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Geriatric Cardiology: Coming of Age

Parag Goyal, MD, MS[a,*], **Min Ji Kwak, MD, MS, DrPH**[b,*], **Christina Al Malouf, MD**[c], **Manish Kumar, MD**[d], **Namit Rohant, MD**[e], **Abdulla A. Damluji, MD, PhD**[f], **Quin E. Denfeld, RN, PhD**[g], **Kim K. Bircher, PharmD, MS**[h], **Ashok Krishnaswami, MD, MAS**[i,j,k], **Karen P. Alexander, MD**[l], **Daniel E. Forman, MD**[m], **Michael W. Rich, MD**[n], **Nanette K. Wenger, MD**[o], **James N. Kirkpatrick, MD**[p], **Jerome L. Fleg, MD**[q]

[a]Department of Medicine, Weill Cornell Medicine, New York, New York, USA;

[b]Division of Geriatric and Palliative Medicine, McGovern Medical School, Houston, Texas, USA;

[c]Department of Medicine, Icahn School of Medicine at Mount Sinai, New York, New York, USA;

[d]Department of Internal Medicine, Pat and Jim Calhoun Cardiology Center, University of Connecticut School of Medicine, Farmington, Connecticut, USA;

[e]Division of Cardiology, University of Arizona, Tucson, Arizona, USA;

[f]Division of Cardiology, Inova Center of Outcomes Research, Falls Church, Virginia, USA;

[g]School of Nursing and Knight Cardiovascular Institute, Oregon Health & Science University, Portland, Oregon, USA;

[h]Department of Pharmacy Practice and Translational Research, University of Houston College of Pharmacy, Houston, Texas, USA;

[i]Section of Geriatric Medicine, Division of Primary Care and Population Health, Stanford University, Stanford, California, USA;

[j]Geriatric Research Education and Clinical Center (GRECC), U.S. Department of Veterans Affairs, VA Palo Alto Health Care System, Palo Alto, California, USA;

[k]Division of Cardiology Kaiser Permanente San Jose Medical Center, San Jose, California, USA;

[l]Department of Medicine/Cardiology, Duke University Medical Center, Duke Clinical Research Institute, Durham, North Carolina, USA;

[m]Divisions of Geriatrics and Cardiology, Department of Medicine, University of Pittsburgh, and VA Pittsburgh GRECC, Pittsburgh, Pennsylvania, USA;

ADDRESS FOR CORRESPONDENCE: Dr Parag Goyal, Department of Medicine, Weill Cornell Medicine, 420 East 70th Street, LH-365, New York, New York 10063, USA. pag9051@med.cornell.edu. Twitter: @ParagGoyalMD.

*Drs Goyal and Kwak contributed equally and are co–first authors.

The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

APPENDIX For the supplemental table, please see the online version of this paper.

[n]Division of Cardiology, Department of Medicine, Washington University School of Medicine, St. Louis, Missouri, USA;

[o]Division of Cardiology, Emory University School of Medicine, Atlanta, Georgia, USA;

[p]Division of Cardiology and Department of Bioethics and Humanities, University of Washington School of Medicine, Seattle, Washington, USA;

[q]Division of Cardiovascular Sciences, National Heart, Lung, and Blood Institute, Bethesda, Maryland, USA.

Abstract

Older adults with cardiovascular disease (CVD) contend with deficits across multiple domains of health due to age-related physiological changes and the impact of CVD. Multimorbidity, polypharmacy, cognitive changes, and diminished functional capacity, along with changes in the social environment, result in complexity that makes provision of CVD care to older adults challenging. In this review, we first describe the history of geriatric cardiology, an orientation that acknowledges the unique needs of older adults with CVD. Then, we introduce 5 essential principles for meeting the needs of older adults with CVD: 1) recognize and consider the potential impact of multicomplexity; 2) evaluate and integrate constructs of cognition into decision-making; 3) evaluate and integrate physical function into decision-making; 4) incorporate social environmental factors into management decisions; and 5) elicit patient priorities and health goals and align with care plan. Finally, we review future steps to maximize care provision to this growing population.

Keywords

cognitive impairment; frailty; geriatric cardiology; multimorbidity; patient-centered care; polypharmacy

Cardiovascular disease (CVD) is the leading cause of mortality and a major cause of morbidity worldwide, particularly among older adults.[1] With an aging population, CVD is expected to impose an increasingly significant societal burden in terms of disability, functional decline, and health care costs.[1,2] More than 23 million people in the United States are aged $75 years; of these, 6.5 million are above the age of 85 years. These numbers are expected to nearly triple by 2060.[3] In fact, it is expected that the number of older adults (aged >65 years) will outnumber children (aged <18 years) for the first time around 2034. This demographic shift toward an older population will be accompanied by a dramatic increase in the prevalence of clinical and subclinical CVD[1,4] due both to increased survival of those who developed disease at a younger age and incident disease that is mediated by pathophysiological risks associated with aging.

Common CVD conditions that mount with older age include hypertension, coronary heart disease, heart failure, cerebrovascular disease, valvular disease, arrhythmias, and peripheral artery disease.[1] Importantly, few older adults with CVD have a single isolated condition; rather, older adults with CVD often have multiple conditions that include both cardiovascular and noncardiovascular disorders.[5] This complexity is further enhanced

by the fact that older adults are heterogeneous not only with respect to medical and cardiovascular health but also regarding their cognition and functional health, social and financial circumstances, and their health care goals and preferences. To date, there are no formal guidelines to assist with such complexity; rather, clinical practice guidelines have historically been disease centric, in some cases leading to conflicting recommendations across guidelines.[6] Moreover, older adults have largely been excluded from major clinical trials in cardiovascular medicine, creating important evidence gaps with regard to real-world efficacy and safety.[7] Taken together, older adults with CVD require comprehensive and integrative patient-centered approaches to organize complex care and optimize outcomes.

This state-of-the-art review highlights the increasing relevance of geriatric cardiology within the modern-day clinical environment and enumerates key principles essential for addressing the needs and vulnerabilities of older adults with CVD. Integration of fundamental cardiovascular care precepts within relevant geriatric principles is increasingly necessary to optimize current and future health care delivery to vulnerable older adults.

WHAT IS GERIATRIC CARDIOLOGY

Geriatric cardiology merges the management of diseases of the heart and blood vessels with a focus on the health care of older people and thus infuses cardiovascular medicine with the principles of geriatrics to provide individualized, holistic, patient-centered care to older individuals with or at risk for CVD.[8,9] Geriatric cardiology is intrinsically collaborative and multidisciplinary, combining expertise of cardiologists, geriatricians, primary care clinicians, advanced practice providers, nurses, pharmacists, dieticians, therapists, and social workers to address the complex needs of older patients.

EVOLUTION OF GERIATRIC CARDIOLOGY.

The concept of geriatric cardiology dates to the ancient Egyptians, who recognized an association between age and heart disease. In the mid-1600s, the British physician Thomas Sydenham introduced the concept of vascular aging when he stated “a man is as old as his arteries.” However, it was not until the mid-20th century when study of the aging cardiovascular system and of older adults with CVD began to accelerate (Figure 1). Although initially limited to adults aged 30 to 62 years, the landmark Framingham Heart Study, which began in 1948, set the stage for future epidemiologic studies, including the Baltimore Longitudinal Study of Aging (1958), the Bogalusa Heart Study (1972), and the Cardiovascular Health Study (1989), along with many others. These studies have provided a wealth of scientific information on normal aging physiology, risk factors for CVD in older adults, and the clinical course and prognosis of CVD in older adults. The year 1948 was also notable for establishing the Gerontology Branch in the newly formed National Heart Institute. In 1966, the Gerontology Branch became the Gerontology Research Center, an intramural laboratory of the National Institute of Child Health and Development (NICHD) that focused on the biology of aging. In 1974, the National Institute on Aging (NIA) was established, and in 1975, the Gerontology Research Center separated from NICHD to become one of the core components of NIA. In 1985 the Laboratory of Cardiovascular

Science was commissioned as an additional intramural branch of the National Institute on Aging.

The first textbook on geriatric cardiology was published in 1970 by Dr Raymond Harris, who in 1985 founded the first geriatric cardiology professional society, the Council on Geriatric Cardiology. The organization's flagship publication, the *American Journal of Geriatric Cardiology*, was led by Editor-in-Chief, Dr Nanette Wenger. In the early 21st century, the geriatric cardiology community began to build relationships with the American College of Cardiology (ACC), culminating in the formation of the ACC Geriatric Cardiology Leadership Council in 2010 and the broader Geriatric Cardiology Section (GCS) in 2011.[10] Over the years, the GCS has made numerous contributions to the field, including several timely publications[7–9,11–20] (Supplemental Table 1) and a series of workshops co-sponsored by the ACC, National Institute on Aging, and American Geriatrics Society. The GCS currently includes 5 productive Working Groups (Research, Advocacy, Palliative Care, Education and Training, and Fellows-in-Training and Early Career Professionals). In the educational realm, the Essentials of Cardiovascular Care for Older Adults geriatric cardiology curriculum was first published in 2007 and updated in 2017 to 2018; the online geriatric cardiology clinical content section featured on the GCS website was initiated in 2014; and GCS authors have contributed extensively to CardioSmart, ACC's patient education portal.

ESSENTIAL PRINCIPLES FOR CARING FOR OLDER ADULTS WITH CVD

With aging, myriad physiological changes occur within multiple organ systems (Figure 2). Within the cardiovascular system, structural changes include increased vascular stiffness, endothelial dysfunction, increased left ventricular wall thickness resulting in diastolic dysfunction, and atherosclerosis; functional changes are characterized by diminished capacity to compensate for increased workload resulting in exercise intolerance, higher risk of heart failure, and conduction system alterations causing higher risk of arrhythmias and heart block.[21–23] In addition, the brain undergoes shrinking in volume, white matter changes, and vascular changes, predisposing to cognitive impairment and dementia[24]; the musculoskeletal system undergoes significant losses of mass and functional capacity, contributing to frailty and increased risk for falls[25]; and kidneys sustain anatomical and functional changes including decreased number of glomeruli, reduced cortical volume, and diminished filtration reserve, predisposing to chronic kidney disease and higher risk for acute kidney injury.[26] Age-related changes to these organ systems are further accelerated by the presence of clinical and subclinical CVD.[27] Accordingly, physiological aging coupled with CVD leads to an increased risk of developing multimorbidity and also impacts other domains of health including cognition and physical function. The social environment can also change with age—increased caregiving needs for oneself and/or increased caregiving duties for others, loss of social support systems, and loneliness all become more common with age.[28,29] Importantly, these changes do not operate individually; rather, they interact with one another, further adding to the complexities and challenges of providing care to older adults with CVD.

Multimorbidity and polypharmacy, cognitive impairment, functional abnormalities, and the social environment inform optimal care for older adults. First, the presence of these deficits could be a consequence of a known condition or could stem from subclinical disease that merits additional evaluation. The accumulation of deficits also increases the risk of harm from diagnostic and therapeutic interventions and may decrease life expectancy, altering risk-benefit calculations for treatment. Decision-making among older adults may be particularly complex, given variations in health outcome goals with age,[30] and evidence gaps related to the use of therapeutic interventions that were primarily studied in younger healthier adults.[7] Finally, it is important to recognize that abnormalities across these domains reflect physiological aging, which may be a more precise reflection of the consequences of aging compared with chronological age. Reliance on chronological age may, in some cases, lead to inappropriate implicit biases in care provision.[31]

Given the age-related biological changes and rising incidence of complex conditions across multiple domains among an aging population, geriatric cardiology is not just a preferred approach to optimizing cardiovascular care to the population—it is a necessary approach. We call for all cardiovascular clinicians to incorporate geriatric cardiology principles into the routine care of older adults with cardiovascular conditions. As a starting point, we describe 5 essential principles necessary to appropriately and effectively address the aforementioned vulnerabilities intrinsic to many older adults with CVD (Table 1).

RECOGNIZE AND CONSIDER THE POTENTIAL IMPACT OF MULTICOMPLEXITY.

The prevalence of multimorbidity, defined as 2 or more chronic conditions, rises with advancing age due to age-related changes and the cumulative effects of CVD and other diseases. For example, aging and inflammatory processes, often jointly described as inflammaging,[32] are compounded by lifestyle and aggregate effects of traditional CVD risk factors (eg, sedentariness, obesity, tobacco). The presence of multiple conditions can worsen prognosis and complicate diagnostic and therapeutic decision-making.[33] In the setting of multimorbidity, it is important to consider life expectancy, competing risk of death from both CVD and non-CVD conditions,[34] and overall treatment burden when formulating care plans for older adults with CVD. With advancing age, noncardiovascular death becomes increasingly common—it is therefore important to consider these competing risks and time to benefit when making decisions about interventions or medications. For example, although the implantable cardioverter-defibrillator has demonstrated robust evidence to prevent sudden cardiac death, the benefits are attenuated with advancing age, especially in patients with multiple chronic conditions, because of the competing risk of noncardiovascular death.[35] Finally, as the number and severity of medical conditions increase, complex disease management plans can lead to increased burden for the patient to manage these conditions, which can impair quality of life.[36]

Polypharmacy is closely linked with multimorbidity. Often defined as the taking of at least 5 medications,[37] polypharmacy is common in patients with CVD because of a proliferation of drugs that can alter the natural history of coronary artery disease, arrhythmias, and heart failure. In fact, polypharmacy is nearly universal in patients with heart failure; a recent study showed that more than 50% of older adults hospitalized for heart failure were taking

10 or more medications at discharge.[38] On the one hand, this reflects major advances in science over the past 2 decades; however, this also increases the risk for adverse drug reactions.[39] Given the prevalence of polypharmacy, multimorbidity, and age-related changes in body composition and hepatic and renal function that mediate pharmacokinetics and pharmacodynamics, older adults are at especially high risk for adverse drug reactions. Although cardiovascular medications have the potential to substantially reduce morbidity and mortality in some older adults, such agents are among the most common causes of adverse drug events requiring emergency room visits and/or hospitalization.[40,41] Moreover, with an increasing number of chronic conditions and medications, therapeutic competition may occur, whereby an agent prescribed for one condition may exacerbate another.[42]

The key to managing polypharmacy is to ensure safe and effective medication prescribing (or deprescribing).[17] A useful strategy to achieve this objective is to routinely assess for adverse events from CVD medications. If any adverse drug event is present, reduction in dose, class-switch, and/or discontinuation may be reasonable strategies, with subsequent re-evaluation of clinical status at a follow-up encounter. It is similarly important to confirm that the medications being prescribed are indicated, reflect a favorable risk-benefit calculation, and are consistent with the patient's health outcome goals. For example, a recent study from an anticoagulation registry in Michigan showed that one-third of patients with an indication for anticoagulation but without an indication for aspirin were prescribed both; the group that took both agents experienced increased bleeding.[43] Finally, it may be reasonable to review noncardiovascular medications to ensure that they are not causing harm. Some medications of concern are outlined in scientific statements from the American Heart Association[44] and the American Geriatrics Society (known as Beers criteria).[45] Tools that can potentially improve prescribing quality include the Screening Tool of Older Persons' Prescriptions and Screening Tool to Alert to Right Treatment (STOPP/START), although these are yet to be routinely used in practice.[46]

EVALUATE AND INTEGRATE COGNITION INTO DECISION-MAKING.

Older adults universally experience anatomical and functional changes in the brain. These changes can occur as a result of age, medical conditions, and/or therapeutic interventions such as medication or procedures. Neurons do not regenerate,[47] and CVDs such as atrial fibrillation[48] and heart failure[49] have been implicated as important contributors to worsened cognition and subsequent dementia. Cellular senescence has also been implicated as an important mechanism driving histologic and physiological changes, with subsequent alterations in cognition.[27] Finally, subclinical thromboembolic events that track with CVD[50] result in reduced cerebral blood flow.[51,52] Impaired cognition can be classified along a spectrum from mild cognitive impairment to dementia, although measurement can be confounded by superimposed delirium, depression, and/or hearing loss. Impairment can span any of several cognitive domains, including learning and memory, executive function, and attention.[53] Each domain is important for self-care practices such as symptom monitoring and medication adherence, hallmarks of cardiovascular management. Cognitive impairment can compromise patient capacity to engage in these behaviors and lead to adverse clinical events.[54,55] Moreover, limitations in self-care behavior engagement may be misconstrued as noncompliance, even when lack of engagement is unintentional rather than volitional.

Depending on its severity, cognitive impairment may be associated with reduced life expectancy,[56] highlighting its importance for consideration in risk/benefit calculations for procedures as well as medications.

To identify changes in cognition, it may be helpful to ask patients and/or their family members about observed changes in memory or forgetfulness especially as it relates to taking their medications. The MiniCog and AD8 are validated ultrabrief screening tools[57,58] for cognitive impairment and can be administered in just 3 minutes. Screening for depression via the validated Patient Health Questionnaire[59] or the Geriatric Depression Scale[60,61] is appropriate in the setting of potential cognitive impairment because depression is common with age and can itself impact cognition. In the acute setting, it may also be reasonable to screen for delirium, which is a transient state of altered consciousness, and is associated with mortality as well as an elevated risk of developing dementia.[62] The Confusion Assessment Method is a validated tool for screening for delirium.[63,64]

Suspected cognitive impairment should lead to a referral for further neurocognitive function evaluation. An improved understanding of neurocognitive function can help identify specific impairments that require accommodation. In the presence of cognitive impairment, it may be reasonable to simplify medication regimens to minimize the risk for medication errors and subsequent adverse drug events. Involving family members and caretakers to assist with medication administration and other self-care behaviors may also be important. In this setting, family members and caretakers are critical for discussions about health priorities and subsequent medical decision-making about medications as well as procedures, especially because the presence of cognitive impairment itself impacts overall life expectancy. When depression is present, it is recommended to pursue behavioral (psychotherapy, cognitive behavioral therapy, and exercise) and pharmacologic interventions (selective serotonin reuptake inhibitors and serotonin norepinephrine reuptake inhibitors), which have shown efficacy and safety for the treatment of depression among older adults.[65]

EVALUATE AND INTEGRATE CONSTRUCTS OF PHYSICAL FUNCTION INTO DECISION-MAKING.

Physical function is closely tied to mortality, preservation of quality of life, and independence—key priorities for older adults.[66,67] Indeed, physical function declines more rapidly among older adults with CVD than in those without CVD.[68,69] Physiological changes that impact physical function include age-related declines of cardiorespiratory fitness, decreased muscle mass, reduced strength, bone loss, and degenerative changes in connective tissue.[70–72] CVD-related changes to physical function occur via cardiovascular instability or reduced perfusion of muscle due to atherosclerosis, reduced exercise tolerance due to heart failure, and consequent sedentary lifestyle aggravating physical deconditioning.[66] These changes may be further accelerated by medications and/or hospitalizations. For example, a longitudinal study showed that 4% of leg lean mass is lost after 5 days of bedrest among older adults.[73]

To incorporate physical function into cardiovascular care, clinicians may consider the following domains: disability as assessed by activities of daily living (ADLs), physical frailty, and falls. Although they overlap, each represents unique constructs that merit

consideration. On the most fundamental level, physical function can be characterized based on the ability to perform ADLs, as defined by Katz,[74] to include bathing, dressing, toileting, transferring, continence, and feeding. Impairments in these basic skills have major implications on prognosis. For example, an impairment in at least 1 ADL is associated with almost halving of life expectancy.[75] Impairment in ADLs is not only associated with higher mortality but also with reduced quality of life and loss of independence.[75] When substantial impairments in quality of life and loss of independence have occurred, discussions about health priorities and subsequent modifications to treatment plans may be necessary.

Frailty is also an important construct of function and is defined[76] as "a clinical syndrome of increased vulnerability resulting from age-associated declines in reserve and function across multiple physiologic systems such that the ability to cope with everyday acute stress is compromised." It may be operationalized based on physical attributes alone, as delineated by Fried[76]—weight loss, weakness, exhaustion, slowness, and low physical activity level—or based on an accumulation of deficits across multiple domains, calculated as a frailty index.[77,78] Regardless of definition, the prevalence of frailty is considerable among patients with CVD[13]—for example, it can affect up to half of adults with coronary artery disease, heart failure, and severe aortic stenosis. There is a dose-dependent *bidirectional* association between CVD and frailty, whereby CVD can lead to frailty, and frailty can lead to CVD. Indeed, a recent study showed that physical frailty was an independent risk factor for incident CVD.[79,80] Shared pathophysiological mechanisms such as inflammation likely account for this bidirectional association and sometimes make it difficult to extricate frailty from CVD. Frailty has well-known associations with all-cause mortality, loss of independence, and disability.[79,81,82] Moreover, frailty increases the risk of various interventions and impacts the risk-benefit ratio for medications.[13]

Falling is another important construct within the physical function domain, especially because the risk of falls is higher among those with CVD.[83–85] This is the case for multiple reasons. First, older adults are already at risk for hypotension and/or falls due to age-related physiological changes, including reduced baroreceptor or autonomic reflex, impaired homeostasis of volume and electrolyte balance, neurologic disorders, decreased perception due to hearing or vision impairment, or cognitive impairment.[86,87] Second, CVD itself can exacerbate many of these abnormalities through inadequate perfusion to muscle or the brain, which are necessary for central nervous system mediated balance control, and inadequate augmentation of heart rate from postural changes increasing the risk of syncope.[87,88] Third, these risks are further exacerbated by medications commonly prescribed to treat CVD.[89] For example, antihypertensives, diuretics, nitrates, and beta-blockers can cause hypotension and syncope and thus predispose older adults to falls.[87]

Assessment of ADLs, frailty, and falls can be done in a few ways. Clinicians can ask about ADLs during routine patient encounters as a part of history taking and/or through a questionnaire. The tools to specifically assess frailty include Fried's Frailty Phenotype Criteria, the Frailty Index, Clinical Frailty Scale, FRAIL scale, grip strength, Timed Up and Go test, and the Short Physical Performance Battery test (Table 2).[76,90–96] These tools vary in the required time and skills to conduct and should be matched to the resources available in each setting. For assessment of falls, a one-question inquiry about any falls occurring

in the prior 6 months is a simple approach. Formal screening tools that quantify falls risks include the Johns Hopkins Fall Risk Assessment Tool, Henderich II Fall Risk Model, and Fall Risk Questionnaire, which can subsequently be incorporated into decision-making and a customized care plan.

Referral of patients with physical function impairment to exercise programs can be effective in improving physical function by increasing strength, balance, and aerobic endurance, leading to improvements in ADLs, mitigation of frailty, and a reduced risk for falls.[66,97] Physical rehabilitation therapy has been shown to improve all 3 physical function constructs.[98] In addition, given the bidirectional association between physical function and CVD, optimization of CVD conditions may also be important in improving function.

Integrating the assessment of physical function is critical in cardiovascular practice because these parameters have important implications on the decision-making process. If aggressive treatment of CVD can meaningfully improve function, it may be reasonable to pursue even high-risk procedures such as left ventricular assist devices. On the other hand, if impairment in function is severe and/or unrelated to CVD, such high-risk procedures may be less likely to alter the disease trajectory and therefore may not be warranted. This underscores the importance of quantifying physical function and incorporating it into decision-making.

INCORPORATE SOCIAL ENVIRONMENTAL FACTORS INTO MANAGEMENT DECISIONS.

Social isolation defined as the physical lack of social support and loneliness defined as the emotional perception associated with the absence of intimate connections are highly prevalent at older age.[28,29] Death of a spouse is more common among women due to the sex-related differences in life expectancy.[99] Spousal support and living arrangements have direct implications on emotional and physical support as widowed older adults are more likely to live alone or in group homes.[99] Social displacement with resulting social isolation and loss of independence is also more common among those with fewer children.[100] The deaths of loved ones and friends with associated declines in social interactions and displacement to group homes result in lower life satisfaction, self-esteem, and sensations of belonging.[101] These changes can be especially challenging for older adults when other capacities such as cognition and function are diminished.

In addition, household income often decreases substantially after retirement. This affects a large proportion of older adults, as the average retirement age in the United States is currently 66 years. With this shift, there is often a reliance on government programs such as Medicare for medical insurance, which may entail significant cost-sharing and high out-of-pocket expenditures. Although policies vary, many insurance carriers do not cover services frequently required by older adults, including medication costs; vision, hearing, and dental needs; and long-term care either at home or in group settings.[102] The resulting financial challenges may be compounded by costs related to transportation and the need for additional assistance in the home.[99,103] These factors can force many older adults to transition to smaller publicly owned or subsidized housing and preclude patients from accessing the medical care they need. Beyond the social context, economic stability, and health care access outlined here, neighborhood-related factors (such as pollution and violence) as well as health literacy levels and language proficiency are likely to impact health outcomes.[104]

Clinicians caring for older adults with CVD should be aware of these social vulnerabilities, especially in the presence of physiological deficits, when developing care plans to ensure that they are feasible. For example, simply inquiring about social support is a critical first step; then screening for loneliness through tools such as the UCLA Loneliness Scale[105] could be considered. In addition, remaining sensitive and vigilant about financial wherewithal and the presence of other social determinants of health can provide invaluable information about patient context that drives behavior and health priorities. Finally, developing novel approaches to assist with some of these limitations, such as through remote monitoring and other forms of gerotechnology, could be valuable but will require further development and validation before broad implementation.[18]

ELICIT PATIENT PRIORITIES AND HEALTH GOALS AND ALIGN WITH CARE PLAN.

In the face of complexity and uncertainty, cardiovascular care should start with what matters to the patient. This is critical to aligning care with individual health outcome goals and care preferences, which are heterogeneous and vary with advancing age.[106,107] This is especially relevant in settings where older adults receive care from multiple clinicians, which is common for older adults with CVD, given the prevalence of multimorbidity. Without clarity on a patient's health outcome goals, receiving care from multiple clinicians can lead to treatment strategies that compete with one another, whereby a treatment strategy that improves one condition may conflict with the patient's goals for another condition. Understanding health outcome goals can also help facilitate decisions about tradeoffs.[108] Although some therapeutic interventions can concurrently improve the quality of life and prolong life, other interventions can only achieve one at the expense of the other. There are also interventions that provide short-term benefits at the expense of long-term harms, and vice versa. For example, treatment of osteoarthritis with nonsteroidal anti-inflammatory drugs may reduce joint pain but increases the risk for future cardiovascular events. Complying with prescribed health plans also comes with tradeoffs—for example, attending medical appointments may come with added stress and anxiety related to the logistical challenges of getting to and from appointments or may come at the sacrifice of spending time with family; similarly, paying for medicines may come at the cost of paying for other things, which may even include basic necessities such as food and clothing. Clinical practice guidelines may not be helpful to reconcile these challenges because most guidelines are disease specific. Although health priorities of older adults often include longevity, health outcomes such as quality of life, function, and independence are often as important or more important than longevity.[66] Accordingly, "What Matters" is critical for clinicians to effectively address the inherent complexities of managing CVD in older adults, serving as an anchor to maximize the likelihood of helping the patient to achieve their care goals with shared decision-making. It is important to recognize that the patient's health outcome goals may change over time and may be highly influenced by their responsibilities and position within their social structures.[109,110] Goals may also evolve as medical conditions advance, disability progresses, and overall life expectancy decreases. Understanding overall prognosis and patient priorities can also help determine the appropriateness of palliative care, an underutilized resource in cardiovascular medicine.[111]

When initiating a conversation about “What Matters,” it may be helpful to explain the underlying reason for such a conversation (eg, “I would like to know what specific goals you would like to achieve through the care that I provide so that I can make sure that my care plan aligns with those goals.”) Follow-up questions may include “What do you want to focus on during your time with me?” or “What activities do you want to get back to doing?” The recently developed Patient Priorities Care toolkit is an excellent resource that can assist clinicians in addressing “What Matters”.[110] These insights can then drive discussions about care preferences and tradeoffs, facilitate personalized care, and prepare clinicians to share a sentiment like the following: “There are several things we could do, but knowing what matters most to you, I suggest we.” This shift from a disease-centric encounter to a holistic patient-centered encounter is necessary to address the rising complexity of older adults with CVD.[112]

GERIATRIC CARDIOLOGY FRAMEWORKS AND IMPLEMENTATION

Conceptual frameworks for comprehensive integrative care of older adults have previously been outlined. In a 2018 State of the Art paper published in the *Journal of American College of Cardiology*, the ACC GCS outlined a multiple domain approach to the management of older adults with heart failure.[113] This approach promulgates 4 key domains relevant to patient care—the medical domain, the mind and emotion domain, the functional domain, and the social domain. Although this approach was devised for the care of older adults with heart failure, the precepts can be broadly applied to any older adult with CVD. On the other hand, the Age-Friendly Health System 4 Ms framework, from the Institute for Healthcare Improvement and the John A. Hartford Foundation,[114] seeks to address the needs pertinent to the older adults with complex medical conditions by integrating: 1) What **M**atters; 2) **M**edications; 3) **M**entation; and 4) **M**obility. In Central Illustration, we have merged these models to generate an overarching framework that combines key elements necessary to provide optimal care to older adults with CVD.

Partnerships between the cardiologist and other clinicians involved in the care of older adults are critical to ensure that there is alignment of care plans. Communication across multiple clinicians is especially relevant, given the rise in the number of specialties seen by older adults in a given year—recent data indicate that almost one-third of Medicare beneficiaries see at least 5 different physicians per year.[115] If multiple geriatric conditions are present, it may be reasonable for a cardiovascular clinician to partner with a geriatrician in the ambulatory setting and potentially pursue a geriatric co-management model in the inpatient setting. Geriatric co-management is a model of care for complex older adults whereby a designated geriatrician or geriatrics-trained nurse provides concurrent care alongside the cardiovascular clinician. Prior work in other countries has shown that geriatric co-management can prevent episodes of delirium and functional decline among older adults undergoing cardiovascular surgery[116] and among older adults hospitalized to a cardiovascular service[117]; and a single-center study done in the United States showed that geriatric co-management reduced cost, days spent in the intensive care unit, and in-hospital mortality among older adults although this was not specific to those with CVD.[118]

Putting these principles into action will take time and effort; the current reimbursement structure for health care delivery in the United States (ie, favoring resource-intensive procedures) does not yet facilitate routine incorporation of these principles.[119] In this setting, activation of a multidisciplinary team with allocation of efforts based on expertise could be helpful for implementing geriatric cardiology principles. For example, pharmacists can assist in characterizing and managing polypharmacy as part of a system-based approach to addressing complexity. Similarly, occupational therapists and physical therapists have unique expertise that could assist in the evaluation and management of the cognitive and functional domains. The perspectives and skillsets of nurses and social workers could likewise be utilized to develop comprehensive, holistic care plans that integrate multiple domains of health. Along these lines, a recent study of older adults with cancer showed that leveraging a multidisciplinary team to implement a systematized approach to assessing and managing geriatric conditions can reduce chemotherapy-related toxicity.[120] In this study, the intervention group received lower doses of chemotherapy but experienced similar survival compared with the usual care group. Although some might argue that similar evidence is needed for older adults with CVD,[121] increasingly frequent integration of geriatric principles into the care of older adults with cancer[122,123] demonstrates that this approach to care is feasible even within the constraints of the current U.S. health care system. With advances in technology and mobile health,[18] implementing mobile applications such as the Essential Frailty Toolset[124] or GeriKit,[125] which are freely available and easily accessible to clinicians, represent yet another specific strategy that can be used to implement geriatric principles into the routine care of older adults with CVD.

THE FUTURE

Even with substantive advances in geriatric cardiology over the last several decades, much work remains in the research, clinical care, education, and health policy realms (Table 3). As previously outlined, adults aged ≥75 years have been underrepresented in most cardiovascular clinical trials, and this deficiency is most pronounced among women, racial and ethnic minority groups, nursing home residents, and older adults with multimorbidity, cognitive impairment, and frailty. Moreover, few studies have examined outcomes valued by older adults, including quality of life and maintenance of function and independence. The National Institutes of Health Inclusion Across the Lifespan Policy,[126] released in December 2017, was designed to ensure that clinical studies supported by the National Institutes of Health do not exclude older patients without compelling justification. Future efforts such as this will be necessary to ensure researchers actively recruit a broad spectrum of older adults' representative of clinical practice, including complex patients with geriatric syndromes, and to integrate relevant outcomes into study design. In addition, continued basic and translational studies in geroscience will be necessary to increase understanding of mechanisms underlying cardiovascular aging and intersections with geriatrics, oncology, and other age-associated conditions—investigations into linkages between CVD and cellular mechanisms such as autophagy and senescence have begun to provide unique insights that will hopefully generate novel therapeutic strategies in the future.[127,128]

Development of strategies to seamlessly incorporate geriatric cardiology principles into the care of older adults is another major unmet need. This aligns closely with the need to revise

current payment structures to encourage the use of comprehensive and integrated care for older adults. In addition, incorporation of geriatric cardiology precepts into the standards of cardiology fellowship training (COCATS: Core Cardiology Training Symposium)[129] is warranted to enhance the skillset of future cardiologists who will inevitably need to contend with the many complexities of caring for older patients. The optimal strategy to ensure that there are sufficient number of clinicians sensitive to fundamental geriatric cardiology principles to provide high-quality care of this complex and rapidly growing subpopulation remains unclear. Further work is also necessary to develop strategies that can leverage technology and/or more broadly integrate multiple disciplines (pharmacists, physical and occupational therapists, social workers, etc) into the care of older adults with CVD.

Finally, at the health policy level, there is need to revise the compensation model for services provided to complex older patients, acknowledging the time and expertise required to deliver optimal multidisciplinary patient-centered care. There is also need for increased Food and Drug Administration requirements to ensure that pharmaceuticals and devices intended for use in older patients are adequately tested in this population before approval and that postmarketing surveillance is sufficient to identify unanticipated adverse events.

CONCLUSIONS

Aging is the most powerful risk factor for CVD, and the number of older adults with CVD is growing rapidly as the population ages. Older adults with CVD often have several non-CVD medical challenges, including multimorbidity, polypharmacy, cognitive impairment, and diminished physical function that add to the complexity of care. Moreover, older patients are often beset with an array of social, environmental, and financial challenges that may impact care preferences and health care delivery. To address these issues and to ensure high-quality, patient-centered care for older adults with CVD, care should involve 5 essential geriatric cardiology principles: 1) recognize and consider the potential impact of multicomplexity; 2) evaluate and integrate cognition into decision-making; 3) evaluate and integrate constructs of physical function into decision-making; 4) incorporate social environmental factors into management decisions; and 5) elicit patient priorities and health goals and closely align them with the care plan. By applying these 5 principles, cardiovascular clinicians have the opportunity to provide comprehensive geriatric cardiology care to their older patients.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS AND ACRONYMS

ACC	American College of Cardiology
ADL	activities of daily living
COCATS	Core Cardiology Training Symposium
CVD	cardiovascular disease
GCS	geriatric cardiology section
START	Screening Tool to Alert to Right Treatment

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HIGHLIGHTS

- Cardiovascular disease in older adults occurs amidst multiple comorbid conditions and geriatric syndromes.
- To meet the needs of older adults, clinicians should consider multicomplexity, cognition, physical function, and social factors.
- Clinicians should formulate comprehensive geriatric cardiology care plans grounded in individualized health care goals and preferences.

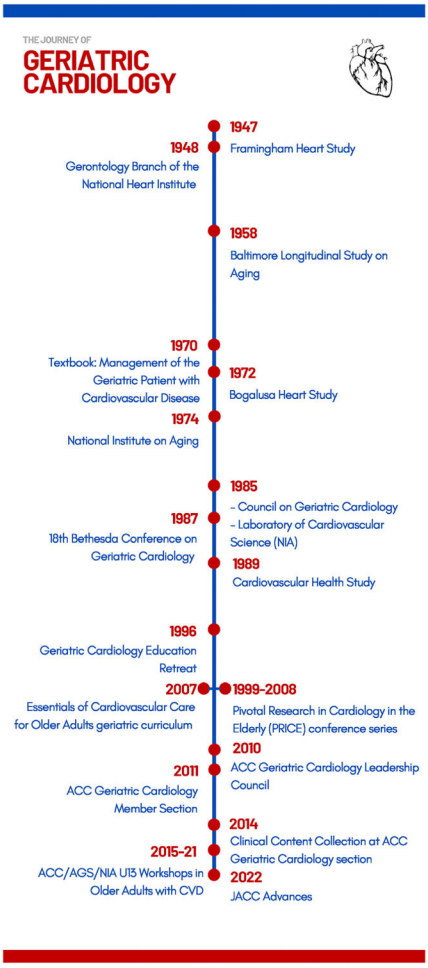


FIGURE 1.

Timeline of Geriatric Cardiology

Key advances in the development and emergence of geriatric cardiology are shown.

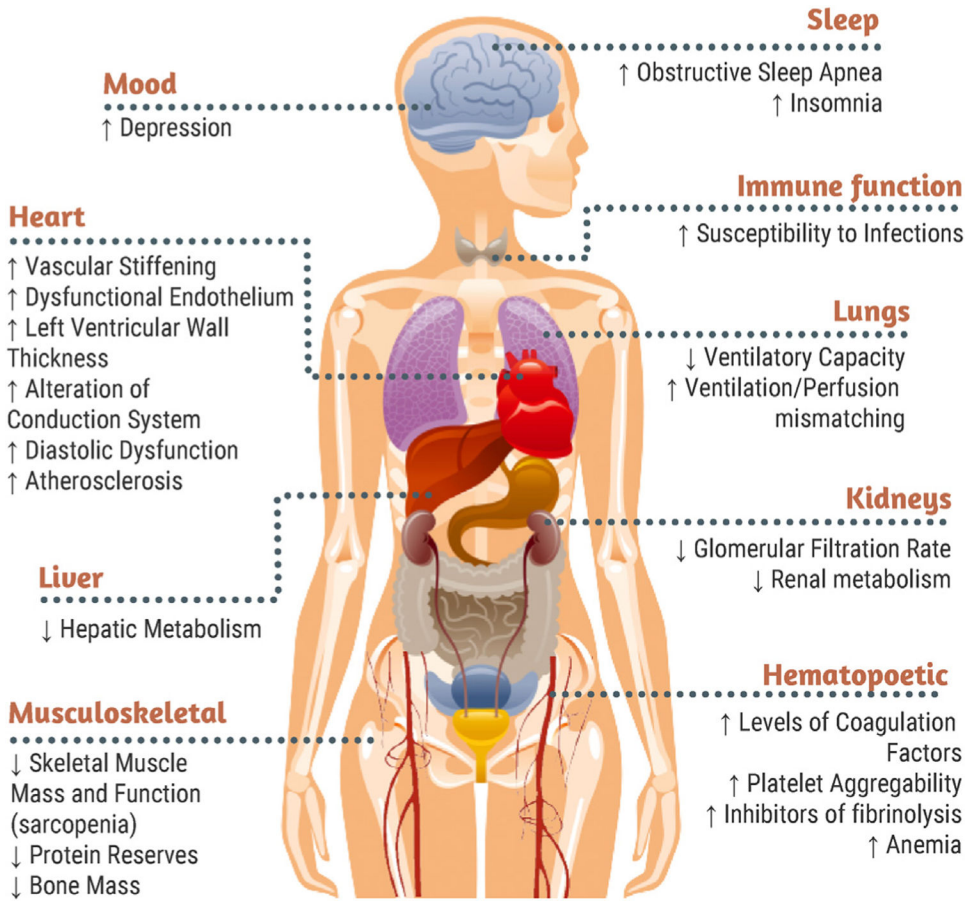
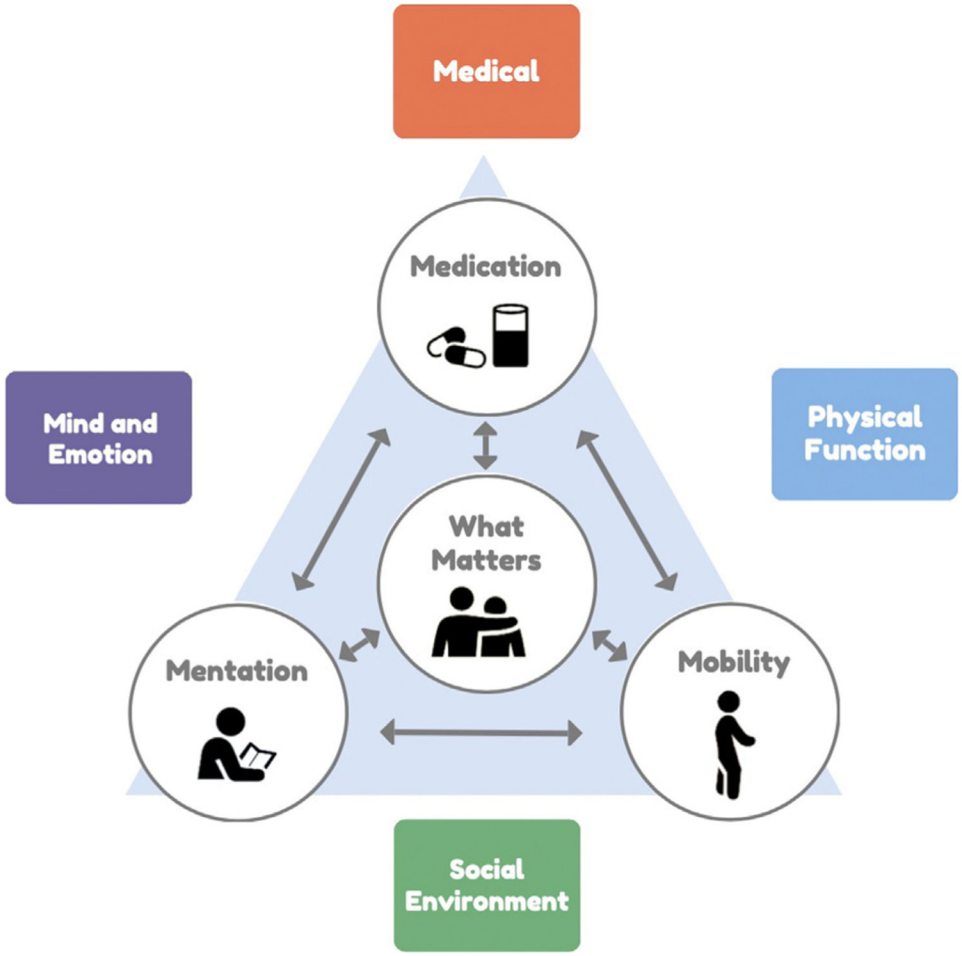


FIGURE 2.

Age-Related Changes to Organ Systems

Age-related changes within multiple organ systems are shown.



CENTRAL ILLUSTRATION.

Conceptual Framework for Geriatric Cardiology

A framework that combines essential principles of care to older adults with CVD is shown.

TABLE 1

Essential Principles for Caring for Older Adults With CVD

1. Recognize and consider the potential impact of multicomplexity
2. Evaluate and integrate cognition into decision-making
3. Evaluate and integrate constructs of physical function into decision-making
4. Incorporate social environmental factors into management decisions
5. Elicit patient priorities and health goals and align with care plan

CVD = cardiovascular disease.

TABLE 2

Tools for Implementing the Essential Principles for Caring for Older Adults With CVD

1. Recognize and consider the potential impact of multicomplexity
Screening ToolofOlder Persons' Prescriptions and Screening Tool to Alert to Right
Treatment (STOPP/START)
Beers criteria
2. Evaluate and integrate cognition into decision-making
MiniCog test
AD8
Patient Health Questionnaire
Geriatric Depression Scale
Confusion Assessment Methods
3. Evaluate and integrate constructs of physical function into decision-making
Katz's Activities of Daily Living
Fried's phenotype of frailty
Frailty index
Clinical Frailty Scale
FRAIL scale
Grip strength test
Timed Up and Go test
Short Physical Performance Battery Test
Johns Hopkins Fall Risk Assessment Tool
Henderich II Fall Risk Model
Fall Risk Questionnaire
4. Incorporate social environmental factors into management decisions
Heathy people 2030
UCLA Loneliness Scale
5. Elicit patient priorities and health goals, and align with care plan Patient priorities care model

CVD = cardiovascular disease.

TABLE 3

Gaps and Challenges in Geriatric Cardiology

I. Research	
A.	Increased enrollment of older adults in clinical studies, including women, racial and ethnic minorities, nursing home residents, and complex elders with multimorbidity, frailty, functional and cognitive limitations
B.	Incorporation of outcomes relevant to older adults into clinical study design, including quality of life, maintenance of independence, physical and cognitive function
C.	Expanded studies in geroscience to clarify mechanisms of cardiovascular aging and intersections with geriatrics, oncology, and other specialties as related with aging
II. Clinical care	
A.	Integration of geriatrics constructs into the care of older adults with cardiovascular disease in the inpatient and ambulatory settings
B.	Continued alignment of clinical practice guidelines, appropriate use documents, and consensus statements with current knowledge and evidence pertinent to older adults, acknowledging where data are insufficient to make recommendations
C.	Use of gerotechnology for improved quality and efficiency of health care delivery
D.	Activation and integration of multiple disciplines to provide care to older adults (pharmacists, physical and occupational therapists, social workers, etc)
III. Education	
A.	Increased education of clinicians caring for older adults, including physicians, advanced practice providers, and pharmacists, about geriatric principles of care, starting with professional school training and continuing throughout professional life
B.	Integration of geriatric cardiology knowledge and competencies into the COCATS guidelines for training of fellows in cardiovascular disease
IV. Public policy	
A.	Revision of CMS reimbursement models to better reflect time required to provide optimal multidisciplinary patient-centered care to complex older adults and better support integrated interdisciplinary models of care
B.	Increased requirements by FDA to ensure that drugs and devices intended for use in older adults have been adequately tested in this population and to ensure adequate post-approval surveillance to identify unanticipated adverse events

CMS = Centers for Medicare & Medicaid Services; COCATS = Core Cardiology Training Symposium; FDA = Food and Drug Administration.