE THERAPY IN OLDER ADULTS

**CARDIOVASCULAR, KIDNEY, AND COGNITIVE BENEFITS.** Hypertension is an established risk factor for CVD (including coronary heart disease, heart failure, and atrial fibrillation), stroke, chronic kidney disease, and cognitive impairment (including vascular dementia and Alzheimer disease). Moreover, there is compelling evidence from numerous clinical trials in older adults that treatment of hypertension substantially reduces the risk of CVD and stroke. In a review of 14 trials involving >40,000 adults age ≥60 years, antihypertensive therapy was associated with reductions of 23.4%, 48.0%, and 32.2% in incident coronary heart disease, heart failure, and

**FIGURE 1** Prevalence of Hypertension in the United States by Age and Sex




Adapted from Martin et al.[7] Data source: National Health and Nutrition Examination Survey, 2017 to 2020.[7]

stroke, respectively.[17] Data from the SPRINT (Systolic Blood Pressure Intervention) trial demonstrated a 26% reduction in incident atrial fibrillation among patients randomized to an intensive BP treatment target (<120 mm Hg) compared to standard therapy (<140 mm Hg).[18] Another metanalysis using data from the Blood Pressure Lowering Treatment Trialists' Collaboration concluded that "pharmacological BP reduction is effective into old age, with no evidence that relative risk reductions for prevention of major cardiovascular events vary by SBP or diastolic BP levels at randomization, down to <120/70 mm Hg."[19]

Data on the effect of antihypertensive therapy on renal outcomes are mixed. SPRINT showed short-term worsening of renal function with intensive compared to standard BP control, but subsequent analyses demonstrated that increases in serum creatinine during intensive BP lowering often reflect benign hemodynamic changes without evidence of intrinsic kidney damage.[20,21] Long-term intensive BP control among patients with chronic kidney disease may delay the need for kidney replacement therapy.[22]

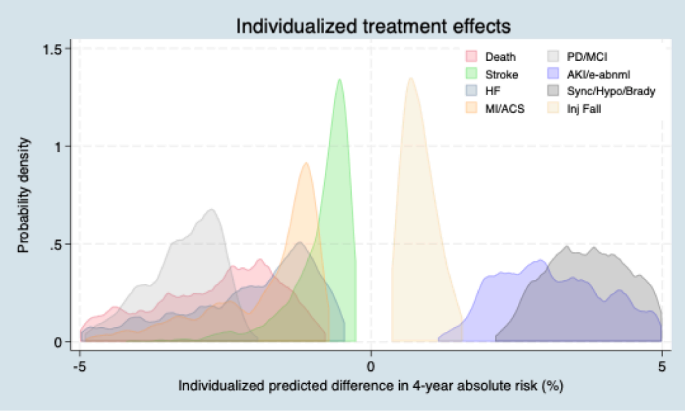
Reports of the effects of antihypertensive therapy on cognitive function in older adults have been generally favorable. In the SPRINT-MIND study (a substudy of SPRINT), intensive BP control was associated with a nonsignificant 17% reduction in the primary outcome of incident dementia, but a significant 19% reduction in incident mild cognitive impairment (MCI) and significant 15% reduction in

**TABLE 1** Randomized Trials of Intensive vs Standard Blood Pressure Control in Older Adults

| | Year | N | Age Range, y | Target SBP, mm Hg | Follow-Up, y | Main Outcome | Comment |
|---|---|---|---|---|---|---|---|
| ACCORD | 2010 | 4,733 | Mean 62.9 | <120 | 4.7 | 12% ↓ in CV death, MI, CVA | Difference not significant<br>Similar in <65 vs ≥65 |
| SPRINT | 2015 | 9,361 | ≥50<br>Mean 67.9 | <120 | 3.26 | 25% ↓ in CV death, MI, ACS, CVA, HF | Similar in <75 vs ≥75 |
| STEP | 2021 | 8,511 | 60-80<br>Mean 66.2 | 110-130 | 3.34 | 26% ↓ in CV death, ACS, ADHF, CVA, AF, coronary artery revascularization | Similar in 60-69 vs 70-80<br>No patients ≥80 |
| ESPRIT | 2024 | 11,255 | ≥50<br>Mean 64.6 | <120 | 3.4 | 12% ↓ in CV death, MI, CVA, HHF, coronary artery revascularization | Similar in <60, 60-70, ≥70<br>≥80 not reported |
| BPROAD | 2025 | 12,821 | ≥50<br>Mean 63.8 | <120 | 4.2 | 21% ↓ in CV death, MI, CVA, HHF | Similar in <80 vs ≥80 but small (n = 177) |

ACS = acute coronary syndrome; ADHF = acute decompensated heart failure; AF = atrial fibrillation; CV = cardiovascular; CVA = cerebrovascular accident; HF = heart failure; HHF = hospitalization for heart failure; MI = myocardial infarction; SBP = systolic blood pressure; SPRINT = Systolic Blood Pressure Intervention.

**FIGURE 2 Outcomes From Intensive vs Standard BP Lowering in Patients ≥80 Years of Age**




| Outcome | No. of events (%) | Distribution of predicted differences in absolute risk from intensive SBP lowering | | |
|---|---|---|---|---|
| | | Median (%) | Lower quartile (%) | Upper quartile (%) |
| Death | 116 (10.6%) | -3.06 | -2.03 | -4.86 |
| Heart failure | 57 (5.2%) | -2.27 | -1.33 | -4.43 |
| Stroke | 37 (3.4%) | -0.69 | -0.50 | -1.03 |
| MI or ACS | 55 (5.0%) | -1.43 | -1.11 | -2.44 |
| PD or MCI | 250 (25.6%) | -3.12 | -2.71 | -3.61 |
| AKI or electrolyte abnormality | 109 (9.9%) | 3.78 | 2.72 | 5.78 |
| Syncope, hypotension, or bradycardia | 105 (9.6%) | 4.35 | 3.47 | 5.75 |
| Injurious Fall | 184 (16.8%) | .79 | 0.60 | 1.02 |

Individualized predicted difference in absolute risk was calculated as the difference in 4-year predicted survival probability of the outcome using an individual trial participant's baseline characteristics, factual randomized treatment assignment, and counterfactual randomized treatment assignment in the SPRINT trial. Negative values indicate an absolute risk reduction and positive values indicate an absolute risk increase with intensive vs standard BP lowering. The model for the cognitive impairment outcome calculates 5-year predicted probabilities. Models assumed no treatment interaction with baseline characteristics. See text for additional details. ACS = acute coronary syndrome; AKI = acute kidney injury; BP = blood pressure; brady = bradycardia; e-abnml = electrolyte abnormality; HF = heart failure; hypo = hypotension; MCI = mild cognitive impairment; MI = myocardial infarction; PD = probable dementia; SBP = systolic blood pressure; SPRINT = Systolic Blood Pressure Intervention; sync = syncope.

the combined outcome of incident dementia or MCI.[23] Cognitive outcomes were similar among SPRINT-MIND participants older or younger than 80 years of age.[24] Extended follow-up of SPRINT-MIND study participants to a median of 7 years reinforced the initial results.[25] These findings align with an individual patient data meta-analysis of 5 randomized trials involving 28,008 participants that found that antihypertensive therapy was associated with a significant 13% reduction in incident dementia.[26] More recently, the results of the China Rural Hypertension Control Project Phase-3 cluster-randomized trial were reported.[27] This study was designed to determine the effectiveness of an intensive BP intervention targeting an SBP <130 mm Hg compared to usual care in reducing the risk of rigorously adjudicated all-cause dementia. The trial enrolled 33,995 participants aged 40 years and older (mean 63 years, 61% female) with uncontrolled hypertension. The HR for incident all cause dementia was 0.85 (95% CI: 0.76-0.95) in favor of the intensive arm. No age group-specific outcomes have been reported but the authors noted that "the effectiveness of BP reduction on the risk of dementia was consistent across subgroups based on age…" The results from these trials led to a new recommendation in the 2025 AHA (American Heart Association)/ACC (American College of Cardiology) Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: "In adults with hypertension, a goal of <130 mm Hg SBP is recommended to prevent MCI and dementia" (Class 1 recommendation, Level of Evidence: A).[28]

An important limitation of these studies is that patients >80 years of age were under-represented, especially individuals with substantial comorbidity. However, the HYVET (Hypertension in the Very Elderly Trial) randomized 3,845 patients ≥80 years of age (mean 83.6 years, 60% female, average SBP 173 mm Hg) to indapamide and, if needed, an angiotensin-converting enzyme inhibitor, or to placebo.[29] The treatment target was an SBP <150 mm Hg. The trial was stopped after a median follow-up of 1.8 years due to a 21% reduction in all-cause mortality in the intervention group. Active treatment was also associated with a 30% reduction in fatal and nonfatal stroke and a 64% decrease in incident heart failure. The benefits of BP reduction were similar in frail and nonfrail participants, as well as in patients aged 80 to 84 vs ≥85 years, men and women, and patients with or without prior CVD.[30,31] Results from an open-label extension study in which placebo subjects switched to active treatment demonstrated that these patients achieved the same reduction in stroke by 12 months, suggesting a relatively short time to treatment benefit in this age group.[32]

SPRINT-Senior, a prespecified substudy of SPRINT, included 2,636 participants 75 years or older (mean 79.9 years, 38% female).[33] After a median follow-up of 3.1 years, intensive treatment was associated with a 34% reduction in the primary composite outcome (CV death or nonfatal myocardial infarction, stroke, acute coronary syndrome, or decompensated

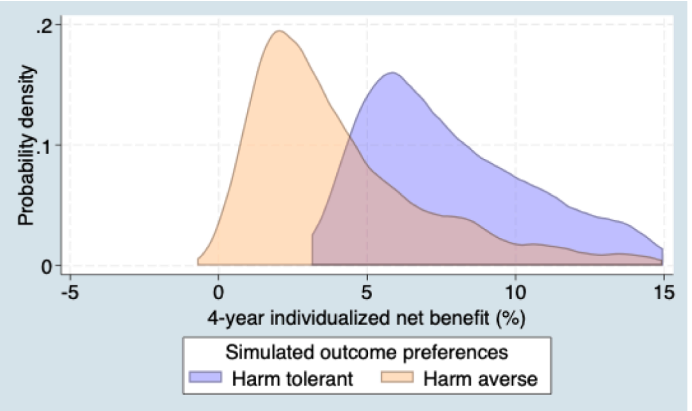
heart failure) and a 33% reduction in all-cause mortality. Frailty was associated with an increased risk for adverse events, but the benefits of intensive treatment were similar across the frailty spectrum, as well as in patients with normal vs impaired gait speed.[34] Patients with diabetes, dementia, advanced kidney disease, nursing home residence, or shortened life expectancy were excluded from SPRINT, so the generalizability of the SPRINT findings to these populations is unknown.

**POTENTIAL HARMS.** Treatment-related adverse events, including hypotension, syncope, electrolyte abnormalities, and acute kidney injury (but not injurious falls), were more common with intensive treatment in SPRINT, highlighting the inevitable trade-off between potential benefits and potential harms associated with more aggressive therapies. Moreover, treatment-related harms often occur earlier than the benefits of BP reduction, which may be a consideration in harm-averse patients and those with limited life expectancy.[35]

**PERSONALIZING THE BENEFIT-HARM TRADE-OFFS.** A key clinical question that arises in this context is how to factor patient preferences and goals of care into the decision-making process in older adults with diverse health profiles, life expectancies, and treatment perspectives. A recent study using data from SPRINT and employing a novel methodology to examine the implications of patient preferences on the benefits vs harms of intensive BP treatment showed that almost all SPRINT participants aged 65 years and older experienced a net benefit (difference between benefits and harms) that favored the intensive SBP target.[4] In addition, although SPRINT participants with advanced age (≥75 years), frailty, or polypharmacy had more treatment-related harms, they also had larger reductions in cardiovascular events, cognitive impairment, and death compared to their lower risk counterparts, which resulted in greater net benefits from more intensive treatment.

Herein, we extend this net benefit approach to 1,098 SPRINT participants ≥80 years of age (median 83 years, Q1-Q3: 81-86 years). The predicted absolute differences in risk from intensive vs standard BP lowering for both benefits and harms are illustrated in **Figure 2**, which shows that the oldest old in SPRINT are predicted to experience both large increases in the risk of adverse events from intensive BP lowering as well as substantial absolute risk reductions for cardiovascular, cognitive, and death outcomes. Individualized net benefit was then calculated as the weighted sum of risk differences across the benefit and harm outcomes. Consistent with prior studies, preference weights corresponding to the relative importance of each outcome for an individual were used to weight the outcomes to reflect "harm tolerant" and "harm averse" scenarios. A positive net benefit indicates the benefits of intensive BP lowering outweigh the harms, and a net benefit of 2% can be interpreted as intensive BP lowering leading to a cumulative 2% lower absolute risk of the weighted composite of events. Under a harm tolerant patient perspective (ie, weighting the benefits much higher than the harms), the median net benefit from intensive BP lowering was 8.0% (Q1-Q3: 5.8%-11.9%), with every participant 80 years and older having a positive net benefit in favor of intensive BP lowering. When modeled to fit a harm averse perspective (ie, weighting the benefits similarly to the harms), the median net benefit was 3.3% (Q1-Q3: 1.9%-5.7%) and 99.5% of the oldest old participants were predicted to have a positive net benefit (**Figure 3**). These findings suggest that when accounting for an individual's risks and care preferences, the benefits of intensive BP lowering outweigh the harms for nearly all community-dwelling, SPRINT-eligible adults ≥80 years of age with hypertension, including those with a harm-averse perspective.

**FIGURE 3** Predicted Net Benefit of Intensive Systolic Blood Pressure Lowering




| | Harm tolerant preferences | Harm averse preferences |
|---|---|---|
| Median net benefit (IQR) (%) | 8.0% (5.8%, 11.9%) | 3.3% (1.9%, 5.7%) |
| Proportion with net benefit >0 | 100% | 99.5% |

Individualized predicted net benefit for each individual was calculated as the sum of the preference-weighted individualized treatment effects for each outcome. Preference weights correspond to the relative importance of each outcome. Harm tolerant preferences reflect cardiovascular, cognitive, and death outcomes as much more important than the BP treatment-related harms. Harm averse preferences reflect cardiovascular and cognitive outcomes as having similar, intermediate importance as BP treatment-related harms.

## DIAGNOSTIC EVALUATION

The principal components of the diagnostic evaluation for hypertension in older adults largely parallel those for younger individuals, that is, appropriate BP measurement, consideration for possible secondary causes, and overall cardiovascular risk assessment. However, recognizing the high prevalence of multimorbidity, frailty, and cognitive impairment in very old adults, it is important to evaluate physical performance, frailty, and cognitive function using validated geriatric outcome assessments that are available in clinical practice. These include the short physical performance battery (4 m gait speed, hand grip strength and standing balance), the clinical frailty scale, and mini-cognitive screen available at https://nihtoolbox.org/solutions/clinical/.[36-38]

**MEASUREMENT MATTERS.** Several pathophysiological aging-related changes, including greater stiffness of the central conduit arterial system and reduced baroreceptor sensitivity, conspire to produce much greater BP variability in the oldest old.[5] As a result, more measurements are required to accurately determine an individual's BP. The current recommendation is to use an average of 3 readings obtained on at least 3 separate occasions. Current guidelines also recommend relying on out-of-office BP values using validated oscillometric devices rather than office measurements. This is especially true for the oldest old, as white coat or office hypertension becomes more prevalent with increasing age.[39] Although more studies are needed, the validity and adherence to out-of-office measurements in older patients has been acceptable, although in 1 study, age >80 years was associated with higher failure rates.[40] In addition, since orthostatic or postural hypotension is common in older adults and is a well-recognized fall risk, it is obligatory to obtain orthostatic BP readings. This is necessary at antihypertensive therapy initiation or dose escalation as the risk for fall-related adverse events may be highest in the first 30 days following intensification of BP medication.[41] In addition, postural BP should be obtained at any point when a patient experiences symptoms of lightheadedness, dizziness, a syncopal event, or a fall.

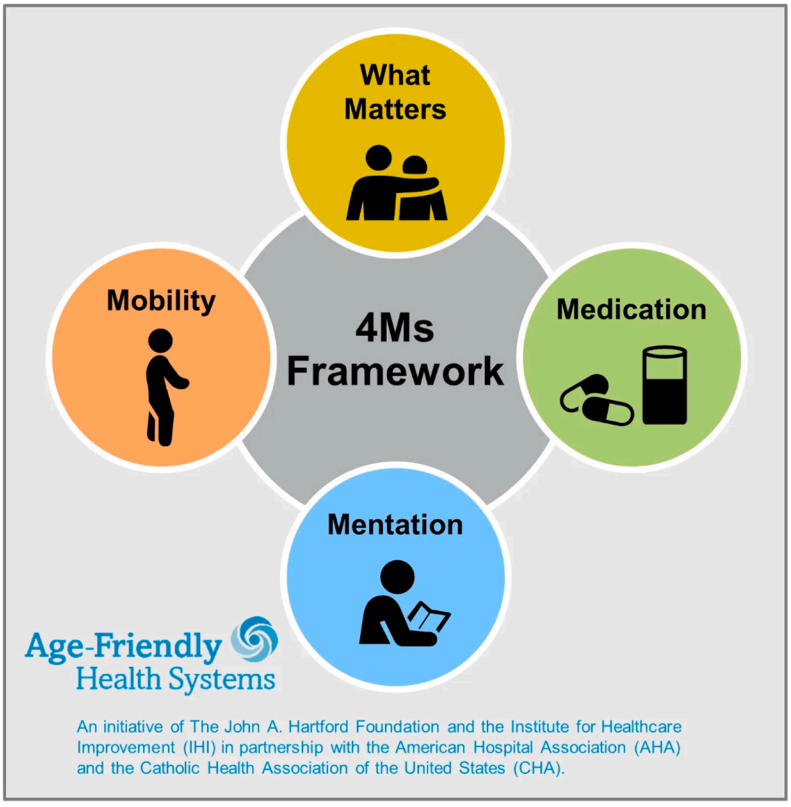
**ASSESSMENT FOR SECONDARY CAUSES AND OVERALL CVD RISK.** There are no specific differences in the evaluation of the oldest old with hypertension with respect to identifying secondary causes for elevated BP.[17] Sleep apnea, renal artery stenosis, and primary hyperaldosteronism are relatively common causes or contributors to hypertension in older adults, and their prevalence increases with advancing age. Sleep apnea is underdiagnosed in older adults, in part because older patients with this condition may not be overweight or obese. The history should therefore include questions about sleep quality, snoring, and daytime sleepiness. Renal artery stenosis should be considered in older adults with relatively new onset hypertension that does not respond readily to therapy, especially in the presence of concomitant vascular disease or risk factors. Similarly, primary hyperaldosteronism should be considered in older adults with difficult to control hypertension despite adherence to a multidrug treatment regimen.

It is also important to assess overall CVD risk to guide treatment decisions. The recently updated AHA/ACC Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults includes a new recommendation to incorporate a patient's 10-year predicted cardiovascular risk, as defined by Predicting Risk of CVD EVENTs into BP treatment decisions.[28,42] Specifically, 10-year CV risk ≥7.5% defines a higher risk subgroup warranting earlier initiation of pharmacotherapy in patients with stage I hypertension. Although the upper age for using the online Predicting Risk of CVD EVENTs risk calculator (https://professional.heart.org/en/guidelines-and-statements/prevent-risk-calculator/prevent-calculator) is 79, the a priori risk for essentially all adults ≥80 years of age with hypertension is well over 7.5%. Notably, the guideline retained an overarching BP treatment goal of <130/80 mm Hg for all adults. To that end, the evaluation should focus on a patient's prior history of coronary heart disease, heart failure, atrial fibrillation, peripheral arterial disease, or stroke, in addition to other CVD risk factors such as hyperlipidemia, diabetes mellitus, smoking history, alcohol intake, recreational drug use, and chronic kidney disease.

## MANAGEMENT

**GENERAL APPROACH.** The complexities surrounding hypertension management in the oldest old have been recognized for many decades, and the controversies surrounding the approach have been the source of debate for a similar period of time.[43] Current U.S. and European guidelines for the management of hypertension acknowledge limitations of the data for treating patients of advanced age and/or with concomitant frailty, cognitive impairment, or limited life expectancy, and the ESC (European Society of Cardiology) guideline added frailty screening as a Class IIa recommendation.[28,44] The

**FIGURE 4** Age-Friendly Health Systems 4 Ms Framework for Care of Older Adults




**What Matters**
Know and align care with each older adult's specific health outcome goals and care preferences including, but not limited to, end-of-life care, and across settings of care.

**Medication**
If medication is necessary, use Age-Friendly medication that does not interfere with What Matters to the older adult, Mobility, or Mentation across settings of care.

**Mentation**
Prevent, identify, treat, and manage dementia, depression, and delirium across settings of care.

**Mobility**
Ensure that older adults move safely every day in order to maintain function and do What Matters.

The 4 Ms model provides a framework for delivering patient-centered care to older adults with acute and chronic medical conditions, including hypertension (see text for details) (https://www.ihi.org/partner/initiatives/age-friendly-health-systems; accessed 9/10/2025) (with permission from ihi.org).

ESC guideline also advises a patient-centered approach in complex older patients with consideration of comorbidities, functional status, and goals of care. The U.S. and ESC guidelines differ in their definitions of hypertension and in their treatment targets (<130/80 regardless of age in the U.S. guideline; 120-129/70-79 in the ESC guideline; <130/80 for patients <65 years of age, <140/80 for patients 65 to 79 years of age, and 140 to 150/<80 for patients age 80 years or older in the European Society of Hypertension guideline). Implications of the variability across guidelines are that treatment of hypertension in the oldest old must be individualized and that there is no uniform, "one-size-fits-all" treatment target. As summarized in the 2024 ESC guideline, "health priorities and a shared-decision approach should be considered when deciding on BP treatments and targets" (Class IIa recommendation).[44] However, in the opinion of these authors, the beneficial effects of BP lowering on cardiovascular and cognitive outcomes that have been demonstrated in SPRINT support a target BP of at least <130/80 in most community-dwelling older adults, including the oldest old, if tolerated, and in the absence of limited life expectancy or other contingencies as described in the next section.

**APPLYING THE GERIATRIC 4 MS FRAMEWORK.** The oldest old population with hypertension is inherently characterized by multicomplexity and a high degree of heterogeneity with respect to functional and cognitive status. As a result, it is not appropriate or necessary to apply a single threshold to serve as the "optimal" level of BP control. Rather, there is a need to adopt an individualized, patient-centric management strategy that aligns with an age-friendly approach to geriatric care. The age-friendly health system initiative was developed to broadly disseminate evidence-based geriatric models of care.[45] This process consolidated the evidence into 4 domains—mobility, medications, mentation, and what matters most—now referred to as the 4 Ms of geriatrics (**Figure 4**). This framework is applicable to hypertension management in the oldest old.

**CENTRAL ILLUSTRATION** Hypertension in the Oldest Old (≥80 Years of Age)

## Epidemiology

- Affects 80% of indivduals aged ≥80
- Major risk factor for:
  - CVD
  - Stroke
  - Cognitive impairment
  - Mortality
- Therapeutic inertia is common; few reach target SBP levels

## Management Framework

- Align with patient-centered goals of care
- Guided by the 4Ms of geriatrics:
  - Mobility
  - Medications
  - Mentation
  - What Matters Most

## Research Priorities

- Include more:
  - Individuals ≥80 years
  - People with dementia
  - Long-term care residents
  - Study deprescribing of antihypertensives

## Benefits vs Harms of Lower SBP Goals


99.5% of participants ≥80 years in the SPRINT trial predicted to have net positive benefit from intensive SBP lowering

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Hypertension is highly prevalent in the oldest old (≥80 years) and is a major risk factor for cardiovascular disease, stroke and cognitive impairment. The 4 Ms model provides a framework for managing hypertension in older adults, and current evidence indicates that the benefits of intensive blood pressure reduction significantly outweigh the potential harms in appropriately selected older patients, including the oldest old. Additional studies are needed in underrepresented populations of older adults and to assess the utility of deprescribing as a component of standard practice in caring for complex older patients. CVD = cardiovascular disease; SBP = systolic blood pressure; SPRINT = Systolic Blood Pressure Intervention trial.

**WHAT MATTERS MOST.** Balancing the overall risk-benefit equation for hypertension management in a patient-centric manner aligns with "what matters most." It also aligns with the caveats included in the AHA/ACC 2025 hypertension guideline's recommendation: "In older adults who may be frail or have a limited life expectancy, a clinician-patient assessment of potential benefits and harms of BP lowering should be pursued to align care with patient goals."[28] Eliciting what matters most for the oldest old population is essential for defining an individualized SBP target and for developing a treatment plan. It is

important that clinicians fully inform patients of the inherent risks and benefits of managing their hypertension to ensure that a given target BP level aligns with the patient's preferences. It is also important to remain flexible, as "what matters most" and related patient preferences may evolve over time. For example, if the target BP cannot be achieved without undue side effects, as defined by the patient, consideration should be given to adjusting the target BP accordingly.

**MULTICOMPLEXITY.** Congruent with the AHA/ACC hypertension guideline cited above, for patients with multicomplexity, a "high burden of comorbidity," or frailty with associated limited life expectancy, the time to benefit from more intensive BP control may exceed their remaining life span, and a less aggressive target may be appropriate. Importantly, the findings from SPRINT may not generalize to the oldest old who do not meet SPRINT's inclusion criteria, including individuals with limited life expectancy, dementia, active cancer, and those residing in institutional settings. Moreover, for individuals with multicomplexity and major competing health priorities, the benefits of BP lowering may not be achievable or of sufficient priority to warrant intervention.

**MENTATION.** Preservation of cognitive function is highly desired by almost everyone, regardless of age. Thus, one of the most consequential benefits identified in the net benefit analysis discussed above was the prevention of MCI and dementia. These results were derived from the SPRINT-MIND study and are supported by meta-analyses involving large numbers of older adults.[23,25,26]

An important component of the "mentation" conversation is to frame the cognitive function benefits that are evident with more intensive SBP control in the context of the patient's competing risks from other chronic conditions. For example, a patient at a high risk to develop cognitive impairment and for whom preventing dementia matters most may opt for a more intensive BP goal of <120 mm Hg. Indeed, a secondary analysis from SPRINT indicated that participants who were at the highest risk for dementia derived the greatest benefit from the intensive BP target.[46] Conversely, among patients with comorbidities that limit their remaining life expectancy, the benefits of more intensive BP control on cognitive function may not be realized and a less aggressive target may be appropriate.

**MOBILITY.** Perhaps the biggest concern that patients and providers share with respect to intensive BP lowering in the oldest old is the potential for a higher rate of injurious falls. Although rates of injurious falls were higher among SPRINT participants who were older and more frail, there was no difference in injurious falls between those randomized to intensive vs standard BP control.[47] SPRINT participants aged 75 years or older had higher rates of syncope, hypotension, and falls, but there was no age-by-treatment interaction for any of these adverse outcomes.[47] Moreover, even among SPRINT participants aged 85 years and older, there was no increased risk for injurious falls with intensive BP control (HR: 1.02; 95% CI: 0.57-1.80).[24] Importantly, fall risk is highest in the period immediately following initiation or intensification of antihypertensive therapy. Patients should be informed of this period of increased risk, caution should be advised, especially in individuals at high risk for falls, and frequent BP monitoring should be implemented to avoid excessive BP reduction.

A final point of relevance to mobility as well as to what matters is that 2 common chronic conditions in hypertensive older adults—heart failure and stroke—have a profoundly deleterious impact on mobility-related functional status. As intensive BP management significantly attenuates the incidence of these 2 outcomes, the risk for loss of mobility is reduced.[48]

**MEDICATIONS.** The medication domain encompasses more than a simple count of the number of medications and avoidance of polypharmacy. Rather it focuses on the right medications to support what matters to the patient while not interfering with mentation or mobility goals. When considering antihypertensive medications for the oldest old population it is important to ensure that age-appropriate dosages (most often adjusting for renal function and occasionally for weight) are selected and to minimize exposure to potentially inappropriate medications for older adults.[49] Conversely, therapeutic inertia is common in older adults, especially among those over age 80, and it is important to adjust the BP regimen to achieve treatment goals when appropriate. In addition, comprehensive medication reconciliation should target any medications, including nonsteroidal anti-inflammatory medications and others, that are known to elevate BP.

Evidence from clinical trials in geriatric hypertension indicates that the number of antihypertensive medications needed to achieve a more intensive BP target is not associated with more serious adverse events. Most SPRINT participants randomized to the intensive arm were treated with a combination of 3 antihypertensive medication drug classes (an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker, calcium channel blocker, and

a thiazide diuretic, most commonly chlorthalidone). Higher rates of electrolyte abnormalities were identified in the intensive therapy arm of SPRINT, undoubtedly related to thiazide diuretic usage. In addition, counterintuitive to the tenet to avoid polypharmacy, data suggest that there may be fewer adverse events with lower doses of multiple antihypertensive agents than with the formerly espoused stepped care approach, wherein maximal dosage of a single antihypertensive drug was used before adding another agent. Accordingly, current guidelines recommend that in patients with SBP ≥140 mm Hg or diastolic BP ≥90 mm Hg, it is appropriate to initiate treatment with a fixed dose combination pill including 2 agents from different pharmacological classes (class 1 recommendation). In addition, several studies have shown that a polypill comprised of 3 or 4 antihypertensive agents at low doses is more effective than standard therapy at lowering BP and associated with better adherence and fewer side effects.[50] However, outcome data for fixed dose combinations and polypills are sparse, and the utility of these approaches in the oldest old has not been established.

Changes in a patient's clinical condition and declines in cognitive and physical function are to be expected over time in the oldest old. These changes in a patient's status should prompt an update to the "what matters most" conversation and, depending on the patient's clinical condition and preferences, consideration of a less aggressive BP goal. The OPTiMIZE (Optimising Treatment for Mild Systolic Hypertension in the Elderly) study randomized 569 patients age 80 years and older (mean 84.8 years, 48% women) with controlled hypertension (average SBP of 130 mm Hg) to a medication reduction strategy or usual care.[51] After a median follow-up of 4 years, the deprescribing approach (average difference 0.35 fewer antihypertensive medications per participant relative to the control group) was noninferior with respect to the primary outcome of hospitalization or death. These data suggest that deprescribing may be safe in selected patients 80 years of age or older with relatively well-controlled hypertension.

Although not well studied in the oldest old population, guidelines recommend nonpharmacological approaches to lowering BP in lieu of or as an adjunct to medications. These interventions focus on modification of lifestyle factors that can aid in BP lowering, including diet, exercise, weight management, not smoking, and treating sleep apnea. The TONE (Trial of Nonpharmacologic Interventions in the Elderly) randomized 875 patients 60 to 80 years of age with BP <145/85 mm Hg on a single antihypertensive agent to a reduced sodium diet, weight loss (if obese), both interventions, or standard care.[52] After a median follow-up of 29 months, the interventions were associated with improved BP control, but there was no effect on incident cardiovascular events. Although TONE did not enroll participants older than 80 years, it seems reasonable to extrapolate the study findings to the oldest old group, especially since a healthy diet and weight control may have benefits beyond BP control.

## SPECIAL POPULATIONS

**PERSONS LIVING WITH DEMENTIA.** It is important to differentiate the impact of lowering SBP to prevent cognitive impairment from appropriate hypertension management among very old persons who are living with dementia as one of their many chronic conditions. However, there is very little evidence to address this question.[53] Managing any chronic condition in these patients confers added complexity such that treatments need to carefully balance risks against any putative benefits of lower SBP. Risks of overtreatment may be greater in these patients who are likely to be more frail, have multiple other chronic conditions and medications, and who may be more prone to orthostatic hypotension, falls, and other adverse events. Moreover, optimal SBP target recommendations will vary based on the underlying subtype of dementia and the extent to which there may be a vascular contribution. Thus, the what matters dictum is likely of even greater relevance in these patients and providers should use a patient-centered approach based on the individual's overall health, dementia severity, and priorities.

**LONG-TERM CARE RESIDENTS.** Although the evidence base for hypertensive management in the oldest old is limited, an even more profound data desert exists for individuals in this age group who reside in long-term care facilities. This population is characterized by a high prevalence of frailty, multimorbidity, cognitive impairment, and dementia and disability, and has largely been excluded from randomized clinical trials until the recent publication of the RETREAT-FRAIL (Reduction of Antihypertensive Treatment in Frail Patients) trial.[54] The basis for this trial was an observational study of nursing home residents age 80 years and older with hypertension that found that all-cause mortality was nearly twice as high among those with SBP <130 mm Hg.[55] The RETREAT-FRAIL trial randomized 1,048 nursing home residents age 80 years and older with hypertension treated with 2 or more medications and a SBP <130 mm Hg to a de-escalation of therapy arm or usual care. During a median follow-up of 38.4 months,

patients in the intervention group received an average of 0.6 fewer BP medications and the between-group difference in SBP was 4.1 mm Hg. There was no difference in either mortality or adverse events. Data on quality of life and physical function were not reported. A clear future research direction is to conduct additional rigorous studies that address the benefits and risks of antihypertensive therapy in this population with respect to patient-centric outcomes of relevance including what matters most, preservation of mobility and mentation, and traditional outcomes of CVD and mortality.[56]

## CONCLUSIONS

The prevalence of hypertension exceeds 80% in the oldest old population and contributes substantially to the burden of CVD, stroke, chronic kidney disease, cognitive impairment, disability, and death in the rapidly growing population age 80 years or older. Antihypertensive therapy reduces risk for CVD, stroke, and cognitive decline in patients of advanced age, and there is strong evidence that the benefits of more intensive SBP reduction to a goal of <120 mm Hg outweigh potential harms for the vast majority of older adults eligible for enrollment in the SPRINT trial (**Central Illustration**). However, patients of advanced age comprise a markedly heterogeneous population, and management of hypertension and other chronic conditions should be undertaken using a patient-centric care model, such as the 4 Ms framework. Additional research is needed to evaluate antihypertensive therapy and treatment goals in older populations under-represented in clinical trials conducted to date, including very old patients (>85-90 years of age), patients with more advanced functional and cognitive deficits, and nursing home residents. Research is also needed to assess the effects of deprescribing antihypertensive medications in the context of patient preferences to reduce polypharmacy and in those with declining life expectancy.

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