



## Care of older adults

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### 1 Background

In the United States, approximately 40 million adults over the age 65 are affected by one or more forms of cardiovascular disease and it remains the leading cause of morbidity and mortality in this population.<sup>[1,2]</sup> Among older adults, therapeutic goals for cardiovascular diseases (CVD) are often confounded by comorbid diseases and/or conditions that dominate their overall sense of health and well-being.<sup>[1,2]</sup> Thus, even while CVD is usually considered a principal concern, management is often complicated by concomitant medical challenges. Whereas, evidence-based care is often premised primarily on goals to increase longevity, the circumstances associated with multimorbidities [e.g., cancer, chronic obstructive pulmonary disease (COPD), Parkinson disease, dementia, and chronic kidney disease] may undercut the perceived value of prolonging life. Thus, in addition to mortality benefit, other effects of cardiovascular (CV) therapy and/or management processes are important as well.

In addition to life prolongation, goals to preserve functional capacity (including cognitive and physical function), maintain independence and quality of life, reduce hospitalization, reduce pain, and moderate personal costs may all be just as or even more important from the patient's perspective. Therefore, decisions regarding cardiovascular treatment in older adults need to be individualized to each pa-

tient's overall health context, comorbid illness, functional status, life expectancy and personal preferences.<sup>[1-3]</sup>

Process of care is also particularly relevant to quality of care for older adults. Many older adults are burdened by sensory and/or cognitive limitations that limit their ability to hear, see, and/or understand their medical circumstances. Extra effort should be made to convey information in a manner that is accessible to each patient.<sup>[1,2]</sup>

Age-related changes impact the efficacy and complexity of providing standard CV therapies as well. Changes in pharmacokinetics, pharmacodynamics, metabolism, frailty and adverse events related to medications including increased prevalence of side effects (e.g., fatigue, changes in taste, dizziness, and depression) demand therapeutic approaches that are better attuned to each patient's particular state and physiologic capacities.<sup>[1,2,4]</sup>

The object of this review is to highlight the added complexity of managing CVD in an older adult population; specifically regarding key non-cardiac factors that affect health care delivery, management and outcomes including coexisting chronic comorbid conditions, geriatric syndromes (i.e., falls, visual and hearing impairment, delirium and cognitive impairment) and frailty.

Key points: (1) Care of older adults should be designed to better respond to a broader perspective of patient-centered concerns, and target not only improved longevity, but improved function, independence, and quality of life. (2) Optimal care of older adults' CVD requires consideration of pertinent non-CVD aspects of care that impact CVD progression and management. (3) Common problems which complicate CV management of older adults include comorbid diseases as well as issues related to aging, sensory changes (vision, hearing), frailty, falls, and dementia. (4) Activities of daily living (ADLs) and independent activities

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of daily living (IADLs) are critical for independent functioning. A change in these activities should warrant further investigations by the treating physician including assessment for cardiovascular [coronary artery disease (CAD), structural heart disease, etc.], neurological [dementia, cardiovascular accidents (CVA), transient ischemic attacks (TIA)], and psychiatric causes (depression, stress). (5) Falls in the elderly population can result in significant morbidity, mortality and functional decline. Identifying and addressing treatable/reversible causes of the falls should be undertaken as soon as the incident has occurred. (6) Vulnerable elders and their caregivers may benefit from referral to a geriatrician and/or an interdisciplinary geriatric team in the inpatient and outpatient settings. A geriatric assessment responds to the broad context of clinical complexity in older adults, and can often increase the potential to live more safely and independently despite the risks associated with disease and age.

## 2 Altered presentation of diseases

While chest pain remains the most common and important symptom of CAD, dyspnea in the absence of chest pain is a commonly reported symptom, particularly in older adults, women, and those with multiple comorbidities.<sup>[5,6]</sup> CAD symptoms may also include nonspecific problems, including fatigue, weakness, and decline in physical activity or function, so it is important to maintain a high-index of suspicion in those at risk.

The concept of altered presentation of disease among older adults applies to a number of conditions, including CAD. A lack of understanding of this phenomenon can lead to delays in diagnosis and treatment, and result in worse outcomes for older adults.<sup>[5,6]</sup> While chest pain remains a common and important symptom of heart disease, dyspnea in the absence of chest pain is even more commonly reported in older adults. In the Global Registry of Acute Coronary Events (GRACE) registry, dyspnea was the primary presenting complaint of CAD in nearly 50% of the participants ages > 85 years.<sup>[6]</sup>

Any medical illness may present nonspecifically and be multifactorial among older adults, particularly those in frail health. Nonspecific symptoms related to an underlying medical illness include changes in cognition, difficulty with balance and falls, new urinary incontinence, or a general change in functional ability. Older adults may also be less likely to report significant symptoms due to pre-existing conditions, cognitive impairment, or a desire to minimize symptoms. Likewise, health care providers may minimize complaints among older adults with complex medical illness or frail health.<sup>[2]</sup>

## 3 Multimorbidity

Cellular senescence, inflammation, oxidative stress, telomere attrition, telomerase activity, and apoptosis are biological factors underlying aging and the development and progression of CVD and can also provoke the development of other disease states over time.<sup>[7-9]</sup> The accumulation of chronic conditions as a result of genetics, lifestyle choices, environmental factors, treatment of prior conditions (e.g., CVA as a complication of coronary artery bypass grafting) and aging itself culminates in a vastly heterogeneous older population of adults with multiple medical problems.<sup>[2]</sup> The prevalence of multimorbidity (the coexistence of 2 or more chronic conditions) rapidly increases with age such that it occurs in over 70% of 75 or older.<sup>[2,10]</sup> In older adults with heart failure the burden of multimorbidity is significant with over 50% having 5 or more coexisting chronic conditions.<sup>[11,12]</sup> Clustering of multimorbidity occurs both at a CVD level, where heart failure frequently exists with ischemic heart disease, hypertension, hyperlipidemia, and atrial fibrillation and at the non-CVD level where heart failure is commonly associated with diabetes mellitus, arthritis, depression and frailty.<sup>[12,13]</sup> The impact of multimorbidity is particularly evident in the management of heart failure where increasing non-cardiac comorbid conditions is associated with an increase in re-hospitalization and mortality.<sup>[14]</sup> In addition, the societal cost of multimorbidity is substantial with increasing costs per number of chronic conditions such that individuals with 6 or more chronic conditions on average have over three times the spending compared to average per capita Medicare spending.<sup>[15]</sup>

## 4 Geriatric syndromes

Geriatric syndromes represent clinical conditions common in older adults that share underlying causative factors and involve multiple organ systems. Unlike traditional medical syndromes, they do not fit a discrete metabolic, pathological or genetic disease category.<sup>[16,17]</sup> Examples of geriatric syndromes include incontinence, cognitive impairment, delirium, falls, pressure ulcers, pain, weight loss, anorexia, functional decline, depression, and multimorbidity.

### 4.1 Delirium

Delirium affects over two million hospitalized persons each year and is estimated to affect between 25% and 60% hospitalized older adults. The hallmark of delirium is characterized by its acuity, fluctuating course, alteration in global cognitive function and reversibility. In addition, a

common feature relates to an altered level of consciousness resulting in both the familiar hyperactive and agitated form and more frequently (over 60% of cases) a more hypoactive and under-recognized phenotype.<sup>[18]</sup> Dementia and mild cognitive impairment, in contrast to delirium, feature a more chronic progressive course and may affect a more specific cognitive domain pattern. While patients with dementia are more at risk of developing delirium, it is frequently under-recognized and not adequately managed within that population. Delirium is associated with prolonged hospital stay, increased costs, increased readmission rate to the hospital (12%–65% at 6 months), and higher in-hospital and 1-year mortality.

The Confusion Assessment Method (CAM) offers a validated screening tool to diagnose delirium.<sup>[19]</sup> Per the CAM, delirium is likely present if the patient has both an acute onset with fluctuating course, inattention, and either disorganized thinking or altered level of consciousness.<sup>[19]</sup>

Key risk factors for delirium include older age, cognitive impairment, surgery, polypharmacy (especially medications with anticholinergic properties), infection, sensory impairment, psychoactive drugs, comorbid illness, and functional decline. Precipitating factors during an acute illness include hypoxia, electrolyte abnormalities, dehydration, malnutrition, medications, and alcohol withdrawal. Environmental factors also contribute to problems, including tethers such as catheters and IVs that contribute to risk of falls, noisy wards, and frequent tests and procedures that further disrupt diurnal rhythms and sleep.<sup>[20,21]</sup>

Key points: Delirium is a common complication of hospitalization and surgery among older adults. Assessing risk for delirium and implementing a multimodal intervention can prevent its onset. Identification of other potential hazards of hospitalization for older adults, including sleep disruption, dehydration, malnutrition, and immobility, can improve outcomes.<sup>[22]</sup>

## 4.2 Dementia

Dementia is prevalent in approximately 13% of community dwelling older adults over the age of 65 and increases to approximately 40% by the age of 80.<sup>[23]</sup> In adults over the age of 65 with a diagnosis of advanced heart failure these estimates can reach 30%–60%.<sup>[24]</sup> These figures likely underestimate the prevalence due to reduced patient and provider recognition of the disease, particularly in the early stages. The most common causes of dementia globally are Alzheimer's disease (AD) and vascular dementia which can also co-exist and result in a more progressive trajectory.<sup>[25]</sup> The presence of dementia significantly increases the financial cost, management complexity and mortality rates for an

older adult. In older adults who are classified as frail the prevalence of cognitive impairment is five times greater than those who are not frail. Moreover, the combination of these factors causes a more rapid decline in cognition and disability.<sup>[26]</sup> Hypertension and frailty also lead to a combined effect, with increased risks for the development of mild cognitive impairment, a prodromal phase of Alzheimer's type dementia. For an individual that has both HTN and mild cognitive impairment, institutionalization and mortality rates are similar to those with dementia and significantly higher than those with HTN alone.<sup>[27]</sup> Executive function, specifically, appears to be impaired in older adults with CVD and can dramatically reduce their capabilities to initiate and participate in their disease management.<sup>[28]</sup> High rates of unidentified cognitive impairment in older adults suggest that periodic screening is necessary to accurately establish future risk and determine benefits of simplification of treatment strategies.

## 4.3 Frailty

Frailty encompasses a biological decline across multiple interrelated organ systems and a subsequent loss of reserve in response to stressors, such as acute illness, and can result in a poor tolerance CVD and/or to CVD therapy.<sup>[29]</sup> Frailty is an independent predictor of a wide range of CVD including subclinical CVD, coronary artery disease, congestive heart failure and CVD mortality. Objective frailty, in the most part, refers to a phenotype that includes weight loss, exhaustion, weakness, slowness, and low levels of activity. In addition, cognitive impairment now appears to be a common and significant component of frailty and should be assessed for in combination with objective tools.<sup>[30]</sup> Currently, there is no widespread standard for assessment of frailty in the CV setting despite the recognition as a significant factor in the evaluation of an older adult with CVD. Many parameters can be used to assess frailty.<sup>[30]</sup> Despite the recognition of frailty as a significant factor in the evaluation of an older adult with CVD, there is no widespread standardized tool utilized for the assessment of frailty although numerous methods have been used.<sup>[30]</sup> Grip strength and gait speed are sensitive and frequently used physical functional measures, but faltering cognition, ADLs, and other deficits are also sometimes used to define frailty.<sup>[30,31]</sup>

Gait speed (defined as  $\geq 6$  s to walk 5 m in one notable study of older surgical patients) is probably the most commonly used frailty parameter, particularly due to its convenience.<sup>[32]</sup> Slow gait speed, is independently associated with mortality risk over time in patients with CVD, but the particular speed cut-points may vary with the specific populations.<sup>[33]</sup>

Frailty is relevant to all aspects of CVD management, including patients with aortic valve disease, heart failure, atrial fibrillation, and CAD. It is possible that patients categorized as frail may benefit from added precautions and/or cardiac rehabilitation, but these concepts remain to be proven.

#### 4.4 Sensory impairments (hearing and vision loss)

Hearing and vision loss are very common in the geriatric population, with more than 40% reporting difficulties with hearing, and more than 13% having visual impairment after the age of 65 years.<sup>[34]</sup> Age-related hearing loss or presbycusis, the most common type of hearing loss in older adults, is a multifactorial high frequency sensorineural hearing loss that commonly results in a component of impaired speech discrimination.<sup>[35]</sup> Cerumen impaction and chronic otitis media leading to conductive hearing loss may be present in up to 30% of elderly patients with hearing loss, and can be treated by the primary care clinician.

Patients, clinicians, and health care staff often do not recognize hearing loss, particularly in its early stages. Older adults may not volunteer difficulties associated with the hearing loss through a fear of social embarrassment. Implications include increased susceptibility to delirium, poor health literacy, and misdiagnosis of depression and/or dementia.

Screening is endorsed by most professional organizations, including the US Preventive Services Task Force. Despite the paucity of data evaluating routine screening for improving patient outcomes the role of any provider, commonly evaluating older adults for hearing changes has the potential to trigger appropriate evaluation.

## 5 Falls

Falls in the elderly population can result significant morbidity, mortality and functional decline. Defining the context of the fall and addressing treatable and reversible causes of falls should be undertaken as soon as the incident has occurred, however, the cause of falls in older adults tends to be multifactorial in nature and requires considerable time to unearth predominate driving factors for each event.<sup>[36]</sup> Older adults with CVD are particularly at risk of falling through the signs and symptoms associated with the disease process. Physiological changes in the aging cardiovascular system result in impaired reflexes, orthostatic hypotension, bradycardia, and impaired tolerance to activity. In addition, common CV conditions such as aortic stenosis, arrhythmias, and heart failure feature symptoms (i.e., dizziness, loss of consciousness, blood pressure drop) that may also result in

increased risk.<sup>[37]</sup> Falls occur frequently, and are dramatically more common in those with a prior history of falling. They can result in soft tissue injury, head injuries, fractures, including the most feared complication of a hip fracture, which occurs in 3%–5%.<sup>[38]</sup> In addition, far reaching repercussions can include reduced physical activity, reduced social engagement and social isolation through a fear for further falls. Fall prevention, especially in the home, can be challenging but risks (i.e., polypharmacy, hypotension, unrecognized sensory impairments) can be moderated with a coordinated care approach. Within a more structured environment of long-term and skilled care, Jensen *et al.* found that an interdisciplinary and multifactorial prevention program targeting nursing home residents, staff, and the environment can reduce falls and femoral fractures by approximately 12% suggesting fall reduction is possible and a multifaceted intervention approach may produce benefit.<sup>[39,40]</sup>

## 6 Geriatric review of systems

All clinicians, including cardiologists, need to understand the prevalence and impact of the various health problems in older adults. The so-called “geriatric syndromes” represent the most commonly occurring, but overlooked problems in the older patient.<sup>[41–43]</sup>

The following is a brief screen, which identifies potentially preventable or treatable conditions, and can be obtained from the medical record, the patient, or the caregiver. (1) Appetite: How is your appetite? Have you lost weight or are your clothes big on you? Do you have any trouble with the taste of food, chewing, or swallowing? Weigh at each visit and compare with prior weights over the course of 12 months. (2) Falls: Have you fallen in the last year? How often? Did you suffer any injuries? Where did you fall? Do you get dizzy when you stand up? Are you afraid of falling? Do you use a cane or walker? (3) Incontinence: Do you lose urine involuntarily/accidentally? Do you lose urine when you cough, laugh, or sneeze? Do you often have wetting accidents? Do you get up at night to urinate? (4) Medications: A complete medication history should be taken including over the counter and herbal therapies used. (5) Memory: Have you noticed a change in memory or found it difficult to complete tasks you usually do? Are you or a family member concerned about your memory? (6) Mood: Do you feel depressed? Have you lost interest in things that used to interest you? (7) Pain: Are you having any pain? Intensity, location, onset, duration, radiation, quality, and associated symptoms. (8) Sleep: Do you have difficulty falling asleep? Do you have any difficulty staying asleep? Are you excessively sleepy during the day?

Identifying the myriad of symptoms and problems often present in older adults can seem far beyond the scope of a cardiologist. However, geriatric syndromes often affect and in some cases are crucial to the management of heart disease. For example, certain cardiovascular medications increase problems with gait and balance (antihypertensive medication and orthostatic hypotension) and incontinence (loop diuretics). The cardiologist will also want to assess the patient's cognitive function, and their capacity for understanding treatment options and adhering to a treatment plan.<sup>[2]</sup>

Coordinated care between the cardiologist, primary provider, and other sub-specialists is critical for optimal care.<sup>[2]</sup> In addition, referral to a geriatric care assessment for a comprehensive assessment performed by an interdisciplinary team of providers can provide the expertise and care planning needed to navigate the typical difficulties of late life, and to best maintain independence.

A comprehensive geriatric assessment can be triggered by a cardiovascular provider for patients whose management is particularly encumbered by age-related complexity. It provides a multidimensional, interdisciplinary, diagnostic process to assess medical, psychological, and functional capabilities of older adults which can be applied as a means to develop a coordinated and integrated plan of treatment and long-term follow-up.

## 7 Disability, social support and processes of care

ADLs encompass activities required for successful independent living on a daily basis these tasks include bathing, grooming, transferring, toileting, eating and dressing. IADLs include relatively more advanced activities required on a more infrequent basis but still instrumental to remaining independent such as handling finances, shopping, preparing food, answering the telephone and transport.<sup>[44]</sup>

Disability and underlying physical, cognitive, and sensory limitations are not inevitable consequences of aging. Yet, approximately 20% of older US adults have chronic disabilities, 7%–8% have severe cognitive impairments, roughly one-third have mobility limitations, 20% have vision problems, and 33% have hearing impairments.<sup>[45]</sup> Women, minorities, and persons of low socioeconomic status are especially vulnerable. Routine screening for the ADLs and IADLs provides important opportunity to anticipate (and take steps to possibly modify) advancing disability and frailty.

Up to a third of hospitalized older adults experience a decline in their ability to perform ADLs in the course of their hospitalization.<sup>[46]</sup> Patients who experience declines in function during hospitalization have higher rates of rehospi-

talization, prolonged institutionalization, and mortality after discharge, and many (41%) never return to their preadmission level of function. The Assessing the Care of the Vulnerable Elderly (ACOVE) project has published specific quality measures to optimize outcomes in hospitalized older adults.<sup>[47]</sup>

Many older adults are burdened by sensory and/or cognitive limitation that limit their ability to hear, see, understand their medical circumstances, or access of health care services. Extra efforts to convey information in a manner that is accessible to each patient, overcome logistic constraints, and which facilitate patient-centered choices, in spite of intrinsic age-related limitations, are important aspect of care of older CVD patients.<sup>[2]</sup> Patient-centered goals of care in the elderly are critical to the personalized treatment approach for each patient. Older patients do not necessarily desire longevity as their sole outcome but may also have expectations about modifying pain, independent life or increasing function. Goals of care are different for each patient and depend on the patient condition and his/her expectations from life.<sup>[2,48]</sup>

Older adults with CVD and multimorbidity can become more dependent over time, frequently relying on family members to support these deficits. Primarily a spouse or adult child will become burdened with resulting social, physical and financial strains whilst negotiating a confusing and complex health care system on behalf of their loved one. Insufficient financial means, living far away, employment restrictions (caregiver) and different perceptions of the appropriate goals of care can result in significant stress among caregivers and in turn affect their ability to provide the required support and have a detrimental effect on their own health. Stress can complicate all aspects of life for frail older adults and their caregivers.<sup>[49]</sup> Key risk factors for caregiver stress include: (1) a caregiver who is also frail; (2) a patient with cognitive impairment, emotional disturbance, substance abuse, sleep disruption, or behavioral problems; (3) low income or financial strain; and (4) acute illness or hospitalization.<sup>[50]</sup> Caregiver stress is an important contributing factor to increased morbidity and mortality, and should prompt referral to team and community resources. Occasionally, these immense expectations and levels of stress can lead to neglect or abuse by their caregivers, especially when complicated changes in personality and behavioral issues seen in individuals with dementia.<sup>[51]</sup> Physicians should be attuned to both caregiver burden and burnout and consider the possibility of patient abuse by caregiver if circumstances and physical findings suggest it and should consider referral of the patient to a social worker, patient resource manager, or geriatric assessment team with the goal of helping the patient and the caregiver.

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## References

- 1 Bell SP, Orr NM, Dodson JA, et al. What to expect from the evolving field of geriatric cardiology. *J Am Coll Cardiol* 2015; 66: 1286–1299.
- 2 Forman DE, Rich MW, Alexander KP, et al. Cardiac care for older adults. Time for a new paradigm. *J Am Coll Cardiol* 2011; 57: 1801–1810.
- 3 Fried TR, Tinetti ME, Iannone L, et al. Health outcome prioritization as a tool for decision making among older persons with multiple chronic conditions. *Arch Intern Med* 2011; 171: 1854–1856.
- 4 Brenes-Salazar JA, Alshawabkeh L, Schmader KE, et al. Clinical pharmacology relevant to older adults with cardiovascular disease. *J Geriatr Cardiol* 2015; 12: 192–195.
- 5 Alexander KP, Newby LK, Cannon CP, et al. Acute coronary care in the elderly, part I: Non-ST-segment-elevation acute coronary syndromes: a scientific statement for healthcare professionals from the American Heart Association Council on Clinical Cardiology: in collaboration with the Society of Geriatric Cardiology. *Circulation* 2007; 115: 2549–2569.
- 6 Brieger D, Eagle KA, Goodman SG, et al. Acute coronary syndromes without chest pain, an underdiagnosed and undertreated high-risk group: insights from the Global Registry of Acute Coronary Events. *Chest* 2004; 126: 461–469.
- 7 Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part I: aging arteries: a “set up” for vascular disease. *Circulation* 2003; 107: 139–146.
- 8 Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part II: the aging heart in health: links to heart disease. *Circulation* 2003; 107: 346–354.
- 9 Lakatta EG. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part III: cellular and molecular clues to heart and arterial aging. *Circulation* 2003; 7: 90–97.
- 10 Arnett DK, Goodman RA, Halperin JL, et al. AHA/ACC/HHS strategies to enhance application of clinical practice guidelines in patients with cardiovascular disease and comorbid conditions: from the American Heart Association, American College of Cardiology, and U.S. Department of Health and Human Services. *J Am Coll Cardiol* 2014; 64: 1851–1856.
- 11 Braunstein JB, Anderson GF, Gerstenblith G, et al. Non-cardiac comorbidity increases preventable hospitalizations and mortality among Medicare beneficiaries with chronic heart failure. *J Am Coll Cardiol* 2003; 42: 1226–1233.
- 12 Forman DE, Ahmed A, Fleg JL. Heart failure in very old adults. *Curr Heart Fail Rep* 2013; 10: 387–400.
- 13 Held FP, Blyth F, Gnjjidic D, et al. Association rules analysis of comorbidity and multimorbidity: The Concord Health and Aging in Men Project. *J Gerontol A Biol Sci Med Sci* 2015; DOI: 10.1093/gerona/glv181 [published Online First: 27 October 2015].
- 14 Ather S, Chan W, Bozkurt B, et al. Impact of noncardiac comorbidities on morbidity and mortality in a predominantly male population with heart failure and preserved versus reduced ejection fraction. *J Am Coll Cardiol* 2012; 59: 998–1005.
- 15 Boyd CM, Darer J, Boult C, et al. Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases: implications for pay for performance. *JAMA* 2005; 294: 716–724.
- 16 Inouye SK, Studenski S, Tinetti ME, et al. Geriatric syndromes: clinical, research, and policy implications of a core geriatric concept. *J Am Geriatr Soc* 2007; 55: 780–791.
- 17 Tinetti ME, Inouye SK, Gill TM, et al. Shared risk factors for falls, incontinence, and functional dependence: unifying the approach to geriatric syndromes. *JAMA* 1995; 273: 1348–1353.
- 18 Inouye SK. Current concepts: delirium in older persons. *N Engl J Med* 2006; 354: 1157–1165.
- 19 Inouye SK, Van Dyck CH, Alessi CA, et al. Clarifying confusion: the Confusion Assessment Method. A new method for detection of delirium. *Ann Intern Med* 1990; 113: 941–948.
- 20 Inouye SK, Zhang Y, Jones RN, et al. Risk factors for delirium at discharge: development and validation of a predictive model. *Arch Intern Med* 2007; 167: 1406–1413.
- 21 Inouye SK, Charpentier PA. Precipitating factors for delirium in hospitalized elderly persons. Predictive model and interrelationship with baseline vulnerability. *JAMA* 1996; 275: 852–857.
- 22 Inoyue SK, Bogardus ST Jr, Charpentier PA, et al. A multi-component intervention to prevent delirium in hospitalized older patients. *N Engl J Med* 1999; 340: 669–676.
- 23 Kawas C, Gray S, Brookmeyer R, et al. Age-specific incidence rates of Alzheimer's disease: the Baltimore Longitudinal Study of Aging. *Neurology* 2000; 54: 2072–2077.
- 24 Pressler SJ, Subramanian U, Kareken D, et al. Cognitive deficits in chronic heart failure. *Nurs Res* 2010; 59: 127–139.
- 25 Gorelick PB, Scuteri A, Black SE, et al. Vascular contributions to cognitive impairment and dementia: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2011; 42: 2672–2713.
- 26 Robertson DA, Savva GM, Kenny RA. Frailty and cognitive impairment—a review of the evidence and causal mechanisms. *Ageing Res Rev* 2013; 12: 840–851.
- 27 Luppia M, Luck T, Weyerer S, et al. Prediction of institutionalization in the elderly. A systematic review. *Age Ageing* 2010; 39: 31–38.

- 28 Alosco ML, Spitznagel MB, van Dulmen M, *et al.* Cognitive function and treatment adherence in older adults with heart failure. *Psychosom Med* 2012; 74: 965–973.
- 29 Fried LP, Tangen CM, Walston J, *et al.* Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56: M146–M156.
- 30 Afilalo J, Alexander KP, Mack MJ, *et al.* Frailty assessment in the cardiovascular care of older adults. *J Am Coll Cardiol* 2014; 63: 747–762.
- 31 Rockwood K, Mitnitski A. Frailty defined by deficit accumulation and geriatric medicine defined by frailty. *Clin Geriatr Med* 2011; 27: 17–26.
- 32 Afilalo J, Eisenberg MJ, Morin JF, *et al.* Gait speed as an incremental predictor of mortality and major morbidity in elderly patients undergoing cardiac surgery. *J Am Coll Cardiol* 2010; 56: 1668–1676.
- 33 Green P, Arnold SV, Cohen DJ, *et al.* Relation of frailty to outcomes after transcatheter aortic valve replacement (from the PARTNER trial). *Am J Cardiol* 2015; 116: 264–269.
- 34 Gates GA, Cooper JC Jr, Kannel WB, *et al.* Hearing in the elderly: the Framingham cohort, 1983–1985. Part I. Basic audiometric test results. *Ear Hear* 1990; 11: 247–256.
- 35 Li-Korotky HS. Age-related hearing loss: quality of care for quality of life. *Gerontologist* 2012; 52: 265–271.
- 36 Kenny RA, O'Shea D. Falls and syncope in elderly patients. *Clin Geriatr Med* 2002; 18: xiii–xiv.
- 37 Jansen S, Bhangu J, de Rooij S, *et al.* The Association of Cardiovascular Disorders and Falls: A Systematic Review. *J Am Med Dir Assoc* 2015; Published Online First: Oct 8. DOI: 10.1016/j.jamda.2015.08.022.
- 38 Alexander BH, Rivara FP, Wolf ME. The cost and frequency of hospitalization for fall-related injuries in older adults. *Am J Public Health* 1992; 82: 1020–1023.
- 39 Jensen J, Lundin-Olsson L, Nyberg L, *et al.* Fall and injury prevention in older people living in residential care facilities. A cluster randomized trial. *Ann Intern Med* 2002; 136: 733–741.
- 40 Papaioannou A, Santesso N, Morin SN, *et al.* Recommendations for preventing fracture in long-term care. *CMAJ* 2015; 187: 1135–1144.
- 41 Chaudhry SI, Wang Y, Gill TM, *et al.* Geriatric conditions and subsequent mortality in older patients with heart failure. *J Am Coll Cardiol* 2010; 55: 309–316.
- 42 Elsayy B, Higgins KE. The geriatric assessment. *Am Fam Physician* 2011; 83: 48–56.
- 43 Ellis G, Whitehead MA, O'Neill D, *et al.* Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database Syst Rev* 2011; CD006211.
- 44 Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. *J Am Geriatr Soc* 1983; 31: 721–727.
- 45 Freedman VA, Martin LG, Schoeni RF. Recent trends in disability and functioning among older adults in the United States: a systematic review. *JAMA* 2002; 288: 3137–3146.
- 46 Gill TM, Allore HG, Holford TR, *et al.* Hospitalization, restricted activity, and the development of disability among older persons. *JAMA* 2004; 292: 2115–2124.
- 47 Min LC, Wenger NS, Reuben DB, *et al.* A short functional survey is responsive to changes in functional status in vulnerable older people. *J Am Geriatr Soc* 2008; 56: 1932–1936.
- 48 Case SM, O'Leary J, Kim N, *et al.* older adults' recognition of trade-offs in healthcare decision-making. *J Am Geriatr Soc* 2015; 63: 1658–1662.
- 49 Kasuya RT, Polgar-Bailey P, Takeuchi R. Caregiver burden and burnout. A guide for primary care physicians. *Postgrad Med* 2000; 108: 119–123.
- 50 Mittelman MS, Ferris SH, Shulman E, *et al.* A family intervention to delay nursing home placement of patients with Alzheimer disease. A randomized controlled trial. *JAMA* 1996; 276: 1725–1731.
- 51 Paris B. Abuse and neglect.... ..so prevalent yet so elusive. *Geriatrics* 2003; 58: 10.