

# Knowledge Gaps in Cardiovascular Care of Older Adults: A Scientific Statement from the American Heart Association, American College of Cardiology, and American Geriatrics Society: Executive Summary

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The incidence and prevalence of most cardiovascular disorders increase with age, and cardiovascular disease (CVD) is the leading cause of death and major disability in adults aged 75 and older. Despite the effect of CVD on quality of life, morbidity, and mortality in older adults, individuals aged 75 and older have been markedly underrepresented in most major cardiovascular trials, and virtually all trials have excluded older adults with complex comorbidities, significant physical or cognitive disabilities, frailty, or residence in nursing homes and assisted living facilities. As a result, current guidelines are unable to provide evidence-based recommendations for diagnosis and treatment of older adults typical of those encountered in routine clinical practice. The objectives of this scientific statement are to summarize current guideline recommendations as they apply to older adults, identify critical gaps in knowledge that preclude informed evidence-based decision-making, and recommend future research to close existing knowledge gaps. To achieve these objectives, a detailed review was conducted of current American College of Cardiology/American Heart Association (ACC/AHA) and American

Stroke Association (ASA) guidelines to identify content and recommendations that explicitly targeted older adults. A pervasive lack of evidence to guide clinical decision-making in older adults with CVD was found, as well as a paucity of data on the effect of diagnostic and therapeutic interventions on outcomes that are particularly important to older adults, such as quality of life, physical function, and maintenance of independence. Accordingly, there is a critical need for a multitude of large population-based studies and clinical trials that include a broad spectrum of older adults representative of those seen in clinical practice and that incorporate relevant outcomes important to older adults in the study design. The results of these studies will provide the foundation for future evidence-based guidelines applicable to older adults and enhance person-centered care of older individuals with CVD in the United States and around the world.

The prevalence of cardiovascular disease (CVD) increases progressively with age, and persons aged 65 and older account for more than half of all cardiovascular hospitalizations and procedures in the United States, as well as approximately 80% of all cardiovascular deaths.<sup>1</sup> Although people aged 75 and older account for only approximately 6% of the total population, more than 50% of cardiovascular deaths occur in this age group.<sup>1</sup> Cancer is the leading cause of death in U.S. adults aged 18 to 74, and it is only after age 75 that CVD becomes the dominant cause of mortality.<sup>1,2</sup> The global burden of CVD is increasing, primarily because of the aging of the population, and men and women aged 80 and older account for a disproportionate number of cardiovascular deaths.<sup>3</sup> CVD is also a major cause of chronic disability, loss of independence, and impaired quality of life in older individuals.<sup>4,5</sup> Despite the high prevalence, morbidity, and mortality of

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CVD in older adults, most randomized clinical trials have explicitly excluded older adults or have enrolled only relatively healthy older adults with few comorbidities or functional impairments.<sup>6,7</sup> As a result, the generalizability of the results of most major clinical trials to older adults, especially those aged 75 and older with multimorbidity, is uncertain.<sup>6,8</sup> Moreover, because of age-related changes in cardiovascular structure and function,<sup>9,10</sup> coupled with changes in other organ systems, including the kidneys, liver, skeletal muscle, and brain, older adults are at greater risk of complications related to pharmacological and non-pharmacological interventions. It therefore should not be assumed that outcomes reported in clinical trials involving younger and healthier participants are applicable to older adults, who have fundamental differences in risks and potential benefits of diagnostic, therapeutic, and preventive interventions. Furthermore, few clinical trials have assessed outcomes important to older adults, such as quality of life, maintenance of independence, and physical and cognitive function.<sup>8</sup> Current evidence-based practice guidelines have inherent gaps in providing recommendations for treating older adults with CVD, the majority of whom would not have been eligible for participation in most of the major clinical trials. The objectives of this joint American Heart Association (AHA), American College of Cardiology (ACC), and American Geriatrics Society (AGS) Scientific Statement are to summarize current guideline recommendations as they apply to older adults; identify critical gaps in knowledge that preclude informed decision-making; and recommend future research to close existing knowledge gaps, thereby leading to enhanced care and outcomes for the expanding population of older adults with CVDs. The present document is an executive summary of the previously published full scientific statement.<sup>11,12</sup>

## METHODS

At least two members of the Writing Committee reviewed current ACC/AHA and American Stroke Association (ASA) practice guidelines (Appendix S1) relevant to older adults. Content and recommendations that explicitly focused on older adults were extracted. Pertinent gaps in knowledge limiting the applicability of guideline recommendations to older adults, especially those aged 75 and older and those with multimorbidity or other complexities of care (e.g., cognitive impairment, nursing home residence) were identified, and research recommendations for overcoming these knowledge gaps were proposed. Sixteen content experts representing the ACC, AHA, and AGS reviewed the manuscript, and all comments and suggestions were addressed.

## GUIDELINE RECOMMENDATIONS FOR MANAGEMENT OF OLDER ADULTS

Although most guidelines acknowledge that care of older adults with CVD should be individualized, there is substantial variability in guidelines with respect to recommendations specific to the care of older persons. Selected comments and recommendations pertinent to older adults are summarized below. In the full statement, a list of recommendations for closing existing knowledge gaps follows each of these sections. (See Table 1 for selected recommendations.)<sup>11,12</sup>

**Table 1. Selected Research Recommendations According to Cardiovascular Disorder**

<b>Acute coronary syndromes</b>	
Benefits versus risks of pharmacological agents (e.g., antiplatelet drugs, statins, beta-blockers, renin-angiotensin system inhibitors, etc.) and invasive interventions with respect to person-centered outcomes and as a function of comorbidity burden	
Optimal management of type 2 myocardial infarction (elevation of cardiac biomarkers due to myocardial oxygen supply–demand mismatch related to noncoronary illness)	
<b>Stable ischemic heart disease (SIHD)</b>	
Comparative effectiveness of medical therapy versus revascularization with respect to quality of life, functional capacity, and survival in the context of multimorbidity	
Optimal strategies for rehabilitation to maximize quality of life and functional capacity in older adults with SIHD or after revascularization procedures	
<b>Atrial fibrillation</b>	
More-effective models for assessing and balancing stroke risk versus bleeding risk, especially in individuals with multimorbidity	
Role of ablation procedures and device therapy in older adults with high symptom burden or high bleeding risk	
Long-term effects of rate control versus rhythm control on quality of life and cognitive function	
<b>Ventricular arrhythmias</b>	
Efficacy and safety of implantable cardioverter-defibrillators (ICDs) for prevention of sudden cardiac death in multimorbid older adult	
Safety and comparative effectiveness of antiarrhythmic drugs	
<b>Aortic stenosis</b>	
Definition of the role of transcatheter aortic valve replacement (TAVR) in intermediate- and low-risk older adults	
Clarification of the bidirectional relationship between TAVR and frailty, including identification of individuals with reduction in frailty after TAVR	
<b>Heart failure (HF)</b>	
Benefits versus risks of pharmacological agents and devices (e.g., ICDs and cardiac resynchronization therapy) in older adults with HF and reduced ejection fraction	
Elucidation of the pathophysiology and identification of effective interventions for HF with preserved ejection fraction	
Definition of the role of diet (e.g., electrolyte and fluid intake), dietary supplements, and exercise in prevention and treatment of HF	
Models for integrating palliative care principles into management of older adults with HF	
<b>Peripheral arterial disease (PAD)</b>	
Comparative effectiveness of behavioral (e.g., exercise, diet), pharmacological, percutaneous, and surgical interventions in older adults with PAD	
Clarification of the effect of PAD on quality of life and functional outcomes and the effects of therapeutic interventions on these endpoints	
<b>Cerebrovascular disease and stroke</b>	
Comparative effectiveness studies to assess pharmacological and nonpharmacological interventions in all stroke types and effect on person-centered outcomes	
Role of risk factor control for primary and secondary prevention of stroke, including optimal targets for blood pressure, lipids, glucose, and other modifiable risk factors	
Clarification of association between cerebrovascular disease and brain injury and cognitive function and development of strategies to minimize risk of cognitive decline	
<b>Perioperative care</b>	
Development of expanded models for estimating surgical risk that incorporate multimorbidity, cognitive function, and frailty and consider person-centered outcomes	
Development of strategies to reduce the risk of common perioperative complications, including delirium, functional decline, organ dysfunction, and prolonged recovery time	

## Acute Coronary Syndromes

The 2013 American College of Cardiology Foundation (ACCF)/AHA Guideline for the Management of ST-Elevation Myocardial Infarction is narrow in scope and provides few recommendations specific to older adults.<sup>13–16</sup>

The 2014 AHA/ACC Guideline for the Management of Patients with Non-ST-Elevation Acute Coronary Syndromes includes a separate section that addresses management of older adults.<sup>17</sup> Three Class I and two Class IIa recommendations are provided. Among these it is noted that “management decisions for older patients with [non-ST-elevation acute coronary syndromes] NSTEMI/ACS should be patient-centered, and consider patient preferences/goals, comorbidities, functional and cognitive status, and life expectancy.” The need for dosage adjustment of many medications to reduce the risk of adverse effects is acknowledged, as is the greater risk associated with revascularization procedures in older adults. It is noted that the potential benefits of aggressive treatment in older adults with NSTEMI/ACS are often the same as or greater than those in younger individuals, and it is emphasized that such therapies should not be withheld solely on the basis of age.

## Stable Ischemic Heart Disease

The 2012 ACCF/AHA Guideline for the Diagnosis and Management of Patients with Stable Ischemic Heart Disease includes a section that focuses on management of older adults.<sup>18</sup> The guideline acknowledges that, although there is strong rationale to treat ischemic heart disease (IHD) in older adults, there are limited data pertaining to older adults, and most recommendations are inferred from studies in younger individuals. Guideline-directed medical therapy is recommended as the initial approach for most individuals with stable IHD, including elderly adults. Revascularization is appropriate in selected individuals but should be undertaken only after due consideration of individual preferences, functional capacity, quality of life, and prognosis.

The 2011 ACCF/AHA/Society for Cardiac Angiography (SCAI) guidelines for percutaneous coronary intervention (PCI) include a single paragraph devoted to older adults.<sup>19</sup> It is pointed out that older adults present with a substantially worse clinical risk profile than younger individuals and that advanced age is a strong predictor of mortality after PCI.<sup>20,21</sup> Older adults are also at greater risk of major bleeding and stroke,<sup>22</sup> although despite greater risks, angiographic success rates and clinical benefits are similar in older and younger individuals, and the absolute benefit of PCI may be greater in older adults because of higher baseline risk.<sup>23</sup>

The 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery discusses issues pertinent to older adults.<sup>24</sup> It is acknowledged that individuals aged 80 and older undergoing coronary artery bypass graft (CABG) surgery tend to have more-severe coronary artery disease (CAD), higher comorbidity burden, more perioperative complications, higher mortality, longer stays, and lower probability of discharge to home than younger individuals.

Although the Society of Thoracic Surgeons Predicted Risk of Mortality or Major Morbidity<sup>25</sup> score incorporates gait speed as a surrogate for frailty, it does not adjust for functional capacity, cognitive impairment, or certain comorbidities (e.g., hepatic dysfunction), limiting its utility in many older individuals.

## Heart Rhythm Disorders

The 2014 AHA/ACC/Heart Rhythm Society (HRS) Guideline for the Management of Patients with Atrial Fibrillation provides a discussion of atrial fibrillation (AF) in elderly adults.<sup>26</sup> It is noted that older people are predisposed to AF due to “changes in cardiac structure and function that accompany aging.” The high prevalence of comorbidities is acknowledged, and a table listing the most-common coexisting conditions in older adults with AF is provided. Older age is a potent risk factor for stroke in individuals with AF, as highlighted in the CHA<sub>2</sub>DS<sub>2</sub>-VASc risk score, which assigns 1 point for aged 65 to 74 and 2 points for aged 75 and older.

In a consensus statement on AF ablation<sup>27</sup> and in the 2014 guideline,<sup>26</sup> it is acknowledged that older adults are not well represented in the ablation literature. Data on long-term outcomes after ablation in older adults are lacking. AV node ablation with pacemaker implantation to maintain a regular rhythm in individuals who have failed pharmacological therapy carries a Class IIa recommendation without reference to age.<sup>26,28,29</sup>

The 2006 ACC/AHA/HRS Guidelines on Management of Patients with Ventricular Arrhythmias include a section devoted to the management of older adults.<sup>30</sup> The guidelines note that there is a decline in sudden cardiac death after age 80 due to competing causes of death. Medical therapy for ventricular arrhythmias does not differ according to age, but dosage adjustment must be considered in older adults.

The ACC/AHA/HRS Guidelines on Management of Patients with Ventricular Arrhythmias and Guidelines for Device-based Therapy of Cardiac Rhythm Abnormalities have sections devoted to older adults.<sup>31,32</sup> The 2006 guidelines state that “comorbidities, life expectancy, and quality-of-life issues must be addressed forthrightly with patients and their families,”<sup>30</sup> and the guidelines indicate that a device should not be placed in an individual with a life expectancy of less than 1 year.

Although the guidelines for implantable cardioverter-defibrillators (ICDs) do not distinguish indications based on age, older adults have been underrepresented in clinical trials.<sup>30</sup> The durability of ICD benefit is shorter and the risk of procedural complications higher in individuals aged 80 and older than in younger individuals.<sup>33</sup>

The guidelines for device-based therapy address end-of-life planning in individuals with cardiac devices, stating that such devices should not be placed in those with a life expectancy of less than 1 year.<sup>31,32</sup> The guidelines also have a section on device deactivation. Clinicians who implant devices are encouraged to discuss end-of-life issues and options for deactivation before implantation.<sup>34</sup> The guidelines say that “age itself should not be the predominant consideration in the use of device-based therapy among the elderly.”



## Valvular Heart Disease

The 2014 AHA/ACC Guideline for the Management of Patients with Valvular Heart Disease section on aortic stenosis is largely based on data from studies in older adults, so the recommendations are generally applicable to older adults.<sup>35</sup> The guideline emphasizes that age is not a contraindication to aortic valve replacement (AVR),<sup>35</sup> with several studies showing excellent outcomes in very elderly adults undergoing surgical or transcatheter AVR (TAVR).<sup>36–39</sup> The guideline recommends determining the operative risk for each individual using an online calculator such as that of the Society of Thoracic Surgeons (www.sts.org).<sup>40</sup> The guideline states that AVR is not indicated in individuals with a life expectancy of less than 1 year or with a likelihood of 2-year survival with benefit of less than 25%. Frail individuals are also less likely to benefit from TAVR than nonfrail individuals.<sup>38,41</sup> The guideline acknowledges the important role of individual preferences and points out that a multidisciplinary heart valve team may be particularly beneficial in evaluating older adults for possible AVR.

## Heart Failure

The 2013 ACCF/AHA Guideline for the Management of Heart Failure focuses predominately on heart failure (HF) with reduced ejection fraction (HFrEF).<sup>42</sup> Throughout the guideline, topics pertinent to older adults are highlighted, including the observation that 3% to 4% of African Americans have a mutation of the serum protein transthyretin (TTR V122I) that increases risk of cardiac amyloid deposition and HF after the age of 65; the risk of hyperkalemia in older adults treated with renin-angiotensin-aldosterone-system inhibitors; and the association between older age and increases in natriuretic peptides, which reduces their diagnostic utility and usefulness in guiding therapy. The guideline acknowledges that older adults with HF typically have multimorbidity and suggests that treatment be customized based on each individual's circumstances and goals of care.

There is growing interest in mechanical circulatory support (MCS) as destination therapy (DT) for older adults with advanced HFrEF, especially those aged 70 and older who are not candidates for heart transplantation. Advanced age is a risk factor for adverse outcomes, and age of 80 and older is a relative contraindication to DT-MCS.<sup>43</sup> CMS guidelines for MCS require inclusion of a palliative care specialist on the multidisciplinary team.

Comprehensive discharge planning and postdischarge support with special attention to care transitions should be deployed to achieve "guideline directed medical therapy" and prevent hospitalizations, which may improve quality of life and survival without increasing costs. The guideline also endorses palliative care as a component of management, especially for individuals with repetitive hospitalizations.

In contrast to the sections devoted to HFrEF, the section of the guideline devoted to HF with preserved ejection fraction (HFpEF) is brief.<sup>42</sup> Although the guideline acknowledges that HFpEF is predominantly a disorder of older adults, especially women,<sup>44</sup> it does not provide

specific recommendations for management because of the lack of proven effective therapies.

## Peripheral Arterial Disease

The 2005 ACC/AHA Practice Guidelines for the Management of Patients with Peripheral Arterial Disease and the 2011 ACCF/AHA Focused Update highlight the strong association between older age and peripheral arterial disease (PAD).<sup>45</sup> Consequently, the guidelines recommend that providers ask adults aged 50 and older about a family history of abdominal aortic aneurysm in first-degree relatives to identify high-risk individuals who may require additional evaluation. For older adults with noncompressible arteries because of calcification, caution is advised about limitations of the ankle-brachial index for diagnosing PAD and the potential for false-negative results.

## Cerebrovascular Disease and Stroke

Cerebrovascular disease and stroke comprise several discrete and heterogeneous conditions, mostly affecting elderly adults. Since 2010, there have been at least 11 ASA/AHA guidelines and scientific statements related to cerebrovascular disease and stroke.<sup>46–56</sup> Common themes are that older adults tend to have more-complex anatomy and greater vessel tortuosity and are at greater risk of adverse outcomes from stroke, as well as from pharmacological, percutaneous, and surgical interventions.

The 2014 Palliative and End-of-Life Care in Stroke: A Statement for Healthcare Professionals from the AHA/ASA promotes a focus on "patient and family-centered care that optimizes quality of life by anticipating, preventing, and treating suffering" while also recommending a balanced and collaborative approach to end-of-life decision-making.<sup>54</sup> These issues cut across all types of stroke and are especially important in elderly adults with stroke.<sup>54</sup>

Ischemic stroke is the most common type of stroke in the United States and is addressed in eight of the 11 guidelines.<sup>47,48,51–56</sup> There are several recommendations and comments related to the care of elderly adults with acute ischemic stroke.

The effectiveness of intravenous recombinant tissue-plasminogen activator is not well established in individuals aged 80 and older.<sup>52</sup>

Decompressive surgery for malignant cerebral edema is effective and potentially lifesaving, but older age and individual and family valuations of achievable outcomes may affect decisions regarding surgery.<sup>52</sup>

The value of surgery for elderly adults with massive cerebellar lesions (ischemic or hemorrhagic) and severe comorbidities is unknown.<sup>54</sup>

Intracerebral hemorrhage is the most lethal form of stroke, especially in elderly adults. The 2010 Guidelines for the Management of Spontaneous Intracerebral Hemorrhage<sup>46</sup> note that older age is one of several risk factors for recurrence. Data from the Surgical Trial in Lobar Intracerebral Hemorrhage II trial (~40% aged ≥70) suggest that early surgical intervention may be beneficial, especially for superficial intracerebral hemorrhages and especially in individuals with poor prognosis, including elderly adults.<sup>57</sup>

Subarachnoid hemorrhage is most commonly due to rupture of an intracranial aneurysm. The 2014 Palliative and End-of-Life Care in Stroke statement cautions that “although elderly, comatose patients with poor-grade SAH [subarachnoid hemorrhage] have a high likelihood of a poor outcome, it still may be reasonable to attempt a limited trial of aggressive treatment for some patients given the potential for considerable recovery.”<sup>54</sup>

Vascular cognitive impairment is primarily a condition of elderly adults and is caused by clinical strokes, silent strokes, and white matter lesions. It is the second most common cause of dementia and overlaps with Alzheimer’s disease in a substantial proportion of individuals. In the statement Vascular Contributions to Cognitive Impairment and Dementia,<sup>49</sup> it is noted that lowering blood pressure can be useful for the prevention of late-life dementia in young and middle-aged individuals, but the usefulness of blood pressure reduction in people aged 80 and older for prevention of dementia is not well established.

Primary stroke prevention is addressed in multiple guidelines and statements. Recommendations and comments pertinent to older adults include:

- Hypertension treatment is effective in preventing stroke across the age spectrum, including adults aged 80 and older.<sup>48</sup>
- Aggressive blood pressure control coupled with antithrombotic prophylaxis in elderly adults with atrial fibrillation is effective in reducing stroke risk.<sup>48</sup>
- The value of antiplatelet agents in addition to warfarin in elderly adults with AF is undefined.<sup>48</sup>

Carotid duplex ultrasound screening is reasonable before elective CABG surgery in individuals aged 65 and older and in those with PAD, history of cigarette smoking, history of stroke or transient ischemic attack, or carotid bruit.<sup>47</sup>

Measures for secondary prevention of ischemic stroke include antithrombotic therapy in individuals with AF<sup>51</sup> and carotid artery stenting or carotid endarterectomy in individuals with cerebrovascular disease amenable to intervention. For individuals aged 70 and older, carotid endarterectomy may be associated with better outcomes than carotid artery stenting, particularly when arterial anatomy is unfavorable for endovascular therapy.<sup>55</sup>

### Perioperative Management for Noncardiac Surgery

Older adults account for the majority of major surgical procedures performed in the United States and Europe.<sup>58</sup> Older age is an independent predictor of perioperative complications and death after cardiac and noncardiac surgery.<sup>59,60</sup> In addition, older adults undergoing surgery are at heightened risk for noncardiac complications, including infections, pulmonary disorders, renal insufficiency, postoperative cognitive impairment and delirium, gastrointestinal problems, deep venous thrombosis and pulmonary embolism, pressure ulcers, and deconditioning.<sup>61</sup> These can result in longer stays, greater likelihood of discharge to a transitional care or chronic care facility, greater risk of disability and dependency, poorer quality of life, and lower likelihood of full recovery to preoperative levels of physical and mental function.

The 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Non-cardiac Surgery acknowledges that older adults are at greater risk of perioperative cardiac complications and death.<sup>58</sup> The guideline recommends the use of validated prediction tools for assessing risk of perioperative major adverse cardiac events.<sup>62,63</sup> In addition to age and functional status, sex is considered in the ACS NSQIP Surgical Risk Calculator.<sup>62</sup> Nevertheless, although the guideline recognizes the effect of older age and functional limitations on surgical risk, it does not consider other geriatric factors, such as cognitive function, frailty, and multimorbidity in risk assessment, and it does not include recommendations specific to older adults.<sup>58</sup>

### KNOWLEDGE GAPS ACROSS GUIDELINES

Several common themes pertaining to knowledge gaps extend across most of the ACC/AHA and ASA guidelines. In general, studies upon which the guidelines are based enrolled few older adults and included older adults with fewer comorbidities who were not representative of the older population treated for CVD in the community. The importance of assessing relevant domains beyond chronological age, such as frailty and cognitive function, and the incorporation of individual preferences into shared decision-making have not been adequately assessed. The utility of all cardiac preventative measures, diagnostic tests, and therapeutic interventions, including medications, invasive procedures, and other programs (e.g., cardiac rehabilitation) in the management of older adults with CVD warrants careful scrutiny, especially in the context of multimorbidity, polypharmacy, functional limitations, and frailty.<sup>64</sup>

### Recommendations to Close Knowledge Gaps Across Guidelines

Intensive efforts are needed to recruit representative older adults in clinical cardiovascular research. There should be mandatory reporting of enrollment, assistance with transportation and other challenges limiting inclusion of older adults, and detailed postmarketing surveillance. Studies that include the full spectrum of community-dwelling and institutionalized older adults are essential, especially considering the marked heterogeneity of the older population. In particular, older adults with multiple comorbid conditions, functional and cognitive deficits, and frailty should be actively included in clinical studies when feasible. Studies should also address sex, racial and ethnic, and cultural factors through prespecified enrollment criteria and subgroup analyses. Methodologies for increasing participation of older adults in clinical research should be explored (e.g., Food and Drug Administration labeling of drugs and devices as being approved or not approved for use in elderly adults) (Table 2).

In addition to assessing conventional clinical outcomes, future studies should incorporate health status, quality of life, functional capacity, maintenance of independence, and cognitive function into study design.

There is a need for studies that assess cost-effectiveness, value, and resource use in the diagnosis and

**Table 2. Recommendations to Close Knowledge Gaps**

Increase enrollment of older adults in clinical trials, cohort studies, and registries
Eliminate age restrictions
Include older adults with multimorbidity and geriatric syndromes
Include institutionalized older adults when appropriate
Incorporate relevant outcomes into study design
Quality of life
Functional capacity and maintenance of independence
Cognitive function
Develop models for integrating individual preferences, values, and goals of care into clinical decision-making
Inclusion of family and significant others
Cultural sensitivity
Overcoming impediments to decision-making
Develop models for more accurately assessing prognosis in the context of competing risks
Incorporation of health status and goals of care
Tools and biomarkers for predicting trajectory of disability and frailty
Delineate optimal strategies for prevention of cardiovascular disease in older adults
Person-centered goals for risk factor interventions
Exercise and rehabilitation for primary and secondary prevention

treatment of older adults with or at risk of CVD and with reference to specific person-centered clinical outcomes.

Models for integration of individual preferences, values, and goals of care into the decision-making process for management of CVD in older adults are needed. Such models should involve caregivers and significant others and must anticipate and incorporate methods of overcoming impediments to decision-making, such as cognitive impairment and sensory deficits. Research is also needed to develop tools that enable care providers to integrate individual preferences and goals of care into the decision-making process. Similarly, research is needed to better define subgroups of individuals who, as a result of advanced disability, cognitive impairment, or other factors, may be unlikely to derive significant benefit from aggressive therapies and who may be better served by referral for palliative care or hospice.

Studies are needed to develop more-accurate models of assessing prognosis and life expectancy in older adults with CVD in the context of multiple chronic conditions and heterogeneous functional and cognitive status. Better tools are needed to more-accurately characterize domains of health in older adults, and studies are needed to evaluate strategies for incorporating data on health status and prognosis into the decision-making process. Similarly, tools and biomarkers are needed to predict the trajectory of cognitive impairment, disability, and frailty, because these factors often influence clinical decision-making.

Additional studies are needed to delineate optimal strategies for prevention of CVD in older adults, including person-centered blood pressure, lipid, and diabetes mellitus goals; methodologies and targets for enhancing fitness; and novel approaches to primary and secondary CVD prevention.

Studies are needed to evaluate rehabilitation services (traditional cardiac rehabilitation and therapies focused on strength, balance, and gait training) for optimizing clinical and functional outcomes.

## SUMMARY

Despite the high prevalence of CVD in older adults, there is limited evidence to guide clinical decision-making in individuals aged 75 and older and virtually no high-quality evidence in individuals age 80 and older with multiple coexisting conditions, major physical or cognitive disabilities, frailty, or residence in long-term care facilities. Moreover, there is little guidance for how to manage CVD and related interventions at the end of life. There is also a pervasive lack of information on the effect of diagnostic and therapeutic interventions on person-centered outcomes in older adults, including quality of life, functional outcomes, and maintenance of independence. Often there is an emphasis on pharmacological and surgical or catheter-based interventions, with much less attention given to nonpharmacological interventions such as diet, lifestyle, and exercise. Age-associated alterations in physiology of the cardiovascular system and other organ systems, as well as mounting chronic comorbidities and disabilities also affect care of older adults. Although older adults with CVD are at greater risk of adverse outcomes, including death, such that the absolute benefit of effective therapeutic interventions is potentially greater than in younger individuals, older adults are also at greater risk of complications arising from pharmacological agents and diagnostic and therapeutic procedures. Thus, there is a fundamental shift in the balance between risk and benefit in older adults that has been inadequately addressed in clinical trials and that must be considered on an individualized basis. This scientific statement summarizes vital knowledge and evidence gaps relevant to common CVDs with high prevalence in older adults. To overcome these deficiencies, there is a critical need for large population-based studies, examination of registries (e.g., National Cardiovascular Data Registry, AHA Stroke Registry) and existing databases (e.g., Medicare and Veterans Affairs databases), interrogation of “big data” derived from electronic health records, and clinical trials using novel study designs that incorporate person-centered outcomes relevant to older adults and, most importantly, include a broad mix of older adults typical of those seen in clinical practice. The results of these studies will enable translation of important findings into future evidence-based guidelines, transforming care and enhancing outcomes for the growing population of older individuals with CVD in the United States and around the world.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1. List of American College of Cardiology/ American Heart Association and American Stroke Association Guidelines Reviewed

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