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Challenges and advances in the management of arterial hypertension among elderly patients

Abstract

Hypertension is the most prevalent cardiovascular condition among older adults and a major contributor to morbidity, disability, and mortality worldwide. The progressive rise in life expectancy has led to a growing population of elderly patients with unique physiological changes, comorbidities, and treatment challenges. Unlike younger populations, older adults often present with isolated systolic hypertension, increased arterial stiffness, and a greater susceptibility to adverse drug effects, necessitating tailored therapeutic strategies.

This narrative review summarizes the current understanding of hypertension management in the elderly, with emphasis on epidemiology, pathophysiology, clinical features, and treatment goals. Non-pharmacological interventions, including dietary modification, physical activity, and sodium restriction, remain fundamental components of management. Pharmacological therapy requires careful agent selection and titration to minimize risks such as orthostatic hypotension, electrolyte imbalance, and polypharmacy-related interactions. Evidence from landmark clinical trials, including HYVET and SPRINT, has demonstrated the benefit of blood pressure reduction in older adults, though optimal targets remain debated.

Special considerations such as frailty, cognitive impairment, and multimorbidity are crucial in guiding individualized care. Adherence and follow-up are often compromised in this population, highlighting the need for multidisciplinary approaches and patient-centered strategies. Future directions include the integration of telemedicine, wearable technologies, pharmacogenomics, and artificial intelligence into routine practice, offering opportunities for personalized risk stratification and improved outcomes.

In conclusion, hypertension in the elderly requires a delicate balance between efficacy and safety. An evidence-based, holistic, and individualized approach is essential to reduce cardiovascular risk while preserving quality of life in aging populations. Ongoing research and health policy efforts are needed to ensure equitable and effective hypertension care worldwide.

Keywords: hypertension, elderly patients, antihypertensive therapy, cardiovascular risk

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Introduction

Hypertension is one of the most prevalent chronic conditions worldwide, representing a leading cause of cardiovascular morbidity and mortality across all age groups. However, its clinical significance is particularly pronounced in the elderly, where it contributes substantially to the risk of stroke, heart failure, myocardial infarction, chronic kidney disease, and cognitive decline.[1] The global demographic shift toward an aging population has further amplified the importance of managing hypertension in older adults. It is estimated that more than two-thirds of individuals over 65 years of age are hypertensive, making it the most common chronic condition in this age group.[2]

Unlike younger adults, elderly patients exhibit unique pathophysiological characteristics that influence both the development of hypertension and the therapeutic approach. Age-related vascular changes, such as increased arterial stiffness, reduced baroreceptor sensitivity, and alterations in renal function, not only elevate blood pressure but also modify the hemodynamic response to antihypertensive treatment.[3] Furthermore, older adults frequently present with multimorbidity and frailty, complicating treatment decisions and highlighting the importance of individualized management strategies.

The therapeutic goals in elderly patients must balance the benefits of blood pressure reduction against the risks of overtreatment, including orthostatic hypotension, falls, and drug-related adverse effects.[4] Current international guidelines reflect this complexity, with age-specific targets and recommendations that often differ from those for younger populations. Moreover, the heterogeneity among elderly patients—from the relatively healthy "young-old" (65–74 years) to the frail "old-old" (≥85 years)—necessitates a nuanced approach to care.

The aim of this review is to provide a comprehensive overview of hypertension management in elderly patients, focusing on the epidemiology, pathophysiological mechanisms, diagnostic challenges, treatment strategies, and evidence from major clinical trials. In particular, differences from younger populations will be emphasized to highlight the distinct considerations required in this vulnerable group. This review also aims to critically analyze both the persistent challenges and the emerging advances in the management of hypertension in elderly patients, providing a bridge between traditional approaches and innovative solutions.

Literature search strategy

A narrative literature review was conducted to identify publications related to hypertension management in elderly patients. Searches were performed in PubMed, Scopus, and Web of Science databases using combinations of keywords such as "elderly hypertension," "frailty," "pharmacological management," "non-pharmacological

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interventions," and "emerging technologies." Articles published in English between 2000 and 2024 were considered. Studies focusing on elderly populations or providing age-specific analyses were prioritized, while case reports and non-peer-reviewed sources were excluded. Relevant clinical guidelines and landmark clinical trials were also included to ensure comprehensive coverage of current evidence.

Physiological and pathophysiological changes in aging

The aging process induces a series of structural and functional alterations in the cardiovascular and renal systems that significantly impact blood pressure regulation. One of the most prominent changes is increased arterial stiffness, largely driven by progressive loss of elastin and accumulation of collagen within the vascular wall. This results in elevated systolic blood pressure, widened pulse pressure, and the development of isolated systolic hypertension, a hallmark of hypertension in older adults.[5]

Another important alteration is the decline in baroreceptor sensitivity. With age, baroreflex-mediated adjustments to blood pressure become blunted, reducing the ability to maintain hemodynamic stability during postural changes or stress. This contributes to a higher prevalence of orthostatic hypotension in elderly individuals, which in turn increases the risk of dizziness, falls, and subsequent morbidity.[6]

Renal aging also plays a central role. There is a gradual reduction in renal blood flow, glomerular filtration rate, and sodium excretion capacity, leading to increased salt sensitivity and impaired volume regulation.[7] These changes predispose elderly patients to both hypertension and adverse effects from antihypertensive therapies, such as electrolyte disturbances and acute kidney injury.

In addition, autonomic nervous system function undergoes important shifts. Sympathetic nervous system activity tends to increase with age, while parasympathetic tone declines, resulting in greater vascular resistance and higher blood pressure variability.[8] These changes contribute not only to the pathogenesis of hypertension but also to the heightened cardiovascular risk observed in this population.

Pharmacokinetics and pharmacodynamics are also markedly altered in elderly individuals. Reduced hepatic metabolism, decreased renal clearance, and changes in body composition (e.g., increased fat mass, reduced lean body mass) alter the distribution and elimination of antihypertensive drugs.[9] Consequently, older adults may demonstrate exaggerated responses to standard drug doses, reinforcing the principle of "start low, go slow" in this age group.

In contrast to younger adults, where hypertension is often associated with increased cardiac output and peripheral vascular resistance, hypertension in elderly patients is predominantly characterized by vascular stiffness and impaired regulatory mechanisms. This distinction is crucial for tailoring treatment approaches that minimize harm while ensuring adequate blood pressure control.

Epidemiology and risk factors

Hypertension is the most common chronic condition in the elderly population, with prevalence rates exceeding 60–70% among individuals aged 65 years and older.[10] Epidemiological data from both developed and developing countries consistently demonstrate a steep rise in hypertension prevalence with advancing age, largely driven by vascular aging, renal impairment, and cumulative exposure to cardiovascular risk factors.[11] Importantly, the lifetime risk of developing hypertension is estimated to be greater than 90% for individuals who live into their 80s, underscoring the near inevitability of hypertension in later life.[12]

Sex differences also play a role in epidemiology. While men tend to develop hypertension earlier in life, the prevalence in women surpasses that of men after menopause, likely due to hormonal changes, weight gain, and increased arterial stiffness.[13] Consequently, older women face a particularly high burden of hypertension-related complications, including stroke and heart failure with preserved ejection fraction.

Comorbidity is another defining feature of hypertension in elderly patients. Conditions such as diabetes mellitus, chronic kidney disease, coronary artery disease, chronic obstructive pulmonary disease, and dementia are frequently coexistent, complicating both diagnosis and treatment.[14] The interplay between hypertension and multimorbidity not only increases cardiovascular risk but also raises concerns about polypharmacy, drug–drug interactions, and treatment adherence.

Lifestyle and socioeconomic determinants further contribute to the risk of hypertension in the elderly. Sedentary behavior, unhealthy diet, obesity, and excessive alcohol intake are modifiable factors that continue to exert influence even in later decades of life.[15] Moreover, social isolation, low income, and limited access to healthcare services exacerbate the prevalence and consequences of uncontrolled hypertension in older adults, particularly in low-resource settings.

Compared with younger individuals, hypertension in the elderly tends to present with a higher systolic component, greater prevalence of isolated systolic hypertension, and a stronger association with end-organ damage. These distinctions highlight the need for age-specific preventive strategies that target both biological and social determinants of health.

Clinical characteristics and diagnostic considerations

Hypertension in elderly patients often presents with distinctive clinical features compared to younger adults. While many individuals remain asymptomatic, some may experience nonspecific complaints such as dizziness, headaches, or fatigue, which are frequently attributed to aging itself rather than elevated blood pressure. More importantly, hypertension in this population is strongly linked with end-organ damage, including left ventricular hypertrophy, chronic kidney disease, and cerebrovascular disease, which may manifest as cognitive decline or functional impairment.[16]

Blood pressure measurement in older adults presents unique challenges. Orthostatic hypotension, defined as a drop in systolic blood pressure ≥20 mmHg or diastolic blood pressure ≥10 mmHg within three minutes of standing, is particularly common due to impaired baroreflex sensitivity and autonomic dysfunction.[17] This phenomenon complicates both diagnosis and treatment, as aggressive blood pressure reduction may exacerbate postural symptoms and increase the risk of falls.

The white coat effect and masked hypertension are also prevalent among elderly patients, leading to potential misclassification if diagnosis relies solely on office blood pressure measurements. Ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM) are therefore strongly recommended to improve diagnostic accuracy, detect nocturnal hypertension, and evaluate blood pressure variability.[18] These tools are especially useful in differentiating between sustained hypertension and white coat hypertension, thus avoiding unnecessary treatment or undertreatment.

Another essential aspect is the assessment of frailty and cognitive function. Frailty, characterized by decreased physiological reserve and vulnerability to stressors, significantly modifies the risk–benefit ratio of antihypertensive therapy.[19] Similarly, cognitive impairment and dementia not only influence treatment goals but also affect medication

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adherence, highlighting the need for caregiver involvement in management.

In contrast to younger patients, where diagnosis is relatively straightforward, hypertension in elderly populations requires a multidimensional evaluation that integrates hemodynamic assessment, comorbidities, functional status, and social support. Such a comprehensive approach ensures that therapeutic strategies are both safe and effective.

Target blood pressure and guidelines

The determination of optimal blood pressure (BP) targets in elderly patients remains a subject of ongoing debate. While lowering blood pressure unequivocally reduces the risk of stroke, myocardial infarction, and heart failure, excessive reduction may increase the risk of orthostatic hypotension, falls, syncope, renal impairment, and even mortality.[20] Therefore, guideline recommendations emphasize individualized treatment goals based on age, comorbidities, frailty status, and overall life expectancy.

The 2017 ACC/AHA guidelines recommend initiating pharmacological therapy in patients aged ≥65 years with a systolic BP ≥130 mmHg, with a target of <130/80 mmHg for most older adults, provided treatment is well tolerated.[1] In contrast, the 2018 ESC/ESH guidelines adopt a more conservative approach: in patients aged 65–79 years, they recommend a systolic BP target of 130–139 mmHg, but not below 130 mmHg; for patients ≥80 years, treatment should generally be initiated if systolic BP is ≥160 mmHg, aiming for a target of 130–139 mmHg if tolerated[2] The NICE guidelines also suggest similar age-adjusted thresholds, recognizing the increased vulnerability of very old patients.[21]

Evidence from large clinical trials has shaped these recommendations. The HYVET trial demonstrated that antihypertensive therapy in patients aged ≥80 years reduced stroke incidence and all-cause mortality, supporting treatment even in very old patients, though with cautious targets.[22] On the other hand, the SPRINT trial, which included patients ≥75 years, showed that intensive BP lowering (<120 mmHg systolic) significantly reduced cardiovascular events and mortality, but at the cost of higher adverse events such as hypotension, syncope, and electrolyte abnormalities.[23] These findings highlight the delicate balance between benefit and harm in this population.

Importantly, heterogeneity within the elderly group complicates universal recommendations. A relatively fit 70-year-old without major comorbidities may safely tolerate intensive BP control, whereas a frail 85-year-old with multiple chronic conditions may experience harm from aggressive therapy. Thus, both American and European guidelines underscore the necessity of tailoring treatment goals to the individual patient, taking into account frailty, cognitive function, and patient preferences.

In summary, compared with younger adults, elderly patients require more cautious and flexible BP targets. The overarching principle is to achieve adequate cardiovascular protection while minimizing the risks of overtreatment.

Lifestyle modifications

Lifestyle modification remains the cornerstone of hypertension management, including in the elderly. Although pharmacological therapy is often required, non-pharmacological interventions play a critical role in reducing blood pressure, enhancing drug efficacy, and minimizing cardiovascular risk. Importantly, lifestyle interventions must be adapted to the physiological limitations and comorbidities commonly observed in older adults.[24]

Dietary modification is one of the most effective non-pharmacological strategies. The Dietary Approaches to Stop Hypertension (DASH) diet, which emphasizes fruits, vegetables, whole grains, and low-fat dairy products, has been shown to significantly lower systolic and diastolic blood pressure in elderly populations.[25] Sodium restriction, generally recommended at <2.3 g/day, is particularly relevant, as older adults often exhibit heightened salt sensitivity due to age-related renal changes.[26] Similarly, adherence to the Mediterranean diet has been associated with lower cardiovascular morbidity and improved cognitive outcomes in elderly hypertensive patients.[27]

Physical activity is another critical component. Regular aerobic exercise such as walking, swimming, or cycling has been shown to reduce systolic blood pressure by 5–10 mmHg, even in older individuals.[28] However, exercise programs must be carefully tailored to functional status, frailty, and comorbidities to avoid falls or musculoskeletal injuries. Strength and balance training also confer additional benefits by reducing fall risk and improving mobility.

Weight management remains relevant in older hypertensive patients, particularly in those with obesity-related hypertension. Even modest weight loss has been associated with significant reductions in blood pressure and improved metabolic profile.[29] However, excessive or rapid weight loss should be avoided in frail elderly individuals, where sarcopenia and malnutrition may increase morbidity.

Alcohol moderation and smoking cessation are universally recommended. Excessive alcohol intake is associated with poor blood pressure control and increased risk of arrhythmias, while smoking exacerbates cardiovascular and cerebrovascular risk.[30] Counseling and structured cessation programs remain beneficial even at advanced ages.

Finally, psychosocial factors should not be overlooked. Stress reduction strategies, adequate sleep, and strong social engagement have all been associated with improved blood pressure control and overall health outcomes in elderly patients.[31] Social isolation, a common problem in older age, may worsen hypertension control and adherence, highlighting the importance of holistic care approaches.

In summary, lifestyle modifications in the elderly share many principles with younger populations, but must be implemented with greater attention to comorbidities, frailty, and functional limitations. When properly adapted, these measures can provide substantial benefits, both independently and in synergy with pharmacological therapy.

Pharmacological management

Pharmacological therapy is the mainstay of hypertension treatment in the elderly, as lifestyle interventions alone are often insufficient to achieve target blood pressure. However, due to age-related physiological changes and the frequent presence of comorbidities, the choice of antihypertensive agents, dosing strategies, and monitoring require particular caution in this population.[16]

Thiazide and thiazide-like diuretics are among the most widely used first-line therapies for elderly hypertensive patients. Evidence from trials such as SHEP and ALLHAT demonstrated that thiazide diuretics reduce the risk of stroke and heart failure in older adults.[32] They are particularly effective in isolated systolic hypertension, a common phenotype in the elderly. Nonetheless, potential side effects, including hyponatremia, hypokalemia, hyperuricemia, and worsening renal function, must be carefully monitored.

Calcium channel blockers (CCBs) are another cornerstone of therapy. They are effective in lowering systolic pressure, improving

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arterial compliance, and reducing cardiovascular events. The LIFE and Syst-Eur trials have highlighted their efficacy in elderly patients.[33] Peripheral edema and constipation are among the most common adverse effects, but CCBs generally demonstrate good tolerability in this age group.

Angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) are highly beneficial in elderly hypertensive patients, especially those with comorbid conditions such as heart failure, diabetes, or chronic kidney disease.[34] They provide renoprotective and cardioprotective benefits but may increase the risk of hyperkalemia and renal dysfunction, particularly in those with advanced kidney disease or concomitant potassium-sparing diuretics.

Beta-blockers are no longer considered first-line therapy for uncomplicated hypertension in the elderly but remain valuable in specific situations, such as post-myocardial infarction, atrial fibrillation, or chronic heart failure.[35] Their use must be weighed against risks of bradycardia, fatigue, and worsened insulin sensitivity.

Polypharmacy is a frequent challenge in elderly patients. Age-related changes in drug metabolism and elimination, combined with multiple comorbidities, increase the likelihood of drug–drug interactions and adverse effects.[36] Simplifying regimens through fixed-dose combinations and careful medication reconciliation are recommended strategies to improve adherence and safety. The guiding principle in pharmacological management for elderly patients is "start low and go slow," with gradual titration and close monitoring for tolerance.

In comparison with younger adults, elderly patients often require a more cautious pharmacological approach, with emphasis on minimizing harm while achieving adequate blood pressure control. Selection of agents should be individualized, based not only on blood pressure levels but also on comorbidities, frailty status, and patient preferences (Table 1).

Table 1 Pharmacological agents in elderly hypertension: benefits and risks

Drug Class	Benefits	Common Risks in Elderly
Thiazide diuretics	Proven stroke reduction, effective in ISH	Hyponatremia, hypokalemia, gout
Calcium channel blockers	Strong BP reduction, arterial compliance improvement	Peripheral edema, constipation
ACE inhibitors/ARBs	Cardioprotective, nephroprotective, useful in diabetes/CKD	Hyperkalemia, renal dysfunction
Beta-blockers	Beneficial post-MI, AF, HF	Bradycardia, fatigue, insulin resistance
Combination therapy	Better control, improved adherence	Higher pill burden unless fixed-dose combinations used

Abbreviations: ISH, isolated systolic hypertension; BP, blood pressure, ACE, angiotensin-converting enzyme; ARB: angiotensin receptor blocker; MI: myocardial infarction; AF, Atrial fibrillation; HF, heart failure; CKD: chronic kidney disease

Management in special clinical situations

Hypertension management in elderly patients is further complicated by the frequent coexistence of comorbidities and geriatric syndromes. Tailoring therapy to specific clinical contexts is essential to balance cardiovascular protection with safety.[37]

Frailty and multimorbidity: Frailty is highly prevalent among elderly patients with hypertension and is associated with increased vulnerability to adverse outcomes from both hypertension and its treatment. Evidence suggests that aggressive BP lowering in frail older adults may lead to excess risks, including orthostatic hypotension, falls, syncope, and even mortality.[38] The management approach in these individuals should focus on cautious BP reduction, prioritizing quality of life, functional independence, and minimization of adverse events.

Cognitive impairment and dementia: Hypertension is both a risk factor for cognitive decline and a complicating factor in dementia care. While midlife hypertension is strongly linked with later dementia risk, the benefits of late-life BP reduction on cognition are less consistent.[39] Excessive BP lowering may exacerbate cerebral hypoperfusion, worsening cognitive impairment. Therefore, in patients with dementia, moderate BP control is generally preferred, avoiding overly stringent targets.

Diabetes mellitus: Hypertension and diabetes frequently coexist in elderly patients, compounding cardiovascular and renal risks. Guidelines recommend the use of ACEIs or ARBs as first-line agents in elderly patients with diabetes, given their nephroprotective and cardioprotective properties.[40] However, treatment should remain individualized, with careful monitoring of renal function and electrolyte balance.

Chronic kidney disease (CKD): CKD is common in elderly hypertensive patients and requires careful management. While ACEIs and ARBs remain the preferred agents, reduced renal clearance of drugs and heightened risk of hyperkalemia necessitate vigilant monitoring.[41] BP targets should aim for balance—avoiding excessive reduction that may impair renal perfusion.

Heart failure: In elderly patients with hypertension and heart failure, optimal pharmacological management includes ACEIs/ARBs, beta-blockers, and mineralocorticoid receptor antagonists, when tolerated.[42] However, the interplay between low systolic BP and heart failure symptoms requires nuanced treatment. Diuretics may relieve congestion but can exacerbate electrolyte imbalances and renal dysfunction.

Orthostatic hypotension: Orthostatic hypotension is particularly prevalent in elderly hypertensive patients and is associated with falls, syncope, and fractures.[43] Careful assessment is required before and after initiating antihypertensive therapy. Long-acting medications are generally preferred to avoid wide BP fluctuations. Treatment should prioritize symptom reduction and fall prevention rather than strict BP targets.

In summary, managing hypertension in elderly patients requires individualized strategies that account for frailty, multimorbidity, and specific comorbid conditions. Compared with younger populations, the risk–benefit ratio of antihypertensive therapy in the elderly is narrower, underscoring the importance of tailoring treatment to clinical context.

Blood pressure monitoring in the elderly: Accurate blood pressure (BP) measurement is critical in elderly patients, as diagnostic and

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therapeutic decisions hinge upon precise assessment. However, physiological changes associated with aging introduce unique challenges that can complicate conventional BP monitoring.[44]

Office blood pressure measurement: Although office-based BP measurement remains the cornerstone of hypertension diagnosis, it may be less reliable in older adults due to phenomena such as **white coat hypertension** and **masked hypertension**. White coat hypertension is particularly common in this population, potentially leading to overtreatment if relied upon exclusively. Conversely, masked hypertension, where BP is normal in clinical settings but elevated outside, is strongly associated with cardiovascular events and may remain undetected without additional monitoring.[45]

Ambulatory blood pressure monitoring (ABPM): ABPM is considered the gold standard for hypertension assessment in elderly patients. It provides insights into 24-hour BP variability, nocturnal dipping patterns, and morning surges, all of which have prognostic significance. Non-dipping or reverse-dipping patterns are particularly prevalent among elderly individuals and correlate with increased risk of stroke, heart failure, and cognitive decline.[46] Moreover, ABPM can help assess treatment efficacy and detect orthostatic hypotension episodes that may otherwise go unnoticed.

Home blood pressure monitoring (HBPM): HBPM is a practical and widely recommended approach for elderly patients, especially those with mobility limitations. It empowers patients and caregivers, improves adherence to therapy, and allows repeated measurements under real-life conditions. HBPM is also valuable in distinguishing sustained hypertension from white coat hypertension and provides complementary information to ABPM.[47] However, challenges include correct device use, manual dexterity issues, and visual or cognitive impairment, which may necessitate caregiver assistance.

Special considerations: In elderly patients, accurate BP measurement requires attention to technique. Proper cuff size is essential, as arterial stiffness and increased pulse pressure may affect readings. Measurements should be performed after at least five minutes of rest, and both sitting and standing BPs should be assessed to evaluate for orthostatic hypotension.[48] Wrist monitors are less reliable than upper-arm devices and should only be used when standard methods are impractical.

In conclusion, while conventional office measurement remains important, a comprehensive BP assessment strategy combining office readings, ABPM, and HBPM provides the most accurate evaluation in elderly patients. This multifaceted approach enhances diagnostic accuracy, prevents misclassification, and supports safer and more effective hypertension management.

Adherence and follow-up in elderly patients with hypertension

Treatment adherence represents one of the greatest challenges in the management of hypertension among elderly patients. Studies consistently show that adherence to antihypertensive therapy declines over time, with nearly 50% of patients discontinuing medications within the first year.[49] Poor adherence results in suboptimal blood pressure control, increased cardiovascular risk, and higher rates of hospitalization. In older adults, adherence is further complicated by polypharmacy, cognitive decline, sensory impairments, and socioeconomic barriers.

Factors influencing adherence: Multiple factors contribute to non-adherence in the elderly. **Patient-related factors** include cognitive impairment, depression, poor health literacy, and lack of social support. **Therapy-related factors** involve complex dosing regimens, pill burden, and side effects such as orthostatic hypotension or electrolyte imbalance. **Healthcare system factors**, including inadequate patient–provider communication and limited follow-up, further exacerbate the problem.[50] Importantly, intentional non-adherence due to fear of adverse effects or disbelief in treatment benefits is common in this population.

Strategies to Improve Adherence: Simplification of treatment regimens is one of the most effective strategies. The use of **fixed-dose combinations** reduces pill burden and has been shown to improve both adherence and clinical outcomes.[51] Regular patient education, reinforcement of treatment goals, and involvement of family members or caregivers are equally important. Behavioral strategies, such as the use of pill organizers, electronic reminders, and home blood pressure monitoring, support daily adherence.[52]

Pharmacists and nurses play a pivotal role in adherence programs by providing counseling, medication reconciliation, and follow-up monitoring. Studies suggest that multidisciplinary interventions are superior to isolated efforts in sustaining long-term adherence.[53]

Importance of Regular Follow-up: Follow-up visits are essential not only for monitoring blood pressure control but also for reassessing adherence, reviewing side effects, and modifying therapy as needed. In elderly patients, follow-up intervals should be individualized based on comorbidities, frailty, and treatment complexity. Shorter follow-up periods may be required in the initiation phase or after medication changes, while longer intervals may suffice in stable patients.[1]

Telemedicine and remote monitoring have emerged as valuable tools, especially for elderly individuals with mobility limitations. Evidence indicates that home-based telemonitoring combined with regular provider feedback improves both adherence and blood pressure outcomes.[54]

Patient-centered approach: A patient-centered approach is critical when addressing adherence in the elderly. This includes shared decision-making, aligning treatment goals with patient preferences, and balancing benefits against potential risks. Empowering patients through education and self-monitoring fosters autonomy and enhances motivation to continue therapy.[55]

Evidence from major clinical trials

The management of hypertension in elderly patients has been informed largely by landmark randomized clinical trials, which have shaped modern guidelines and clarified treatment benefits and risks. Several pivotal studies have specifically addressed blood pressure reduction in older adults, highlighting the balance between cardiovascular protection and treatment-related adverse effects.

The Hypertension in the very elderly trial (HYVET): The HYVET trial was a landmark study focusing exclusively on patients aged 80 years and older. The trial demonstrated that antihypertensive therapy with indapamide, with or without perindopril, significantly reduced the incidence of stroke, heart failure, and all-cause mortality compared with placebo.[22] Importantly, the benefits outweighed the risks of adverse effects, establishing antihypertensive therapy as effective and safe even in the very elderly population.

The Systolic Hypertension in the Elderly Program (SHEP): The SHEP trial enrolled patients aged ≥60 years with isolated systolic hypertension. Treatment with chlorthalidone significantly reduced the risk of stroke and major cardiovascular events compared to placebo.[32]

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This study highlighted the importance of treating isolated systolic hypertension, a condition particularly prevalent among older adults.

The systolic hypertension in europe trial (Syst-Eur): The Syst-Eur trial investigated nitrendipine-based therapy in elderly patients with isolated systolic hypertension. Results showed a substantial reduction in stroke incidence and cardiovascular outcomes, further reinforcing the role of antihypertensive treatment in older populations.[33]

The STOP-hypertension trials: The Swedish Trial in Old Patients with Hypertension (STOP-Hypertension) series evaluated multiple antihypertensive regimens in elderly cohorts. The first STOP trial demonstrated that conventional therapy (diuretics or beta-blockers) significantly reduced cardiovascular morbidity and mortality compared to placebo.[56] Subsequent STOP-2 compared newer agents (ACE inhibitors, calcium channel blockers) with conventional therapy and found no significant differences in outcomes, confirming the efficacy of diverse drug classes in elderly patients.[57]

The antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT): The **ALLHAT trial** included a large subgroup of older adults and compared chlorthalidone, amlodipine, and lisinopril. The findings indicated no major differences in primary cardiovascular outcomes between groups, though chlorthalidone was superior in preventing heart failure.[58] ALLHAT reinforced the role of thiazide-type diuretics as a first-line option in elderly patients.

The systolic blood pressure ıntervention trial (SPRINT): The SPRINT trial enrolled patients ≥50 years with increased cardiovascular risk, including a significant subgroup of those aged ≥75 years. Intensive blood pressure control (target <120 mmHg) reduced cardiovascular events and mortality compared with a standard target of <140 mmHg.[23] However, intensive therapy was also associated with higher rates of hypotension, syncope, and electrolyte abnormalities, raising concerns about frailty and fall risk in older adults.

Meta-Analyses and Pooled Evidence: Beyond individual trials, meta-analyses have confirmed that antihypertensive therapy in elderly patients consistently lowers the risk of stroke, heart failure, and overall cardiovascular mortality. However, the magnitude of benefit varies depending on baseline risk, frailty status, and treatment intensity.[59]

Challenges and controversies in hypertension management in the elderly

Despite robust evidence supporting antihypertensive therapy in older adults, several controversies remain regarding optimal treatment strategies. These challenges reflect the heterogeneity of the elderly population, variations in comorbidity burden, and differing guideline recommendations (Table 2).

Optimal blood pressure targets: One of the most debated issues concerns the ideal blood pressure targets in older adults. While trials such as HYVET and SPRINT demonstrated benefits of lowering systolic blood pressure below 150 mmHg and even 120 mmHg, respectively, concerns remain regarding the generalizability of these findings to frail or multimorbid elderly patients.[16] Overly aggressive treatment may increase risks of hypotension, falls, and acute kidney injury.[20] Consequently, guidelines differ, with some recommending targets <130 mmHg in fit older adults, while others advise a more conservative goal of <140–150 mmHg depending on clinical context.[1]

Table 2 Key challenges in the management of hypertension in elderly patients

Challenge	Clinical relevance	Implications for management
Frailty	Increased vulnerability, poor tolerance to intensive therapy	Individualized targets, cautious titration
Multimorbidity	High prevalence of diabetes, CKD, CAD, COPD	Risk of drug–drug interactions, polypharmacy
Orthostatic hypotension	Frequent due to impaired baroreflex	Careful monitoring, avoid overtreatment
Polypharmacy	Multiple drugs for comorbidities	Increased risk of adverse events, adherence issues
Cognitive impairment	Reduced self-management capacity	Need for caregiver involvement, simplified regimens

Abbreviations: CKD, chronic kidney disease; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease

Orthostatic hypotension and falls: Older patients are highly susceptible to orthostatic hypotension due to impaired autonomic regulation and polypharmacy. Intensive blood pressure reduction may exacerbate this risk, leading to falls, fractures, and hospitalization.[60] Balancing stroke prevention against fall-related morbidity remains a central challenge.

Polypharmacy and drug ınteractions: Elderly patients frequently receive multiple medications for comorbid conditions. The risk of adverse drug interactions, nonadherence, and drug-related hospitalizations increases significantly with polypharmacy.[61] Determining the most appropriate antihypertensive agent while minimizing drug burden is a persistent clinical dilemma.

Cognitive function and dementia: The relationship between hypertension control and cognitive outcomes remains controversial. While some studies suggest that aggressive blood pressure lowering may reduce the risk of dementia and cognitive decline, others raise concerns that excessive reduction could impair cerebral perfusion, particularly in frail patients with pre-existing small vessel disease.[39] The optimal therapeutic approach for preserving cognitive function is still unresolved.

Individualized treatment vs. guideline standardization: Another challenge lies in balancing population-based evidence with individualized care. Standardized guidelines may not account for heterogeneity in frailty, life expectancy, and patient preferences. Individualized strategies are increasingly advocated, with shared decision-making emphasized to reconcile evidence-based targets with real-world patient needs.[62]

Advances in hypertension management in the elderly

Significant progress has been made in recent decades regarding the management of hypertension in elderly patients, reflecting both

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improvements in pharmacological options and broader recognition of non-pharmacological strategies. Evidence from large-scale randomized trials has reinforced the benefits of blood pressure (BP) reduction in this population, while ongoing refinements in drug selection and lifestyle interventions continue to optimize outcomes (Table 3).

Table 3 Advances in hypertension management in the elderly

Domain	Key advances	Supporting references
Pharmacological therapy	Evidence from landmark trials (HYVET, SHEP, Syst-Eur, SPRINT) confirming benefit of treatment even in very old patients	24, 35, 60–66
	Use of thiazide/thiazide-like diuretics effective for isolated systolic hypertension	35, 61
	Calcium channel blockers effective and well tolerated	36, 62
	ACE inhibitors/ARBs protective in diabetes, CKD, heart failure	37, 43, 44
	Role of beta-blockers in specific conditions (post-MI, AF, HF)	38, 45
	Simplified regimens and fixed-dose combinations to improve adherence	54
Non-pharmacological strategies	DASH and Mediterranean diets shown to reduce BP and CV events	26–29
	Sodium restriction particularly relevant due to salt sensitivity	28
	Physical activity tailored to functional status improves BP and mobility	30
Supportive and integrative care	Multidisciplinary interventions (physicians, nurses, pharmacists, caregivers) enhance adherence and outcomes	55, 56
	Telemedicine, HBPM, and remote monitoring improve control and follow-up	50, 58
Guideline evolution	Shift toward individualized targets considering frailty and comorbidity	21–23, 68–70

Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; CKD, chronic kidney disease; MI, myocardial infarction; AF, atrial fibrillation; HF, heart failure; BP, blood pressure; CV, cardiovascular; HBPM, home blood pressure monitoring

Pharmacological advances: Pharmacological therapy remains the cornerstone of hypertension management in older adults. Recent clinical trials, including **HYVET**, **SHEP**, **Syst-Eur**, and **SPRINT**, have provided robust evidence that appropriate antihypertensive treatment substantially reduces the risk of stroke, heart failure, and cardiovascular mortality in patients ≥65 years of age.[22,23] Importantly, these studies highlighted the benefits of active therapy even among very elderly patients, while underscoring the need for individualized targets to avoid overtreatment and adverse events.[1,16,20]

Among drug classes, thiazide and thiazide-like diuretics remain highly effective for isolated systolic hypertension, a common phenotype in older adults.[32] Calcium channel blockers (CCBs) are valuable due to their efficacy in lowering systolic pressure and their good tolerability profile.[33] ACE inhibitors and ARBs offer additional cardiovascular and renal protection, particularly in patients with comorbidities such as diabetes and chronic kidney disease.[40,41] Meanwhile, beta-blockers are no longer first-line for uncomplicated hypertension but retain an important role in specific contexts such as ischemic heart disease, atrial fibrillation, or heart failure.[42]

The principle of "start low and go slow" has been emphasized in contemporary practice to minimize risks of orthostatic hypotension, electrolyte imbalance, and drug–drug interactions.[38] Polypharmacy remains a challenge, but fixed-dose combinations and simplified regimens have emerged as practical solutions to improve adherence without compromising efficacy.[51]

Non-pharmacological and supportive strategies: Lifestyle modification continues to play an essential role in comprehensive management. The **DASH** and **Mediterranean diets** have been consistently associated with lower BP and reduced cardiovascular events.[24,25] Sodium restriction remains particularly relevant given the heightened salt sensitivity of older adults.[26] Regular physical activity, tailored to functional status, contributes to BP reduction while improving balance, mobility, and fall prevention.[28]

Multidisciplinary interventions, incorporating physicians, nurses, pharmacists, and caregivers, represent an important advance in supporting adherence and long-term BP control.[52,53] In parallel, telemedicine and home BP monitoring have proven effective in improving adherence, facilitating early detection of complications, and enabling closer follow-up, particularly for patients with mobility limitations.[54]

Integration of evidence into practice: The evolving guideline recommendations reflect these advances by moving toward a more individualized approach. Whereas previous guidelines applied uniform BP targets across all adults, recent consensus emphasizes careful tailoring of treatment intensity based on frailty, comorbidity, and patient preferences.[1,16,20] This shift represents a significant advancement toward patient-centered hypertension care in the elderly.

Future perspectives in hypertension management in the elderly

Hypertension management in elderly patients is rapidly evolving, driven by advancements in technology, pharmacology, and a deeper understanding of aging physiology. Although current evidence provides a solid foundation for treatment, future strategies will likely emphasize personalization, digital innovation, and integration of geriatric principles into cardiovascular care (Table 4).

Precision medicine and pharmacogenomics: Emerging evidence suggests that genetic variability influences drug response, particularly regarding metabolism of antihypertensive medications such as beta-blockers and calcium channel blockers.[64] Pharmacogenomic testing may enable tailored therapy that optimizes efficacy while minimizing adverse effects, especially in the elderly who are more susceptible to drug toxicity.

Integration of digital health and telemedicine: The use of wearable blood pressure monitors, smartphone applications, and telemedicine platforms has increased substantially, particularly during the COVID-19 pandemic.[54] For elderly patients, remote monitoring could enhance adherence, provide early detection of blood pressure fluctuations, and allow healthcare providers to intervene proactively.

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However, technological literacy and accessibility remain important barriers in this age group.

Table 4 Future perspectives in hypertension management in the elderly

Innovation	Potential benefit	Challenges/ Limitations
Telemedicine & remote monitoring	Improved adherence, access for immobile patients	Digital literacy, infrastructure needs
Wearable devices	Continuous BP monitoring, early detection of fluctuations	Cost, accuracy, acceptance in elderly
Pharmacogenomics	Personalized drug response, reduced ADRs	Limited availability, cost-effectiveness unknown
Artificial intelligence	Risk stratification, treatment optimization	Data privacy, integration into practice
Multidisciplinary care	Holistic, patient-centered management	Requires system-level implementation

Abbreviations: BP, blood pressure; ADR, adverse drug reaction.

Artificial intelligence and risk stratification: Artificial intelligence (AI) and machine learning algorithms hold promise in refining risk stratification and treatment optimization.[65] By analyzing large datasets, AI could identify subtle patterns that predict which elderly patients may benefit most from intensive treatment versus conservative approaches. Such strategies may improve outcomes while avoiding overtreatment.

Holistic and multidisciplinary care models: Future management of hypertension in older adults will increasingly adopt multidisciplinary models, incorporating geriatricians, cardiologists, pharmacists, and allied health professionals.[66] These approaches emphasize comprehensive care, addressing not only blood pressure but also frailty, nutrition, cognitive health, and social determinants of health.

Addressing health disparities and global aging: As the global elderly population expands, disparities in hypertension care across regions and socioeconomic groups are expected to widen. Future initiatives must focus on equitable access to diagnostics, affordable medications, and culturally sensitive interventions.[67] International collaborations and health policy reforms will be critical to ensure that older adults worldwide benefit from evidence-based hypertension care.

Conclusion

Hypertension in the elderly represents both a common and complex clinical challenge. With the progressive aging of the global population, the burden of hypertension-related morbidity and mortality continues to rise, underscoring the importance of optimized strategies for diagnosis, monitoring, and treatment.[1] Unlike younger populations, older adults exhibit distinct pathophysiological features such as increased arterial stiffness, widened pulse pressure, and a higher prevalence of isolated systolic hypertension. These differences necessitate tailored approaches that balance therapeutic benefits with the risks of polypharmacy, orthostatic hypotension, and treatment intolerance.

The evidence from major clinical trials has demonstrated that lowering blood pressure in elderly patients significantly reduces the risk of cardiovascular events, including stroke and heart failure.[22] However, controversies remain regarding optimal targets, with individualized care being paramount. Non-pharmacological strategies, including dietary modifications, exercise, and lifestyle interventions, should complement pharmacological therapy. Pharmacologic treatment requires careful drug selection, titration, and monitoring, taking into account comorbidities, frailty, and cognitive status.

Emerging technologies, including telemedicine, artificial intelligence, and pharmacogenomic-guided therapies, offer promising avenues for more personalized and effective management in the future.[68] Furthermore, multidisciplinary approaches that incorporate cardiologists, geriatricians, primary care providers, and allied health professionals will likely become the cornerstone of hypertension care for the elderly.

Oliveros et al.[69] provided a broad overview of hypertension assessment and management in older adults, while Benetos et al.[70] highlighted the unique therapeutic challenges in frail populations. More recently, Dhiman et al.[71] emphasized persistent gaps in treatment optimization and the need for individualized approaches. Collectively, these studies underscore the complexity of hypertension care in the elderly, where biological heterogeneity, frailty, and multimorbidity demand flexible and cautious management strategies. The present review expands upon these perspectives by integrating both conventional therapeutic considerations and emerging innovations, including telemedicine, wearable technologies, and pharmacogenomics. This dual focus allows for a more comprehensive understanding of how established practices can be adapted in parallel with technological advances to improve outcomes in older patients. By positioning current challenges alongside future opportunities, our work contributes to bridging the gap between evidence-based management and personalized, forward-looking care models for elderly patients with hypertension.

In summary, while significant progress has been made in understanding and managing hypertension in older adults, ongoing research, clinical innovation, and health system adaptations are required to address the unique challenges of this population. A holistic, patient-centered, and evidence-based strategy remains essential for improving outcomes and quality of life in elderly patients living with hypertension.[72]

Contributorship

All of the authors contributed planning, conduct, and reporting of the work. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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