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Geriatric Cardiology: An Emerging Discipline

John A. Dodson, MD MPH^{a,b}, Daniel D. Matlock, MD MPH^c, and Daniel E. Forman, MD^{d,e}

^aLeon H. Charney Division of Cardiology, Department of Medicine, New York University School of Medicine, New York, NY

^bDepartment of Population Health, New York University School of Medicine, New York, NY

^cDivision of Geriatrics, Department of Medicine, University of Colorado School of Medicine, Aurora, CO

^dSection of Geriatric Cardiology, Department of Medicine, University of Pittsburgh Medical Center, VA Pittsburgh Healthcare System, University of Pittsburgh, Pittsburgh, PA

^eGeriatric Research, Education, and Clinical Center, VA Pittsburgh Healthcare System, University of Pittsburgh, Pittsburgh, PA

Abstract

Given changing demographics, patients with cardiovascular (CV) disease in developed countries are now older and more complex than even a decade ago. This trend is expected to continue into the foreseeable future; accordingly, cardiologists in practice are encountering patients with a greater number of comorbid illnesses as well as “geriatric conditions” such as cognitive impairment and frailty which complicate management and influence outcomes. Simultaneously, technological advances have widened the therapeutic options available for patients, including those with the most advanced CV disease. In the setting of these changes, geriatric cardiology has recently emerged as a discipline that aims to adapt principles from geriatric medicine into everyday cardiology practice. Accordingly, the tasks of a “geriatric cardiologist” may include both traditional evidence-based CV management plus comprehensive geriatric assessment, medication reduction, team-based coordination of care, and explicit incorporation of patient goals into management. Given that the field is still in its relative infancy, the training pathways and structure of clinical programs in geriatric cardiology are still being delineated. In this review we highlight the rationale behind geriatric cardiology as a discipline, several current approaches by geriatric cardiology programs, and future directions for the field.

Keywords

Aging; geriatrics; cardiovascular disease

Corresponding Author: John A. Dodson, MD, NYU School of Medicine, 227 East 30th Street, New York, NY 10016, 646-501-2714, John.Dodson@nyumc.org.

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INTRODUCTION

The emerging field of geriatric cardiology reflects a shift in clinical practice as the typical cardiovascular (CV) patient is now much older than in the past with distinctive goals and complexities related to age.¹ Typical patients routinely present with coexisting geriatric syndromes that affect healthcare goals, care processes, and outcomes. Health systems and payers have also changed, with greater focus on patient-centered outcomes like function and quality of life. Whereas CV medicine continues to progress with technical advances, it is no longer as certain if and how they will align with shifts in patients and payers. Within this context, several programs in geriatric cardiology have been developed over recent years, although the precise definition of what constitutes both clinical practice and training in this field is still evolving.¹ Concomitantly, there has been a substantial increase in scholarship at the intersection of aging research and CV medicine: whereas even a decade ago the terms “geriatrics” and “cardiology” were seldom mentioned together in the scientific literature, this has changed markedly (Figure 1). We expect that in the near future this nascent discipline will continue to grow to keep pace with the burgeoning older demographic and the evolving needs of an aging population. In this context, the purpose of this review is to highlight the development of geriatric cardiology, its current state, and future directions.

THE DEMOGRAPHIC IMPERATIVE

Recently, there has been a marked increase in longevity in both North America and Europe.^{2,3} This trend is expected to continue; for example, in the U.S., between the years 2010 and 2050, the number of people over age 65 is expected to double from 40 million to over 80 million. One of the fastest growing segments of the population is individuals 85 years and older, whose numbers are expected to more than triple over the same time period (Figure 2A).³ In Canada, similar trends are expected (Figure 2B).⁴ Concurrent with this shift, there will be an increased prevalence of “geriatric impairments,” defined as multifactorial non-disease specific conditions including cognitive dysfunction, mobility limitations, frailty, and auditory and visual impairments.^{5,6}

WHY GERIATRIC CARDIOLOGY?

With a few exceptions, CV disease is a disease of aging.^{6,7} Coronary artery disease, hypertension, stroke, arrhythmias, and valvular heart disease all become more common with each passing decade,^{8,9} which is likely attributable to a combination of fundamental biological changes (e.g. telomere length, inflammation),¹⁰ cumulative effects of lifestyle (e.g. sedentary activity, smoking, diet),¹¹ and comorbidities (e.g. chronic kidney disease, diabetes).¹² The typical patient in practice in the U.S. and Canada is already an older adult,^{6,13} and cardiologists are faced with an increasing array of comorbidities and aging-related impairments that complicate traditional, guideline-based management.

Over recent decades, new medications for coronary artery disease (P2Y₁₂ inhibitors, statins, PCSK9 inhibitors), atrial fibrillation (new antiarrhythmic drugs, direct oral anticoagulants), and heart failure (aldosterone antagonists, angiotensin receptor blockers, neprilysin inhibitors) have both expanded clinicians’ armamentarium and complicated potential drug

regimens for older adults with multiple chronic medical conditions. Simultaneously, while traditional dogma was that after a certain age patients were “too old” to perform invasive cardiac procedures, recent decades have witnessed a substantial increase in the number of older adults undergoing an array of interventions including aortic valve replacement (both surgical and transcatheter approaches) for severe symptomatic aortic stenosis (AS),^{14,15} percutaneous coronary intervention (PCI) for acute myocardial infarction (AMI),^{16,17} left ventricular assist device (LVAD) implantation for advanced heart failure,¹⁸ and transcatheter mitral valve repair for severe mitral regurgitation.¹⁹ Multiple factors likely account for these trends, including wider dissemination of medical technologies, the development of less invasive procedures, and changing societal attitudes towards aggressive care in older adults.

Despite technological advances over time, the risk of both medication-related adverse events and procedural complications remains high among older adults.^{20–22} For example, in a trial of revascularization versus medical therapy for AMI, patients age 75 were over 3 times as likely to experience major bleeding with revascularization compared with younger patients.²⁰ Studies have also shown that after cardiac surgery, older patients have a markedly increased risk of acute kidney injury,²³ stroke,²⁴ and death^{21,22,25} compared with their younger counterparts. In addition, older adults experience more prolonged hospital stays and hospital readmissions after cardiac surgery.^{21,22} Despite these risks, some older adults have exceptional long-term outcomes after invasive procedures, and it remains difficult to identify which individuals will benefit.

In response to the increasing range of treatments available to older adults and the challenge of predicting benefit for individual patients, a 2011 White Paper in the *Journal of the American College of Cardiology* stated that “Mainstream cardiology has become, de facto, geriatric cardiology, but it still lacks a systematic approach that incorporates age-related complexities into clinical decision-making.”⁶ Accordingly, the authors recommended that providers develop “the skills needed to assess patient preferences, circumvent hazards of hospitalization, facilitate successful transitions from one care setting to the other, engage in useful risk-benefit discussions, and provide care collaboratively within a care team responsive to the needs of the oldest patients.”⁶ Geriatric cardiology as a discipline strives to meet this challenge by incorporating principles from geriatric medicine into routine clinical practice.

UNIQUE FEATURES OF OLDER ADULTS WITH CARDIOVASCULAR DISEASE

As early as the seventeenth century, Dr. Thomas Sydenham stated “a man is as old as his arteries”.²⁶ Changes both within and extrinsic to the CV system have an important influence on presentation, management, and outcomes in older adults. Within the CV system, there are numerous mechanisms on a cellular level that underlie the aging process including replicative senescence, apoptosis, protein misfolding, and inflammation.^{10,27–29} In the heart, studies have documented an aging-related increase in left ventricular mass,³⁰ increased left atrial size,³¹ myocardial collagen deposition,⁷ and calcium deposition in valvular structures and the coronary arteries.^{32,33} Within the vasculature, large artery stiffness increases with

age due to collagen overproduction, calcification, and endothelial dysfunction.³⁴ As a result of these changes and others, certain diseases are seen almost exclusively in older adults including isolated systolic hypertension, calcific AS, and senile cardiac amyloidosis. The prevalence of other conditions including coronary atherosclerosis, atrial fibrillation, and heart failure increases significantly with advancing age,^{35,36} and these conditions also commonly co-occur.

Outside the CV system, multimorbidity (≥ 2 concurrent diseases) is present in the overwhelming majority of older adults.³⁷ There is a well-established relationship between an increasing number of these conditions with adverse outcomes including hospital readmission, disability, and death.^{38,39} Numerous scenarios from everyday clinical practice illustrate the influence of multimorbidity on CV management: for example, weighing the risk of contrast-induced nephropathy in a patient with chronic kidney disease undergoing PCI; or considering the benefits of an implantable cardioverter defibrillator (ICD) for systolic heart failure in a patient with cancer. The application of evidence-based guidelines is limited in patients with multimorbidity, since many landmark clinical trials excluded these individuals.⁴⁰ Accordingly, in 2012 the American Geriatrics Society published guiding principles for management of older adults with multimorbidity that addressed five domains: patient preferences, interpreting evidence, prognosis, clinical feasibility, and optimizing therapies.⁴¹ These principles serve as a useful template to practice patient-centered care in the setting of limited clinical trial evidence. While overtreatment is a concern, older adults may also be undertreated due to potentially “ageist” attitudes (with belief that chronological age is a contraindication to treatments despite proven benefits),⁴² although evidence in a variety of cardiovascular disorders suggests that treatment in older adults is becoming more aggressive.^{14,16}

Research has shown that geriatric syndromes are common in practice among patients with CV disease.^{43,44} Cognitive impairment, including deficits in memory and executive function, is one of the most frequent and has a well-established relationship with poor outcomes in several CV conditions.^{43,45} For example, most studies report that cognitive impairment is present in over 25% of ambulatory older adults with heart failure,^{43,44} which may be due to impaired cerebral perfusion, heart failure-related diseases (atrial fibrillation, cerebrovascular disease), or other processes such as amyloid deposition or neurodegenerative disease. Irrespective of etiology, cognitive impairment in patients with heart failure has a meaningful impact on outcomes such as hospital readmission, especially when unrecognized.^{43,45} Among older adults with heart failure, management is further complicated by other common geriatric impairments which include incontinence (18–45%), falls (32–43%), and frailty (14–25%).^{46,47}

Frailty, generally defined as an increased physiologic vulnerability to stressors is another geriatric impairment associated with adverse outcomes in CV disease.^{48,49} Multiple instruments have been developed to measure frailty which has complicated standardization across institutions; however, the criteria developed by Fried et al. are among those most commonly cited.⁵⁰ While these criteria have been extensively validated, others have argued that a single measure (e.g. gait speed) is well-correlated with the frailty phenotype, and more efficient to use in everyday clinical practice.⁴⁸ The Short Physical Performance Battery

(SPPB) is another frailty measure that has been used in clinical settings, and has prognostic importance in heart failure populations.⁵¹

Frailty has become a prominent measure used to quantify risk among patients with AS being considered for an intervention, specifically in the area of transcatheter aortic valve replacement (TAVR).^{49,52} In the original PARTNER randomized trial, TAVR led to a remarkable absolute risk reduction (20%) compared with standard medical therapy; however, 31% of patients receiving TAVR still died within one year, underscoring the challenge of selecting which patients experience long-term benefit.⁵³ Following PARTNER, frailty has been identified as a syndrome that meaningfully predicts outcomes among older adults. A study by Green et al. of 159 older adults undergoing TAVR found that frailty was common (48%) and independently associated with 1-year mortality even after adjusting for other characteristics. Beyond TAVR, frailty has been assessed in patients with myocardial infarction and found to be significantly associated with recurrent CV events after adjusting for traditional risk factors.⁵⁴

Other geriatric impairments important in CV disease include functional disability, falls, incontinence, and depression (Table 1). For example, clinicians cite fall risk and the sequelae of traumatic intracranial bleeding as a major reason in withholding oral anticoagulants in patients with atrial fibrillation, although there is tremendous variation in this practice and no clear evidence to guide therapeutic decisions.⁵⁵ It is also unclear whether among patients with atrial fibrillation and frequent falls, devices designed to exclude the left atrial appendage are of particular benefit. These devices carry the risk of immediate post-procedural complications although theoretically they may obviate the need for long-term anticoagulation and therefore attenuate the risk of traumatic intracranial bleeding.

Polypharmacy, while not an impairment in the traditional sense, is also frequently classified among the conditions encountered in older adults that influence outcomes. While cutoffs for polypharmacy have varied in prior studies, one working definition is ≥ 4 chronic medications. Studies in the U.S. and Europe have shown that polypharmacy is present in over half of older adults⁵⁶ and associated with an increased likelihood of adverse drug events which can lead to sequelae including emergency department visits and hospitalizations.⁵⁷ In practice, a major goal of geriatrics has been addressing potentially inappropriate medications that can be stopped, and this approach is being adopted by geriatric cardiology as programs develop.

GERIATRIC CARDIOLOGY IN CLINICAL PRACTICE

In the context of the unique characteristics of older adults with CV disease described above, geriatric cardiology broadly aims to adapt health systems to improve care for these patients. Formal clinical programs in geriatric cardiology are still relatively rare, although we have witnessed several institutions (e.g. New York University, Vanderbilt University, University of Pittsburgh) start such endeavors in recent years. Simultaneously, a handful of training programs (e.g. McGill University, Vanderbilt University) have been developed with the aim of educating the next generation of geriatric cardiologists. These programs are still not officially accredited, although Bell et al. recently advocated for the development of “a

formalized geriatric cardiology skillset” which “would help providers who must immediately have the ability to facilitate effective care for older adults, rather than awaiting years of practice experience to develop practical gestalt.”¹ Regardless of what training model develops, the imperative for geriatrics training among medical subspecialists is evident; there has been a marked shortage of geriatricians in practice for decades, and in 2014 only 56% of U.S. fellowship positions in geriatrics were filled (compared with 99% of CV medicine fellowship positions).¹ On some level, this is related to discrepancies between the high demands of a practice tailored exclusively towards older adults, coupled with historically low reimbursement for this work.

Services provided in a geriatric cardiology outpatient practice may include both longitudinal care for older adults with CV disease, typically in patients with multiple comorbidities and geriatric impairments, as well as one-time consultations from other services within or outside cardiology (e.g. heart failure, structural heart disease, surgical subspecialties). Broadly, the geriatric cardiologist aims to provide coordinated care with other clinicians including medical and surgical subspecialists, physical therapists, and palliative care specialists where appropriate. Involvement of family caregivers and elicitation of patients’ goals of care also a critical part of management. Details of specific programs are provided below.

In the New York University program, for longitudinal care, the first-time visit involves a geriatric assessment including evaluation of upper and lower extremity strength, cognitive impairment, physical function, orthostatic vital signs, and fall history. Medications are reviewed in-depth and a pharmacist is available for in-person consultation with patients on the same day. Patients who are particularly complicated are discussed in a monthly multidisciplinary conference that includes cardiologists, geriatricians, and other relevant clinicians (e.g. surgeons, palliative care experts, neurologists) depending on the case. This team-based approach also aims to explicitly incorporate patients’ goals of care into decision making, as they are highlighted during the conference.

The Vanderbilt University program has paralleled a similar outpatient longitudinal care initiative focusing on providing patient-centered care for older adults. It performs a comprehensive geriatric assessment for all patients, in addition to standard cardiovascular assessment, to provide a more in-depth and accurate risk assessment prior to invasive procedures, as well as to provide a holistic approach to longitudinal management centered around patient goals. In addition, the clinic provides consultation for CV and primary care providers for symptoms across a range of geriatric syndromes that may have a cardiovascular cause (i.e. falls, dizziness, weakness, fatigue). Patients receiving care from the longitudinal practice are co-managed by the service in the hospital during an admission and are also reviewed in post-acute care facilities on discharge.

The University of Pittsburgh has a program with many features similar to those described at New York University and Vanderbilt, but with a distinctive configuration. The Geriatric Cardiology clinic is situated within both the Divisions of Geriatrics and Cardiology. In Geriatrics, consultations mostly guide decisions for a broad spectrum of cardiovascular medications, procedures, and management recommendations. The geriatric cardiologist

guides management within and outside the bounds of guideline standards, with patient-centered rationales to inform patients and their geriatricians. In contrast, within Cardiology the geriatric cardiologist is more specifically oriented to assessment of frailty, risk, and futility in relation to TAVR and procedure-centered management, and includes an emphasis on “pre-habilitation” before and cardiac rehabilitation after interventions. The geriatric cardiologist also works collaboratively with palliative care clinicians in order to refine a standardized approach to patient assessment and management recommendations.

In Canada, McGill University has a geriatric cardiology program that includes a fellowship open to physicians who have completed either geriatric or cardiology subspecialty training. These fellows work with other services including heart failure, structural heart disease, and inpatient consultation, and learn how to incorporate geriatric cardiology assessments into the inpatient and outpatient settings. Fellows participate in multidisciplinary patient conferences, and lend input pertinent to decision-making in the setting of geriatric impairments.

FINANCIAL ASPECTS OF GERIATRIC CARDIOLOGY

Both the U.S. and Canadian healthcare systems are facing enormous cost pressures, largely related to the care of older adults. Accordingly, the financial feasibility of large, integrated clinical programs in geriatric cardiology remains an area of debate, and may restrict rapid growth despite the demographic imperative outlined earlier. Geriatric cardiology faces much of the same obstacles as traditional geriatrics: visits can be long, with extensive assessment and counseling of patients who often have impairments that require extra efforts at communication to ensure comprehension. Caretakers often need to be incorporated into management plans, which increases the complexity of decision making and requires additional time either within or outside office hours. There is no well-reimbursed procedural “skill” in geriatric cardiology that would offset this extra time spent with patients.

In the U.S. and Canada, while the traditional payment model has been fee-for-service, reimbursement patterns are evolving and geriatric cardiology is well-positioned as a vehicle to globally improve outcomes among older adults while achieving institutional cost savings. This may occur in several ways: first, in the U.S., the Centers for Medicare & Medicaid Services Hospital Readmissions Reduction Program penalizes hospitals with excessively high risk-standardized readmission rates, including after AMI and heart failure.⁵⁸ These patients are normally seen by cardiologists, although many readmissions are non-cardiac.⁵⁹ Logically, improved knowledge and attention to geriatric impairments among clinicians with an expertise in both CV management and geriatrics may lead to a reduction in preventable readmissions: for example, stopping a beta blocker in a patient post-AMI with impaired chronotropic response who is also prone to falls; reducing medication complexity in a patient with heart failure and cognitive impairment; or encouraging cardiac rehabilitation in a patient post-AMI despite the presence of frailty..

FUTURE DIRECTIONS

In the U.S., groups of experts have been formed within the two major cardiology societies – the Geriatric Cardiology Section (American College of Cardiology) and the Cardiovascular Disease in Older Populations Committee (American Heart Association) – in order to promote scholarship and patient care in geriatric cardiology. Activities have included highlighting geriatric cardiology-related research at national meetings, leading patient advocacy efforts, creating educational opportunities for fellows, and coordinating panels of experts to generate recommendations that are specifically tailored to older adults with CV disease. Simultaneously, the American Geriatrics Society has a medical subspecialists section, has featured cardiologists at its national meeting discussing issues ranging from anticoagulation in older adults to TAVR, and recently collaborated with the American College of Cardiology and others to convene experts on the issue of multimorbidity in CV disease. We expect that collaborations will continue to develop between these U.S. societies, as well as those in Canada and elsewhere, in order to promote the field of geriatric cardiology to a wider audience.

Geriatric cardiologists may come to serve a critical role in decision making for complex patients who are candidates for invasive procedures. The most likely role would involve partnering with existing multidisciplinary teams that have been developed (TAVR and LVAD are two current paradigms). Through helping other clinicians to identify utility vs. futility for advanced therapies, and incorporating principles such as palliative care and explicit consideration of patients' goals, their involvement may serve as added value that will help teams to select patients who will benefit, versus those who will experience post-procedural decline.

We also expect that shared decision making, which involves the active participation of patients in critical health decisions⁶⁰ will continue to gain prominence in the management of older adults with CV disease. Surveys of older adults repeatedly demonstrate that they may prioritize health outcomes other than simply prolonging life^{61,62}, and treatment burdens weight heavily on their willingness to accept therapies. Decision aids, which provide realistic estimates of benefits and harms in a format that is easily understandable for most patients, can be effectively used as a tool to promote shared decision-making. These aids may help to define the “net clinical benefit” of CV therapies in an easily understandable way. Investigators at the University of Colorado have developed decision aids for both LAVDs and ICDs that are free for public use (<https://patientdecisionaid.org>).

CONCLUSIONS

Geriatric cardiology is still a young field with relatively few clinical programs, but we believe there is tremendous opportunity for growth in coming years as demographics continue to shift towards older, more complicated patients with CV disease. It is likely that a group of cardiovascular subspecialists will develop specific expertise in aging-related issues in order to become “geriatric cardiologists,” although the exact training pathway for this has yet to be determined. Efforts at the level of individual academic institutions and national

subspecialty societies underscore the momentum behind the need for improved CV care for older adults that can potentially be filled by geriatric cardiology programs.

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SUMMARY FOR ONLINE LISTING

Geriatric cardiology is a relatively new field aimed at adapting cardiovascular care to an aging population, by incorporating principles of geriatric medicine into the routine care of older adults with cardiovascular disease. In this review we discuss the rationale behind geriatric cardiology as a discipline, the unique characteristics of older adults with CV disease, features of current clinical programs, and future directions for the field.

Figure 1. Pubmed search of scientific manuscripts including term "geriatric cardiology" or terms "geriatrics" and "cardiology" from 2004–2014.

A.

B.

Figure 2.

A. Percentage of U.S. population over age 75 (projected), 2000–2050. (Reference: http://www.aoa.acl.gov/aging_statistics/future_growth/future_growth.aspx#age).

B. Percentage of Canadian population over age 75 (projected), 2000–2050. Reference: <http://www.un.org/esa/population/publications/worldageing19502050/pdf/059canad.pdf>)

Figure 3. Proposed elements of a geriatric cardiology outpatient visit

In a patient-centered approach, multiple domains are assessed and then integrated in order to determine optimal therapeutic options.

Table 1

Common geriatric issues encountered in cardiology clinical practice, with sample instruments used for assessment

Domain	Sample instruments
Frailty	<ul style="list-style-type: none"> • CHS/Fried frailty criteria⁵⁰ • Short physical performance battery (SPPB)⁶³ • Single-item assessment (e.g. grip strength or gait speed)
Cognitive impairment	<ul style="list-style-type: none"> • Montreal cognitive assessment (MOCA)⁶⁴ • Mini mental status examination (MMSE)⁶⁵ • Mini-Cog⁶⁶
Functional disability	<ul style="list-style-type: none"> • Katz Index of Independence in ADLs⁶⁷ • Lawton Instrumental ADLs Scale⁶⁸
Hearing impairment	<ul style="list-style-type: none"> • Hearing Handicap Inventory for Elderly-Screening (HHIE-S)⁶⁹ • Whispered voice test⁷⁰
Visual impairment	<ul style="list-style-type: none"> • Vision Screening Questionnaire⁷¹ • Visual Function Questionnaire (VFQ-25)⁷²
Falls and fall risk	<ul style="list-style-type: none"> • Fall frequency • Timed Get Up and Go test (TUG)⁷³ • SPPB⁶³
Incontinence	<ul style="list-style-type: none"> • 3 incontinence questionnaire (3IQ)⁷⁴
Polypharmacy, inappropriate medications	<ul style="list-style-type: none"> • Beers criteria⁷⁵
Multimorbidity (≥ 2 chronic medical conditions)	<ul style="list-style-type: none"> • Charlson Comorbidity Index⁷⁶
Depression	<ul style="list-style-type: none"> • Patient Health Questionnaire 2⁷⁷