The Geriatrician's Perspective on Surgery in the Geriatric Population

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The Geriatrician's Role

Geriatricians play a unique role in the care of older patients who are preparing for surgery. They may supply insight as a primary care provider and/or provide specialized recommendations in the pre- and postoperative care of a patient. Geriatricians have clinical skills in caring for a heterogeneous older adult population in different care settings. Geriatricians entering into practice, in and across all care settings (hospital, home office, and long-term care and subacute rehabilitation facilities), are able to provide patient-centered care that optimizes function and/or well-being; prioritize and manage the care of older patients by integrating the patients' goals and values, comorbidities, and prognosis into the practice of evidence-based medicine; assist patients and families in clarifying goals of care and making care decisions; coordinate health care and health-care transitions for older adults with multiple chronic conditions and multiple providers; provide comprehensive medication review to maximize the number of medications and adverse events; provide geriatrics consultations and comanagement; and collaborate and work as a leader or member of an interprofessional healthcare team. All these skills potentially add value to the anesthesiologist [1]. Many of the problems and issues that arise in caring for older adults are common and complex enough that expertise would be a benefit to the patient (Table 8.1).

There is great heterogeneity and variability in aging. Age is a demographic variable used as a surrogate to reflect medical complexity, disease burden, frailty, and physiologic decline in many organ functions. Some members of the oldest old (defined as people age 85 and above) maintain high physical function and should not necessarily be regulated to non-operative management. Caution should be given in ensuring chronological age itself is not used as a tool to determine treatment choices. Geriatricians balance a deep respect for the potential harms of interventions with the potential benefits given a patient's individualized life trajectory. In this chapter, we identify aspects of the geriatrician's role and assessments that may improve perioperative care.

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Geriatric Medicine

What makes geriatric medicine different from, say, internal medicine and family medicine? There is not an absolute singular answer even among geriatricians themselves. However, most geriatricians will identify some commonalities: a focus on our patient's functional capacity, identifying the presence of geriatric syndromes and its impact on function, and comfortably and effectively working in multidisciplinary teams to maximize our patient's function [3]. All three of these aspects are important to the management of older adults in perioperative care.

Functional Assessment

Geriatricians are originally trained in family medicine or internal medicine and are able to evaluate chronic medical conditions that are prevalent in older adults such as heart failure, diabetes, or chronic kidney disease. Geriatricians will also routinely assess patients in terms of functional status and identify geriatric syndromes (see below) that may impede maximal functional abilities. Studies have shown an association between functional dependence and mortality after surgery [4–6]. Functional status is one of the most important predictors of outcomes after anesthesia. In general, low levels of function and functional dependence were associated with postoperative complications and operative mortality.

The geriatric assessment extends beyond the traditional medical evaluation and management of medial illnesses. It involves an evaluation of issues including physical, cognitive, affective, social, environmental, and spiritual aspects that may have a great impact on older adult's life. The goal of such an

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Table 8.1 Geriatrician's specialized clinical skills and knowledge

Physiology of aging
Geriatric syndromes
End-of-life care
Preventive gerontology
Ability to provide patient-centered care to older adults with complex health issues such as multimorbidity, frailty, and disability
Ability to care for older adults across multiple settings from outpatient to the hospital to the nursing home to the home
Desire and skill to work in interdisciplinary care teams
Commitment to advocate for the best care for older adults
Ability and desire to provide clinical care to the full heterogeneous range of older adults: from the robust to the frail to the dependent

Based on data from Ref. [2]

Table 8.2 The comprehensive geriatric assessment (CGA)

Functional capacity assessment of activities of daily living and instrumental activities of daily living
Fall risk and mobility assessment
Cognitive assessment
Affective and mood assessment
Polypharmacy
Social support and environmental assessment
Nutrition and weight change
Urinary continence
Vision impairment
Hearing impairment
Goals of care and advanced care preferences

The CGA is an evaluation and diagnostic framework that seeks to maximize functional status by identifying and treating the presence of common geriatric syndromes and conditions common to frail older adults

assessment is to delay the onset of functional impairment while maintaining the highest level of independence, autonomy, and quality of life possible over a patient's life course.

The comprehensive geriatric assessment (CGA) is a tool that is familiar to all geriatricians. It is an evaluation and diagnostic framework that aims to maximize function by identifying common conditions such as geriatric syndromes and issues that reduce quality of life. Table 8.2 captures the core aspects of almost all CGAs. CGAs may vary by having additional components in the assessment.

The use of CGAs in community-dwelling older adults guides management that in turn results in a decrease in mortality and a reduction in functional decline [7, 8]. However, there is significant variability in the implementation of CGAs in the outpatient environment. Positive results come from programs where a greater number of recommendations are implemented compared to those where there is limited or no implementation of recommendations [9]. In hospitalized older adults, care that is based on CGAs provided more consistent benefits in comparison to standard medical care. A Cochrane Review shows subjects who received CGA were more likely to be alive and in their own homes throughout the surveillance period (median 12 months). Hospitalized subjects who received CGAs were also less likely to be institutionalized, were less likely to suffer death or deterioration, and were more likely to experience improved cognition compared to the usual care group. These effects are consistently demonstrated from trials of geriatric wards (patients admitted directly to the specialist geriatric team) but not replicated in trials of geriatric consultation teams where the geriatric team passes on their recommendations to the primary team and may or may not be involved in delivering direct care [10]. Again, trials showing the most clinically and statistically significant improvement in mortality and functional decline are where recommendations are implemented.

Figure 8.1 illustrates the concept of maximizing function and using aspects of the CGA to achieve that goal. Over time older adults will experience a decline in function due to physiologic changes and conditions that are prevalent among older adults. Many of these changes and conditions are chronic, and cure is not possible. However, mitigating the impact of each condition may be enough to maintain one's level of function above the threshold of losing independence.

Geriatric Syndromes

Geriatric syndromes are multifactorial health conditions that occur when the accumulated effect of impairments in multiple different systems renders an older adult vulnerable to situational challenges [11]. These situational challenges can be a change in an environment such as a hospitalization or an acute exacerbation of a chronic medical condition.

A key aspect of geriatric syndromes is that underlying risk factors often overlap with other fields of medicine (e.g., physical therapy or occupational therapy) because the syndrome is impacted by different physiologic systems. An example of a geriatric syndrome is falls. It is easy to imagine how the decline illustrated in Fig. 8.1 could contribute to falls. Assessment of physical deconditioning, cognition, the physical home environment, medications, and social support all involves different systems and assessment from different specialties. Intrinsic and extrinsic risk factors are identified with the goal of mitigating each risk factor's impact on the geriatric syndrome. Risk factors are often not reduced to zero, but its impact on overall function can be lessened where the cumulative effects have a significant positive impact similar to what is illustrated in Fig. 8.1, Panel b.

Delirium can be used to exemplify this above concept. Delirium occurs not uncommonly in hospitalized older adults and often has multifactorial causality. The Hospital Elder Life Program (HELP) is a multifaceted nonpharmacologic intervention that addresses some of the risk factors that contribute to developing delirium. Table 8.3 outlines HELP's interventions. The HELP interventions have been shown to reduce delirium [12]. More importantly, HELP has been shown to be

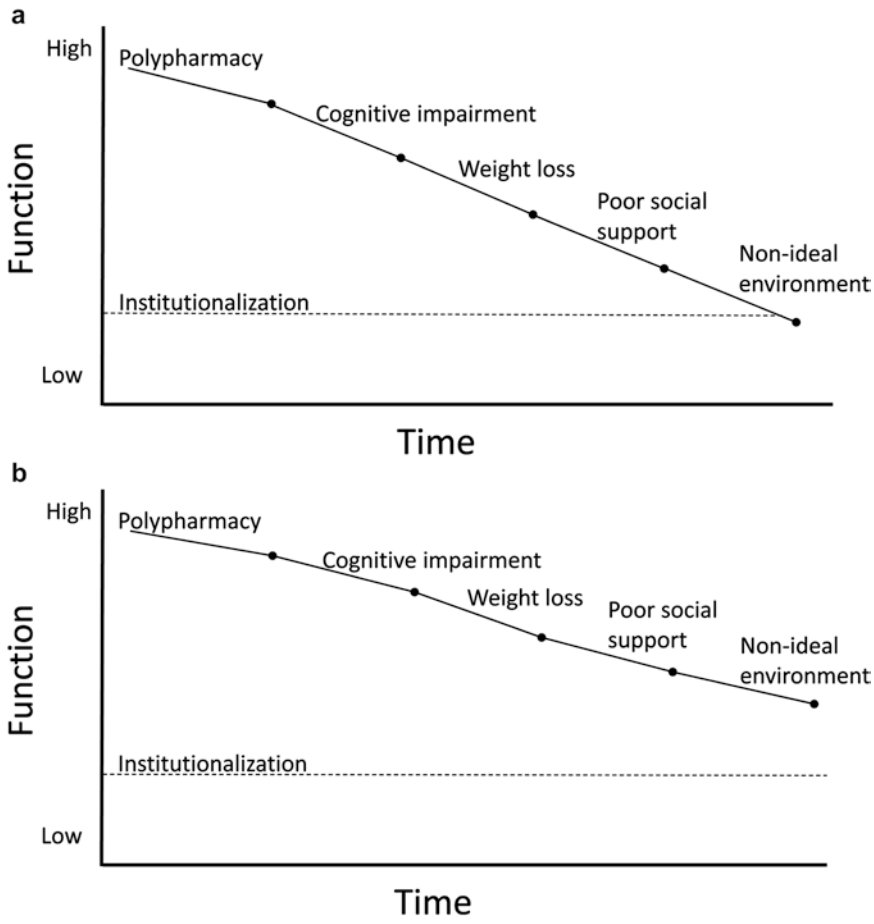


Fig. 8.1 Preservation of maximal function. Preserving high levels of function for as long as possible is one of the goals for geriatric medical care. The *dotted line* represents a low level of function where some form of institutionalization may be required. The comprehensive geriatric assessment is an evaluation and diagnostic framework that aims to maximize function by identifying common conditions such as geriatric syndromes and issues that reduce quality of life. Panel (**a**) shows how common issues can have an impact upon function over time. Panel (**b**) shows those same conditions being mitigated as represented by a change in the slope of the line. The impact of these conditions on function has been lessened, and loss of independence is delayed

dose dependent [13]. The more the risk factors mitigated, the better the results.

In 2012, the American College of Surgeons (ACS) NSQIP and the American Geriatrics Society (AGS) published "Optimal Preoperative Assessment of the Geriatric Surgical Patient: A Best Practice Guidelines." The preoperative domains addressed were those most likely to affect the elderly, including cognition, frailty, polypharmacy, nutrition, and social support [14]. In the following sections, we will be addressing these areas from a geriatrician's perspective.

Interprofessional Care

Many aspects of the geriatric functional assessment require multidisciplinary input. The CGA as outlined above is an inherently multidisciplinary diagnostic and treatment process. The geriatrician identifies the need for mitigating the risk factor's impact on functional decline but then recruits the necessary discipline to evaluate and recommend a treatment course that is integrated into a patient-centered care plan.

Another central task of geriatricians is to coordinate care among several subspecialists and to define, sustain, and communicate clear goals of treatment to all providers involved. In addition to coordinating subspecialist providers, geriatricians must generally work in multidisciplinary teams. Their training and clinical practice often includes long-term care, rehabilitation, and hospice facilities where there is daily side-by-side collaborative care in furthering the patients' goals. Geriatricians' collaborative care coordination among family members, nurses, nurse practitioners, therapists, aides, social workers, and others is a particular skill that is not usually taught in physician training. When a patient depends on others, the patient's physician should have a working knowledge of who is providing that help. In fact, most older adults depend on many individuals to maintain function and independence. The decisions as to whether an older adult should live at home alone, drive independently, or proceed with surgery with anticipated postoperative rehabilitation all can be improved by multidisciplinary input.

Table 8.3 Hospital Elder Life Program (HELP)

Targeted delirium risk factor	Standardized intervention
Cognitive impairment	Orientation protocol: board with names of care-team members and day's schedule; communication to reorient to surroundings Therapeutic-activities protocol: cognitively stimulating activities three times daily (e.g., discussion of current events, structured reminiscence, or word games)
Sleep deprivation	Nonpharmacologic sleep protocol: at bedtime, warm drink (milk or herbal tea), relaxation tapes or music, and back massage Sleep-enhancement protocol: unit-wide noise-reduction strategies (e.g., silent pill crushers, vibrating beepers, and quiet hallways) and schedule adjustments to allow sleep (e.g., rescheduling of medications and procedures)
Immobility	Early-mobilization protocol: ambulation or active range-of-motion exercises three times daily; minimal use of immobilizing equipment (e.g., bladder catheters or physical restraints)
Visual impairment	Vision protocol: visual aids (e.g., glasses or magnifying lenses) and adaptive equipment (e.g., large illuminated telephone keypads, large-print books, and fluorescent tape on call bell), with daily reinforcement of their use
Hearing impairment	Hearing protocol: portable amplifying devices, earwax disimpaction, and special communication techniques, with daily reinforcement of these adaptations
Dehydration	Dehydration protocol: early recognition of dehydration and volume repletion (i.e., encouragement of oral intake of fluids)

Based on data from Ref. [12]
Multicomponent nonpharmacologic interventions for the management of six risk factors for delirium: cognitive impairment, sleep deprivation, immobility, visual impairment, hearing impairment, and dehydration. HELP has been shown to reduce delirium incidence

Goal Setting and Hospitalization-Associated Disability

Goal Setting

It is important to ensure that the patient's goals for care and expectations are in line with anticipated outcomes prior to both elective and nonelective surgical procedures in older adults. The surgical intervention is only the beginning of a longer course to recovery for many older adults. Approximately 65% of Medicare patients who had a lower-extremity joint replacement surgery required stays in either a skilled nursing facility or inpatient rehab after surgery [15]. Incorporating discussions about the typical clinical course after surgery should be an important part of informed consent for surgery. A priority should be placed on understanding the patient's goals and expectations for surgery.

The concept of *lag time to benefit* is helpful when thinking about goals of care for older adults [16]. Lag time to benefit refers to the time between the intervention (in this case surgery) and when positive health outcomes are received (e.g., improvement in mobility, cure from cancer, prevention of repeated bouts of cholecystitis). In other words, lag time to benefit addresses the question "when will it help my patient?" The model was originally intended for decisions of outpatient preventive interventions, such as cancer screening, but can be adopted for decisions regarding surgical interventions. One would expect that most surgical interventions have an immediate benefit. However, when extensive rehabilitation is required before the primary goal is achieved (e.g., improved function), surgery may not be the ideal solution.

Figure 8.2 illustrates a stepwise approach in helping to determine the benefits of offering interventions in older adults. This model incorporates life expectancy, the lag time to benefit, and patient preferences. It is important to elicit your patient's preferences whenever you are delivering care and is most essential when the risks and benefits for a particular intervention are not straightforward.

It can be difficult to estimate life expectancy. Although age is an important factor in life expectancy, it is not the only predictor. At any given age, an older adult's life expectancy may be shortened by comorbidities or decreased functional status (i.e., dependence for activities of daily living) [17]. Life expectancy is also shortened by the presence of frailty. Although most clinicians will have a general clinical gestalt about any given individual's life expectancy, incorporating different mortality models based on demographic variables can provide for a more standardized discussion based on evidence. Many models exist that attempt to prognosticate mortality and life expectancy. These models differ in the cohorts that generate the data for their modeling and range from community-dwelling to hospice cohorts and have variable time frames (months to a decade). ePrognosis (Fig. 8.3) is an application that incorporates many of these models into a simplified step-by-step process in estimating mortality [18, 19]. By inputting patient demographic variables, one can get an estimate of mortality risk for patients in the realm of days to years based on location of care and other patient-specific factors.

Avoiding chronic debility, morbidity, and poor quality of life is often more important to older adults than staying alive. Understanding the patients' hierarchy of what is important in their lives and their goals is a key component of shared decision-making in medicine and not solely regarding surgery. If a patient is not willing to live in a skilled nursing facility, even for a short period of time, it may not be helpful to have them undergo an elective procedure such as posterior spinal fusion that might require such a stay. Alternately, delineating that the patient highly values independence may lead one to recommend such a procedure that could improve their mobility and ability to participate in self-care for the

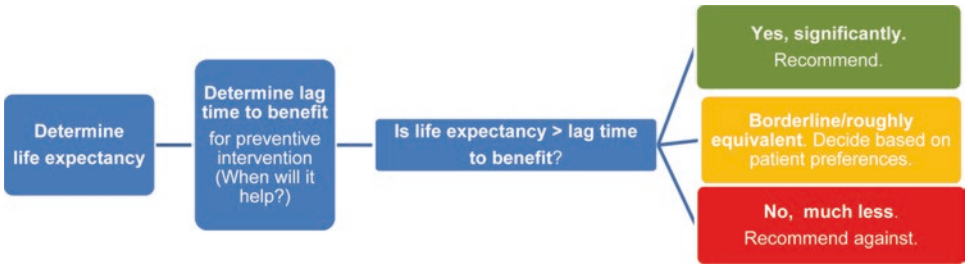


Fig. 8.2 A stepwise approach in helping to determine the benefits of interventions in older adults

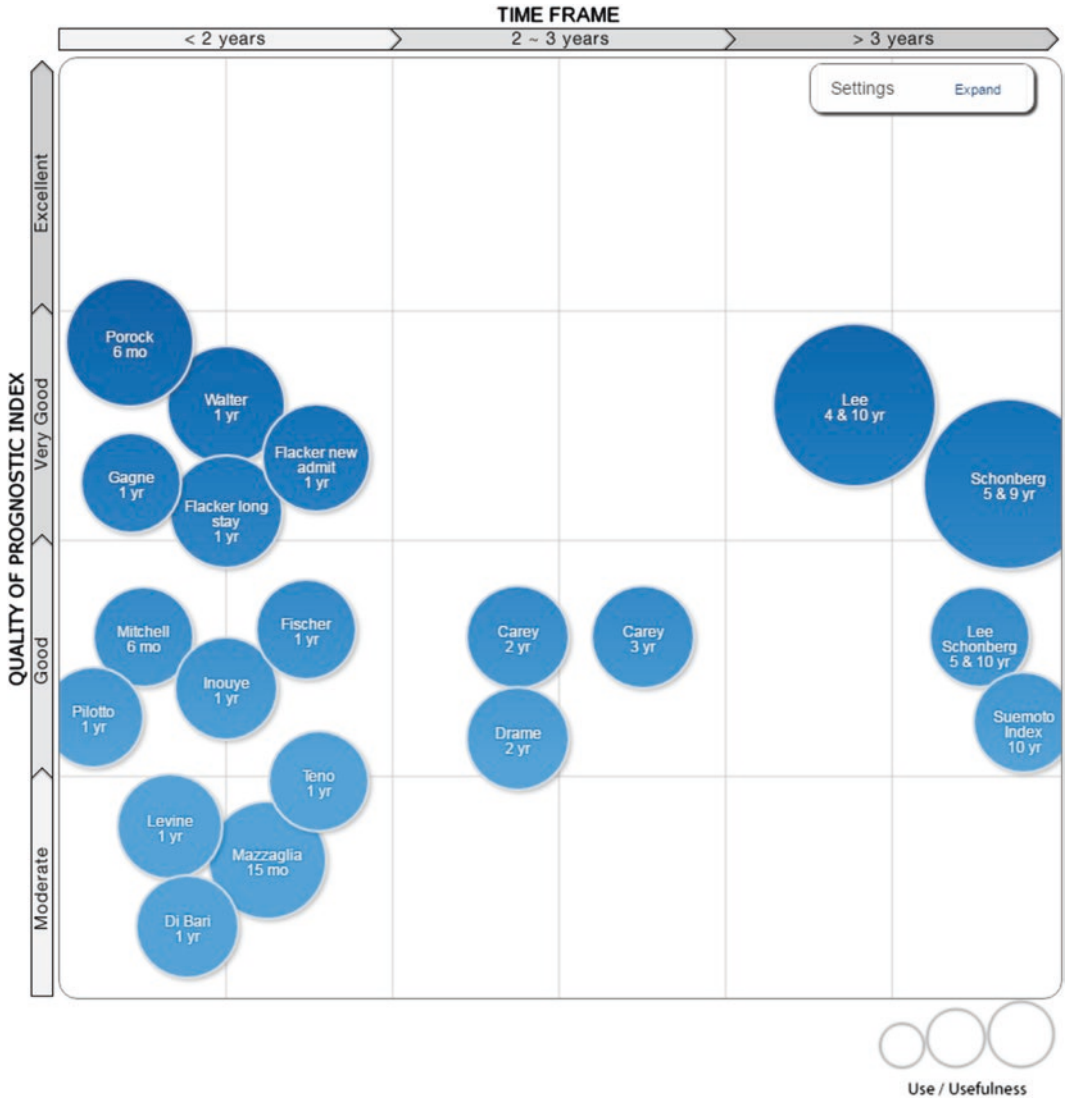


Fig. 8.3 A bubble view of the different models incorporated into ePrognosis. ePrognosis is a repository of published geriatric prognostic indices [18]. Each bubble represents a different prognostic model. The size of each bubble represents the cohort size of the model. The x-axis represents the duration of years of the studied cohort, and the y-axis represents the quality of the data. For example, the Lee SJ et al. model is derived from a cohort of 11,701 community-dwelling older adults and validated in 8009 Health Retirement Survey interviewees and provides all cause 4- and 10-year mortality estimates [20]. The information on patients' prognosis is intended as a rough guide to inform clinicians about possible mortality outcomes and is not intended to be the only basis for making care decisions, nor is it intended to be a definitive means of prognostication (Created using ePrognosis: http://eprognosis.ucsf.edu/index.php)

long term. If a patients' main goal is quality of life or comfort, then their acceptance of risk of discomfort or complications from a procedure with a lower potential to add quality years would be lower.

To find out a patient's preferences, one can simply start by asking the patient the following question: Is one of the following goals more important to you than anything else: (1) Living as long as possible? (2) Keeping your ability to care for yourself and live independently? (3) Keeping comfortable, with minimal symptoms? If the discussion is not straightforward, consultation with a palliative medicine specialist, a geriatrician, or a provider who either has a strong rapport with the patient or with experience in goals of care discussions can be helpful [21].

Hospitalization-Associated Disability

An important part of the discussion of potential treatments is letting patients know what the potential next steps are and expected outcomes after a procedure, including recovery time in the hospital, estimated time in a rehabilitation facility, and frequency and timing of follow-up. Hospitalizations itself is commonly associated with functional loss in older adults. Hospitalization-associated disability is the loss of the ability to perform one of the basic activities of daily living (ADLs) and occurs between the onset of the acute hospitalization and discharge from the hospital [22]. Declines in ability to perform ADLs and mobility after hospitalization are common [23–27]. Age is the most important risk factor [28]. Thirty-five percent of patients declined in ADL function between baseline and hospital discharge in a prospective observational study of nearly 3000 patients aged 70 and older (mean age of 80) hospitalized to medical services. This rate of functional decline had a striking relationship with age, with rates exceeding 50% in patients aged 85 and older [28]. Similarly, in another prospective observational study in medical patients involving over 2000 patients, 40% of older adults continued to have a new or additional disability in ADL at 3 months post discharge compared to prior to admission. At 1 year, nearly a third of patients still had not recovered their prior function [23].

Striking reductions in mobility after hospitalizations for older adults are also seen. Nearly 500 hospitalized medical patients aged 70 and older followed prospectively showed that low mobility and bed rest were common [24]. Using average mobility level, scored from 0 to 12, the low mobility group was defined as having a score of 4 or less, high as higher than 8, and bed rest was assigned a score of 0. Complete bed rest episodes occurred 33% of patients. The development of new functional decline, becoming newly institutionalized, and having in-hospital death were all shown to have an inverse relationship with the initial level of mobility. In other words, the lower one's mobility, the worse the outcomes.

Similar results were shown in a separate observational prospective study involving nearly 700 community-dwelling 65 years or older surgical and nonsurgical patients. On average, patients hospitalized for any reason experience decline in mobility [25]. Patients with a nonsurgical admission had little to no recovery of mobility to their baseline even after 2 years. Interestingly, surgical patients had better mobility before admission and recovered to at least their preadmission mobility within a year of hospitalization. The authors speculated that preoperative screening helped to determine the best candidates for surgical procedures.

Sager et al. developed a simple instrument to help identify patients at risk of functional decline following hospitalization. The Hospital Admission Risk Profile (HARP) was developed and validated in two separate cohorts from four university and two private nonfederal acute care hospitals [29]. Using logistic regression analysis, the authors identified increasing age, lower admission Mini-Mental Status Exam scores, and lower preadmission IADL were independent predictors of functional decline. A scoring system was developed for each predictor variable, and patients were assigned to low-, intermediate-, and high-risk categories (Table 8.4). The HARP reinforces the value of identifying prior cognitive function and physical function as markers of

Table 8.4 The Hospital Admission Risk Profile (HARP)

Variable	Risk score
Age	
<75	0
75–84	1
≥85	2
Cognitive function (abbreviated MMSE)[a]	
15–21	0
0–14	1
IADL function prior to admission[b]	
6–7	0
0–5	2
Total score	
Risk categories	**Total score**
High risk	4–5
Intermediate risk	2–3
Low risk	0–1

Based on data from Ref. [29]]

An instrument that can be used to identify patients at risk of functional decline following hospitalization

[a]Abbreviated Mini-Mental State Exam includes only the orientation (10 items), registration (3 items), attention (5 items), and recall (3 items) portions of the original 30-item test

[b]A person is judged independent in an activity if he/she is able to perform the activity without assistance. A person is scored dependent if he/she either does not perform an activity, requires the assistance of another person, or is unable to perform an activity. IADL activities include telephoning, shopping, cooking, doing housework, taking medications, using transportation, and managing finances

posthospitalization outcomes. Other authors have also demonstrated that including information from short multidimensional prognostic assessments identifies older adults most likely to develop hospitalization-associated disability [30, 31].

There are multiple other tools available to assess for functional status. As recommended by the American College of Surgery/American Geriatric Society Guidelines, one can quickly screen for functional status at baseline [14]. One can ask patients these four screening questions:

1. Can you get out of bed or chair yourself?
2. Can you dress and bathe yourself?
3. Can you make your own meals?
4. Can you do your own shopping?

Deficits in any of these areas should prompt a more in-depth look at functional status and involvement of physical and occupation therapy as well as a geriatrician to further assess for reversible factors and help assess expected trajectory after surgery. A number of interventions have been implemented to reduce the incidence of hospitalization-associated disability. Many of these interventions are multidimensional addressing cognitive function, sensory impairment, mobility, nutrition and hydration, and limiting iatrogenesis [32].

Geriatric Syndromes

There is a growing recognition that geriatric syndromes such as cognitive impairment, sensory impairment, falls, malnutrition polypharmacy, and frailty have an impact on surgery and postoperative outcomes. Screening for many of these syndromes in the preoperative assessment is considered the best practice.

Cognitive Impairment

Cognitive impairment is common among older adults and includes both dementia and mild cognitive impairment. The prevalence of dementia increases with age. In persons 71–79 years old, the prevalence is 5% and increases to nearly 25% in those 80–89 years old and 37% in those 90 years old and older [33]. Mild cognitive impairment (MCI) is a state of cognitive function where the impact is not severe enough to interfere with essential daily tasks referred to as instrumental activities of daily living (IADLs) (e.g., medication management and finances). Dementia, however, is severe enough cognitive impairment that it impairs one's abilities to manage their own IADLs and eventual basic ADLS (e.g., dressing, bathing, etc.). MCI is classified into two subtypes, amnestic and non-amnestic. Amnestic MCI is clinically significant memory impairment that does not meet the criteria for dementia. Non-amnestic MCI is characterized by a decline in function in other non-memory cognitive domains such language or visuospatial skills. The rate of progression of MCI to dementia is uncertain [34]. MCI prevalence widely varies because of differences in the definition of MCI and methods used to determine cognitive impairment and ranges from 3% to 42% in adults 65 years and older [33].

Older adults with cognitive impairment have higher postoperative mortality and are at higher risk of postoperative delirium with potential for chronic impact on cognition and postoperative cognitive dysfunction (Chap. 30, Postoperative Delirium and Cognitive Dysfunction) and institutionalization. A systematic review found that cognitive impairment (defined as a chart diagnosis of dementia) was an independent predictor of postoperative mortality with risk of death ranging from 1.8 to 5.8 times higher compared to those without cognitive impairment [21]. Delirium risk in those who are cognitively impaired increases by two- to seventeen-fold, and the risk of nursing home placement on discharge doubles in comparison to those who are cognitively intact [21]. A discussion of the increased risk of delirium, discharge to a skilled nursing facility, and mortality should be included as part informed decision-making for patients with cognitive impairment and their families.

Screening for baseline cognitive impairment can help identify individuals whom collateral informants are needed to ensure accurate history of medical history and medication list. A validated quick screening tool for cognitive impairment is the Mini-Cog [35]. This tool involves a three item recall and a clock draw (Fig. 8.4). Another useful validated clinical tool is the Ascertain Dementia 8-item Informant Questionnaire (AD8). The AD8 can be used in a questionnaire form and is filled out by informants rather than the patient [36]. The AD8 can be particularly helpful in seeking corroborative history for dementia and can be used clinically over the phone when informants may not be present. Those who have a history of cognitive impairment or a suspicion after screening should have collateral informants involved and strong consideration for referral to a geriatrician or other providers who can further assess their cognitive impairment.

Identification of preexisting cognitive impairment is not only important because it increases the awareness of postoperative delirium risk but also because the multicomponent nonpharmacologic interventions such as the Hospital Elder Life Program (HELP) have the strongest evidence for *preventing* delirium. The strength of the evidence of multicomponent nonpharmacologic interventions for *management* of delirium is lower [37]. Nevertheless, multicomponent nonpharmacologic interventions are an integral part of caring for a patient at risk for delirium. HELP (Table 8.3) reduced the incidence of delirium in hospitalized medical older adult patients (mean age 80 year old) by 5% compared to those who received usual care. The number needed to treat is 20. The multicomponent

Step 1: Three Word Registration

Look directly at person and say, "Please listen carefully. I am going to say three words that I want you to repeat back to me now and try to remember. The words are [select a list of words from the versions below]. Please say them for me now." If the person is unable to repeat the words after three attempts, move on to Step 2 (clock drawing).

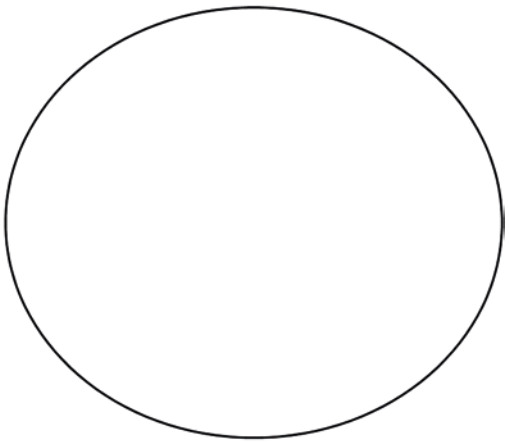
The following and other word lists have been used in one or more clinical studies.[1–3] For repeated administrations, use of an alternative word list is recommended.

Version 1	Version 2	Version 3	Version 4	Version 5	Version 6
Banana	Leader	Village	River	Captain	Daughter
Sunrise	Season	Kitchen	Nation	Garden	Heaven
Chair	Table	Baby	Finger	Picture	Mountain

Step 2: Clock Drawing

Say: "Next, I want you to draw a clock for me. First, put in all of the numbers where they go." When that is completed, say: "Now, set the hands to 10 past 11."

Use preprinted circle (see next page) for this exercise. Repeat instructions as needed as this is not a memory test. Move to Step 3 if the clock is not complete within three minutes.



Step 3: Three Word Recall

Ask the person to recall the three words you stated in Step 1. Say: "What were the three words I asked you to remember?" Record the word list version number and the person's answers below.

Word List Version: ____ Person's Answers: _____ _____ _____

Scoring

Word Recall: ____ (0-3 points)	1 point for each word spontaneously recalled without cueing.
Clock Draw: ____ (0 or 2 points)	Normal clock = 2 points. A normal clock has all numbers placed in the correct sequence and approximately correct position (e.g., 12, 3, 6 and 9 are in anchor positions) with no missing or duplicate numbers. Hands are pointing to the 11 and 2 (11:10). Hand length is not scored. Inability or refusal to draw a clock (abnormal) = 0 points.
Total Score: ____ (0-5 points)	Total score = Word Recall score + Clock Draw score. A cut point of <3 on the Mini-Cog™ has been validated for dementia screening, but many individuals with clinically meaningful cognitive impairment will score higher. When greater sensitivity is desired, a cut point of <4 is recommended as it may indicate a need for further evaluation of cognitive status.

Fig. 8.4 Mini-Cog™ (© S. Borson. All rights reserved. Reprinted with permission of the author solely for clinical and educational purposes. May not be modified or used for commercial, marketing, or research purposes without permission of the author (soob@uw.edu))

nonpharmacologic interventions reduced the total number of days with delirium and the total number of episodes of delirium [12]. However, once an initial episode of delirium had occurred, the intervention had no significant effect on the severity of delirium or on the likelihood of recurrence placing emphasis on the importance of identifying those at risk for delirium then implementing preventative nonpharmacologic measures. Perhaps more importantly is that the HELP interventions have been shown to have a dose-response curve. Higher levels of adherence to the interventions resulted in reduced rates of delirium in a directly graded fashion [13].

Falls

Falls are common in older adults with one in three older adults falling each year [38]. In the inpatient setting, the rate of falls in older patients is between 3.4 and 5.2 per person year with over half of these falls resulting in serious injury including fracture and head injuries. Risk factors for falls in the inpatient setting include gait instability, agitated confusion (e.g., delirium), urinary incontinence, a history of prior falls, and use of psychotropic medications [39]. Screening for a history of falls and/or performing a mobility assessment such as the Timed Up and Go Test in the outpatient setting may identify older adults at risk for falls in the postoperative period and those who are more likely to be institutionalized after surgery. Screening for falls can be as simple as asking "have you fallen in the past year?" If a yes response is given, the individual is considered at increased risk of falling.

The Timed Up and Go Test (TUGT) is performed by having an older adult stand up from a chair, walk 10 feet, turn around, and return to the seat [40]. If it takes greater than 12 s, the patient is considered at increased risk of falls, and a more comprehensive geriatric assessment prior to elective surgery may be needed. Several small studies have found having an abnormal preoperative TUGT to be associated with an increase in postoperative institutionalization, length of stay, postsurgical complications, and one-year mortality [41, 42]. Inpatient care providers should be made aware in advance of those who are at increased risk of falls, so preventive strategies can be implemented. Successful strate-

gies for preventing inpatient falls have included patient education and multifactorial interventions (with variation of interventions between studies) that target fall risk factors (e.g., therapy or exercise for decreased mobility, medication review). Further research is needed to elucidate which interventions are most effective.

Polypharmacy

The elderly are four times as likely as those under 65 years of age to be hospitalized due to a medication mishap [43]. This is in part due to the higher risk of polypharmacy in this population secondary to an increased number of medical conditions and greater number of physicians involved in their care [44]. Polypharmacy has been associated with adverse outcomes including risk of hospitalizations, falls and fall-related injury, weight loss, decline in functional and cognitive status, and mortality [45, 46]. The frequency of these geriatric syndromes as well as risk of adverse drug reaction (ADR) increases in proportion to the number of used medications [47]. In fact, polypharmacy has been recognized as the most important risk factor for an ADR. The risk increases from 13% for a person taking two medicines to 58% and 82% when taking five and seven or more medications, respectively [47–49].

While no consensus definition exists for the term "polypharmacy," a threshold of five or greater concurrent medications is generally accepted [50–52]. Some studies and authors have tried to be more specific by using the term "inappropriate" polypharmacy when multiple medications are used to treat a single ailment or condition. The lack of consensus in defining polypharmacy has proven problematic when attempting to compare different strategies aimed at reducing medications and their associated clinical endpoints [52].

Believing that a patient is taking too many medicines does not help the clinician know which ones to stop [46]. Medical training often fails to supply providers with adequate knowledge and skills needed to prescribe appropriately to individuals who use multiple medications. As a result, physicians may inadvertently cause drug-drug-related problems. This is especially seen in older adults because of the multiple prescription medications and an inadequate understanding of pharmacology [53].

The term "deprescribing" has been used to describe the complex process of planned and supervised tapering or ceasing of inappropriate medicines with the goal of managing polypharmacy and improving outcomes (Table 8.5) [54, 55]. This is especially important in the inpatient setting as polypharmacy is a preoperative risk factor for delirium and falls [56]. In addition, patients taking medications unrelated to their surgery are 2.5 more likely to develop postoperative complications [57, 58].

Table 8.5 A guided assessment of a "deprescribing process"

1. Obtain a complete medication list
2. Determine the indication for each medication
3. Evaluate each medication's potential for drug-induced harm
4. Determine if a medication should be discontinued by evaluating the: – Appropriateness of the indication – Efficacy – Whether it is being used to treat adverse effects of other medications – Benefit-to-harm ratio – Treatment burden – The patient's life expectancy exceeds the time to therapeutic benefit (i.e., lag time to benefit, e.g., the use preventative medications such as statin use for primary prevention)
5. Develop a plan for discontinuing medications one at time, starting with medications with the highest treatment burden and lowest benefit (e.g., benzodiazepines)
6. Discontinue medications and monitor for withdrawal or return of symptoms

Based on data from Refs. [46, 50, 59]

Medication reconciliation is a framework used to help reduce medical errors by ensuring accuracy of a patient's medication list. This process is the first step in deprescribing and is particularly important at times of transitions in care when prescribing errors are high [47]. A "brown bag" review in which patients bring in all of their medicines (including all prescriptions and over-the-counter medicines, vitamins, supplements, and herbal preparations) for documentation can be invaluable preoperatively. This type of review provides useful information about what a patient is actually taking versus what they have been prescribed. Utilizing a list from medical records or from the patient may not accurately reflect how and which medications are being taken in the home.

There are numerous decision aid tools to assist providers in reducing polypharmacy with little direct evidence to support one specific method of review over another. These tools have been developed in various settings and have varying levels of support for their use [44]. Although few have been used or validated in the perioperative setting, they all have face validity and could be of benefit. The selected tools below have been chosen for their usefulness and practicality of application when assessing polypharmacy in the elderly (Table 8.6). One shortcoming is while these tools do make recommendations regarding specific medications and medication classes, they do not offer guidance on dosing or alert providers to potentially harmful doses of appropriate medications for the geriatric patient.

Although each type of surgical procedure requires different precautions, there are some general principles for management of medications in the perioperative period. An accurate and comprehensive medication list is essential to appropriately manage patients' medications perioperatively. Review of this list and a straightforward, clear plan regarding discontinuation or continuation for each of the patient's

Table 8.6 Clinical tools to reduce polypharmacy

Tool to reduce polypharmacy	Description	Applications	Limitations
Beers Criteria[a]	Widely adopted consensus-based list identifying potentially inappropriate medications in the elderly	Easy to use. Requires little individualization or time-consuming decision-making. Can be incorporated into computerized decision support systems	Many of the drugs are not in current clinical use. There is insufficient evidence to include some drugs on the list. Harm resulting from the use of some of the inappropriate medications on the list may be minor compared with other inappropriate prescribing
DBI[b]	Evidence-based tool used to assess a patient's total sedative and anticholinergic drug load	Shown to be superior to the Beers Criteria in predicting functional decline. Shown to be correlated with poorer physical and cognitive performance, falls, frailty, and reduced functional capacity [48]. Can be incorporated into computerized decision support systems	Not widely available limiting usability for most clinicians
STOPP/START[c]	STOPP is a multidisciplinary validated consensus derived tool with check lists based on guidelines validated for geriatric prescribing. START consists of evidence-based indicators of medications commonly omitted by physicians	Logically organized and structured with easy-to-use explicit lists of medication criteria. Requires a short time to complete (3 min). Can be incorporated in computerized decision support systems	Does not take into account the particularities of the health system (funding, co-payment) or the comorbidity of the patient. Clinical judgment is essential for each patient
GRAM[d]	Clinical informatics tool prospectively monitoring for potential risk of falls or for delirium within 24 h of nursing home or hospital admission	Shown to significantly reduce the rate of delirium	Not widely utilized

DBI Drug Burden Index, *STOPP/START* Screening Tool to Alert Doctors to Right Treatments and Screening Tool of Older Persons' Potentially Inappropriate Prescriptions, *GRAM* Geriatric Risk Assessment Medguide
[a]American Geriatrics Society 2015 Beers Criteria Update Expert Panel [60]
[b]Gallagher et al. [62]
[c]Hilmer et al. [61]
[d]Lapane et al. [63]

chronic medications should be made at a preoperative appointment. In the immediate preoperative period, providers should repeat their review of the patient's medications and confirm that recommendations regarding management have been implemented. Ensuring nonessential medications have been stopped can reduce perioperative complications. In particular, herbal use can pose important cardiovascular, coagulation, and sedative risks in the perioperative period (see Chap. 13, Preoperative Risk Stratification and Methods to Reduce Risk, Table 13.8) [58]. A general practice of stopping self-prescribed OTC medications, herbals, or supplements 2 weeks before surgery is a strategy supported by the American Society of Anesthesiology and will ensure that longer-acting medications (e.g., St. John's wort or garlic) will be fully eliminated [58]. Instructions should be kept simple for geriatric patients and caregivers such as stopping all nonessential medications at one time rather than a staged fashion will increase the likelihood that patients will be compliant with instructions. Clearly communicating continuing mediations with that are medically necessary or have the potential for withdrawal is equally important.

Most medications are tolerated well through surgery, and most drugs should be continued through the morning of surgery unless completely unnecessary (e.g., vitamins) or contraindicated. In particular, antihypertensives, anticonvulsants, and psychiatric medications should be given unless specifically contraindicated [64]. Notable exceptions to this continuation rule include:

- Angiotensin converting enzyme inhibitors (ACEIs) and angiotensin II receptor blockers (ARBs) may be held 24 h prior to anesthesia induction and surgery because of the potential for adverse circulatory effects such as hypotension [58].
- Anticoagulants/antiplatelets including nonsteroidal anti-inflammatory agents (NSAIDs) could be held but are vari-

able depending on the particular medication, indication for use, and type of surgery.

- Selective estrogen receptor modulators (SERMs) and estrogens should be held at least 1 week preoperatively (4 weeks for estrogen if possible) for surgeries associated with a moderate to high risk of deep vein thrombosis [64].
- Diabetic oral agents should be held the morning of surgery. The exception is metformin which should be held for at least 1 day before surgery and restarted after 2–3 days when it is certain that no acute renal dysfunction has developed postoperatively [64].
- Postprandial insulin should be held the day of surgery. Sliding-scale insulin can be used instead as needed to control serum glucose periprocedurally. Long-acting insulin can be administered but should be reduced by 50% of the usual dose day of surgery.

The long elimination half-life of some medications (e.g., the half-life of amiodarone is 58 days) may make it unreasonable to stop them to achieve low-serum drug concentrations before surgery.

Preoperative medication management in the elderly is commonly nuanced. Special attention to standardized surgery order sets with preset medications is imperative because medications in order sets are commonly inappropriate for older patients. Uniformity and ease of clinical care are some advantages of using a standardized order set. However, the preset doses may put older adults at high risk for hemodynamic, cognitive, or respiratory impairment. Discontinuation or dose adjustment of as needed (or routine) antihistamines, antiemetics, acetaminophen, narcotics, muscle relaxants, and anticonvulsants may be warranted. In some instances, the prescribing provider should be contacted for an in-person evaluation. For example, acute coronary syndromes (ACS) may present as nausea rather than typical chest pain. Atypical presentations of ACS are more common in older patients. In comparison to typical chest pain, patients with atypical pain or dyspnea were older and had more cardiovascular risk factors yet were significantly less likely to receive evidence-based therapy and suffered worse in-hospital outcomes. The mortality rates were 3%, 2.5%, and 6% in patients presenting with typical chest pain, atypical chest pain, and dyspnea, respectively [65].

Given the high likelihood that medications with central nervous system effects will likely be added postoperatively, an effort to reduce a patient's anticholinergic or sedative medication burden when possible is ideal. The authors of this chapter consider each clinical encounter as an opportunity to reconcile medications and identify the appropriateness of each medication. Discontinuation or dose reduction starting with the least destabilizing agents is ideal. For example, urinary anticholinergics like oxybutynin and non-benzodiazepine sleeping agents like zolpidem can potentially be stopped, and centrally active muscle relaxants like methocarbamol often can be titrated down (if on high/prolonged doses) or stopped as well. Thought should also be given to employing opioid-sparing techniques to reduce the potential untoward effects of opiate use. These may include scheduled preoperative acetaminophen or the addition of regional techniques such as neuraxial blockade or peripheral nerve blocks when appropriate (see Chap. 19) [56]. Initiating narcotics at half the dosage of typical younger patients and avoiding initiation of long-acting opiates (e.g., topical fentanyl, methadone) or opiates with active metabolites (morphine, meperidine) will also reduce central nervous system burden and potentially lessen delirium and fall risk [56].

Ensuring medications are scheduled in a way to avoid dosing in early morning or very late at night can reduce risk of sleep deprivation and fragmentation and consequently incidence delirium [12]. The National Institute for Health and Clinical Excellence (NICE) recommends efforts to improve sleep quality (i.e., avoiding unnecessary night time interruptions and to reducing environmental noise) to reduce delirium in hospitalized patients [66]. Clinical evidence linking sleep fragmentation with delirium comes from preventative nonpharmacologic strategies in the Hospital Elder Life Program. The nonpharmacologic sleep intervention not only reduced the use of sedative and hypnotics but also reduced delirium incidence [12, 67].

Sensory Impairment

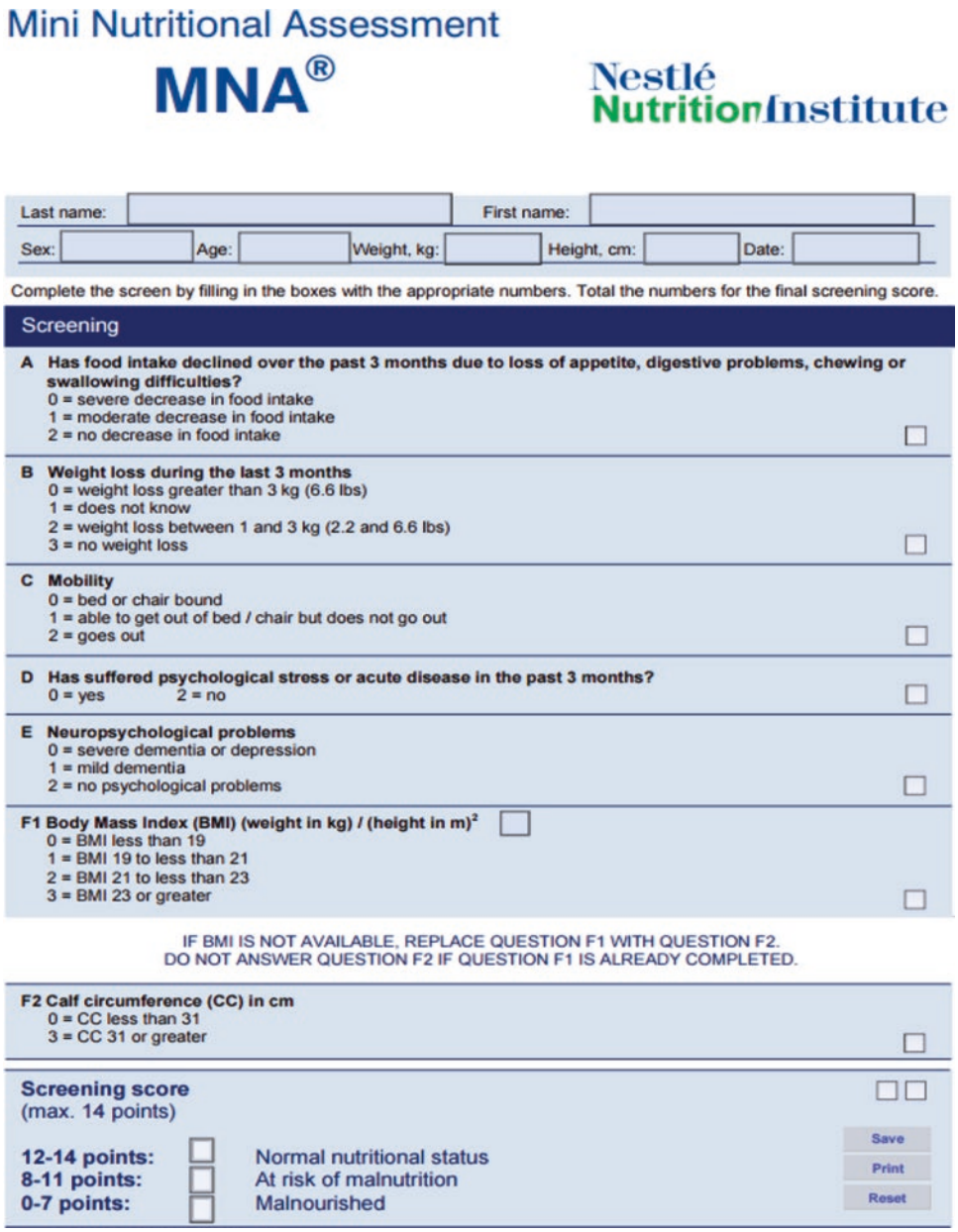
Sensory impairment including vision and hearing loss is extremely common and places inpatient older adults at risk for delirium, falls, and miscommunication with providers. Nearly one in three adults over the age of 65 has hearing loss, and 12% of adults 65–74 years of age have visual impairment with prevalence of both conditions increasing with age [68, 69]. Inquiring about these deficits and use of assistive devices (i.e., hearing aids and glasses) can aid in planning for the patient's hospital stay. Older adults with sensory impairment should be encouraged to bring these assistive devices with them to the hospital to aid in communication and reduce their risk of delirium. For those with visual or hearing impairment without access to assistive device, interactions can be enhanced by the use of devices such as hearing amplifiers, magnifying glasses or reading glasses, and using reading materials with larger font. Most hospitals will have access to resources such as large-print versions of reading materials for those with low vision. Speaking slowly, in a lower tone (i.e., deepening voice), at moderate volume at eye level can be very helpful in enhancing understanding for those who are hearing impaired. Counterintuitively, yelling does not usually help those with sensorineural hearing impairment. Yelling increases the pitch of the voice and making it harder for most with sensorineural hearing impairment to understand.

Malnutrition and Weight Loss

Malnutrition is common in community-dwelling older adults impacting over 20% of older adults. It is more even more prevalent in institutional settings. Malnutrition places older adults at increased risk for postoperative complications including infections, poor wound healing, delirium, and prolonged length of stay [14, 70]. There are multiple tools available to screen for malnutrition. One brief validated tool is the Mini Nutrition Assessment (Fig. 8.5) [71]. Another approach recommended by the American College of Surgery/American Geriatric Society preoperative guidelines for older adults is to screen for risk of malnutrition by identifying those with one of the following three factors: (1) BMI < 18.5 kg/m^2, (2) serum albumin <3.0 g/dL, and (3) unintentional weight loss of 10%–15% within 6 months [14]. Patients with one of these three factors should be referred to a dietician to discuss perioperative nutrition.

Social Support and Environmental Assessment

For older frail patients, the presence of a good social support is often the determining factor of whether a functionally dependent older adult remains at home or is institutionalized. The lack of available family and friends as caregivers may lead to poor posthospitalization outcomes [72]. Those who are cognitively impaired and without reliable family mem-



Mini Nutritional Assessment

MNA®

Nestlé Nutrition Institute

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems

F1 Body Mass Index (BMI) (weight in kg) / (height in m)^2
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2.
DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 Calf circumference (CC) in cm
0 = CC less than 31
3 = CC 31 or greater

Screening score
(max. 14 points)

12-14 points: Normal nutritional status
8-11 points: At risk of malnutrition
0-7 points: Malnourished

Save Print Reset

Fig. 8.5 Mini Nutrition Assessment (MNA©). (The MNA a simple validated tool that can be used for adults 65 years of age in identifying malnutrition. The MNA form is protected by copyright laws © Nestlé, 1994, Revision 2009. N67200 12/99 10 M and is also a registered trademark of ®Société des Produits Nestlé S.A., Vevey, Switzerland, Trademark Owners. www.mnaelderly.com)

bers or caregivers may have difficulty remembering preoperative instructions and following through on postoperative plans including wound care and medication changes. It is often prudent to question who would be available to help if the patient becomes ill even in robust and healthier older adults.

The older adult's social support structure can be assessed by asking questions during the social history and also be triggered if dependency is noted during the functional assessment. For example, the clinician should inquire as to who provides help for the specific ADL and/or IADL functions and what time and days these individuals are available. Social work can assist in inquiring about social support prior to surgery allowing for more careful investigation and planning. For some, the lack of adequate social support may mean bringing in other paid or unpaid/family caregivers postoperatively, and for others, this may mean at least a temporary need for nursing homestay after surgery. Careful planning for those with inadequate social support can reduce unnecessary prolongation of hospitalization after surgery to make necessary arrangements and can help ensure that the patient has the needed support to follow through on postoperative recommendations.

Frailty

Frailty is a clinical syndrome that affects 10%–20% of community-dwelling older adults and is one of the leading causes of morbidity and mortality in older adults [73]. A recent consensus statement defined frailty as "a medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance, and reduced physiologic function that increases an individual's vulnerability for developing increased dependency and/or death" [74]. Due to rapid population aging, the prevalence of frailty is expected to exponentially increase over the next few decades. The care of older adults with frailty will continue to pose significant and unique challenges to providers and the health-care system. Moreover, as the number of older adults undergoing major surgery increases, the impact of frailty on the perioperative management of older adults will require further research to optimize care and outcomes for these vulnerable patients.

Factors that influence frailty include age, body mass index (including obesity), comorbidity, cognitive impairment, dementia, and environmental or lifestyle factors. Frailty exists on a spectrum to a state of failure to thrive, inanition, and ultimately death. Frailty in older individuals is characterized by diminished physiologic reserve with a heightened vulnerability to decompensation and serious adverse health outcomes following acute stressors. Acute stressors can be minor in nature and result in significant morbidity in frail older patients.

Frailty is an adverse prognostic risk factor for many chronic diseases prevalent in older adults, such as cancer, dementia, coronary artery disease, congestive heart failure, and chronic kidney disease. Thus, there is a relationship between frailty and comorbidity. Frailty is associated with functional decline and disability but can occur independent of these outcomes. Interventions that impact upon frailty are a rapidly developing area of basic and clinical research, and more data are needed to provide optimal medical and surgical care for frail older individuals. Interventions that influence the progression of frailty are currently limited and thus a high research priority.

Pathophysiology

Frailty is a dynamic, accelerated aging process where gene-gene and gene-environment interactions play a significant role in its development and progression. On a systems level, age-related declines in multiple physiological systems, such as the neurologic, musculoskeletal, endocrine, and immune systems, contribute to frailty. Dysregulation of these physiologic systems along with chronic inflammation and changes in levels of steroid hormones and 25-hydroxyvitamin D influences the development of sarcopenia, which is a key feature in those with moderate to severe frailty. Elevations in pro-inflammatory cytokines such as interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α), and C-reactive protein (CRP) promote chronic low-grade inflammation and contribute to the high prevalence of subclinical and clinical cardiovascular disease among frail individuals.

On a cellular level, cell senescence is a driver of aging phenotypes. Senescence is a state of irreversible growth arrest that occurs in cells upon genotoxic damage, which is a protective mechanism against cancer development. Senescent cells accumulate with aging in tissues. However, this protective mechanism early in life paradoxically promotes aging phenotypes such as cancer in late life. This observation occurs due to elaboration of the senescence-associated secretory phenotype (SASP) by senescent cells, which is pro-inflammatory and pro-tumorigenic in nature [75]. Clearance of senescent cells with small molecule inhibitors has shown promise in reversing signs of age-related pathologies, such as sarcopenia in preclinical models [76]. Thus targeting of senescent cells holds promise to improve our ability to potentially treat and reverse frailty and other age-associated diseases, such as cancer and cardiovascular disease.

Diagnosis

There is currently no gold standard for the diagnosis of frailty. Many frailty tools exist in the literature; however, most are difficult to operationalize into routine clinical practice due to their length or need for technology to measure handgrip strength and gait speed. The gestalt approach to diagnose frailty is unreliable and bias prone. Frailty among obese individuals, termed "sarcopenic obesity," can be overlooked due to excess adipose tissue masking low muscle mass.

Fried and colleagues characterized the frailty phenotype in a longitudinal study of community-dwelling older adults, which was predictive of adverse health outcomes [77]. The frailty phenotype was defined as a clinical syndrome with three or more of the following features: unintentional weight loss (10 lbs. in the past year), self-reported exhaustion and weakness (measured through grip strength), and slow gait speed and low physical activity. Individuals meeting two features were considered pre-frail and were at intermediate risk for adverse outcomes compared to non-frail individuals. The frailty phenotype was independently predictive of falls, disability in activities of daily living, hospitalization, and mortality. The study also showed that frailty was not synonymous with either comorbidity or disability. Rather, comorbidities were a risk factor for frailty, and disability was an outcome of frailty. Frailty was associated with lower socioeconomic status and education as well, demonstrating that extrinsic factors contribute to the syndrome of frailty.

Another conceptual model of frailty is based upon the accumulation of deficits with advancing age. The Frailty Index was devised by Rockwood and colleagues which evaluates impairments in medical, social, psychological, nutritional, and functional domains along with laboratory abnormalities. The more deficits that accumulate in an individual, the more likely for the development and progression of frailty [78]. In addition, there is a positive correlation in the severity of cognitive impairment with frailty.

Prior to the diagnosis of frailty, it is important to exclude potential conditions that can also present with signs and symptoms of weakness, weight loss, and functional decline. Depression, cognitive impairment, thyroid dysfunction, cardiovascular disease, and hematologic and malignant conditions should be considered in the differential diagnosis. A careful medication review should be performed and evaluation for potential drug-drug interactions and adverse drug effects. Other considerations in evaluation of frail patients are psychosocial factors such as food insecurity or dependency for feeding and activities of daily living. A general laboratory work-up for frail patients should include a complete blood count with differential, chemistry panel, liver function panel, prealbumin, vitamin B12, 25-hydroxyvitamin D, thyroid function tests, and hemoglobin A1c. Age-appropriate cancer screening should be considered.

Screening

The ability to detect frailty is important because it can help guide clinical decision-making and identify patients at high risk for adverse outcomes. A positive frailty screen should be followed by a comprehensive geriatric assessment (CGA). The 2013 Frailty Consensus recommended screening for frailty for all persons 70 years or older and those with significant (>5 lbs.) unintentional weight loss in the past year [74]. The current evidence to date supports screening for frailty as a variable in the perioperative risk assessment in older adults. Baseline preoperative frailty has been consistently correlated with poor surgical outcomes, serious adverse events, prolonged length of stay, discharge to an institutional care facility, hospital readmissions, and short- and long-term mortality.

However, no consensus exists on which frailty screening and measurement tool to use. The most well-developed and well-validated are the Fried criteria, Frailty Index, Edmonton Frail Scale, FRAIL Scale, and Clinical Frail Scale-9 (CFS-9). The CFS-9 developed by Rockwood and colleagues was found to be the best predictor of 1-year mortality in hospitalized geriatric patients, when compared to other frailty screening methods [79]. A study by Revenig and colleagues demonstrated that frailty assessment is feasible and provides critical information not captured by traditional surgical risk assessments. These authors used a modified version of the Fried frailty phenotype with shrinking and grip strength and inclusion of hemoglobin and American Society of Anesthesiology Class as additional variables [80].

Following the identification of frailty on a screening tool, comprehensive geriatric assessment can identify other geriatric syndromes that can be optimized in frail individuals and improve perioperative outcomes [81]. Among the criteria in the frailty phenotype, as a single measure for screening, gait speed (m/s) appears to be the best predictor of many adverse health and postoperative complications.

Consequences of Frailty

Frailty increases risk of mortality by twofold, independent of age and comorbidities. For frail older adults who are hospitalized or undergo surgery, these individuals are at increased risk of complications, delirium, cognitive decline, infection, sepsis, prolonged length of stay, institutionalization, disability, and death. In a recent analysis of the National Surgery Quality Improvement Program database, frailty was shown to have a significant impact on postoperative outcomes that varied with type of surgery but did not necessarily correlate with complexity of surgery. Colectomy, esophagectomy, lung resection, pancreatic resection, cardiac procedures, gastrectomy, nephrectomy, endovascular abdominal aortic aneurysm repair, and lower-extremity bypass surgery had the highest to lowest mortality rates in severely frail individuals

[82]. Frailty has an important role in trauma care as well. Trauma centers are experiencing a disproportionate rise in the number of elderly trauma patients. Knowledge of the magnitude of frailty on trauma outcomes is needed. However, measures that are easy, reliable, and validated in the trauma population are limited [83]. Surgical intervention in patients who are frail requires knowledge of the patient's priorities and goals of care in order to set realistic expectations on outcomes, impact on quality of life, and prognosis.

Frailty in Cardiovascular Disease

The majority of cardiovascular deaths occur in older adults. Frailty is common in older adults with cardiovascular disease (CVD) and confers a twofold increase in mortality even after adjusting for age and comorbidities [84]. Congestive heart failure, chronic angina, and symptomatic atrial fibrillation may limit exertional capacity and contribute to frailty by reducing exercise tolerance and muscle function. Cardiac rehabilitation, which is underutilized, improves outcomes in patients with CVD and may be of particular benefit for frail patients.

The Cardiovascular Health Study screened for subclinical CVD in 4735 older adults. Frail individuals had increased prevalence of wall motion abnormalities and LVH on echocardiography, prehypertension, abnormal ankle brachial indexes, carotid artery stenosis, and brain infarcts on magnetic resonance imaging, which were clinically silent [85]. Current guidelines by the American College of Cardiology/American Heart Association (ACC/AHA) do not discuss frailty. A better understanding of the impact of frailty on CVD outcomes may improve the care of patients with CVD.

Interventions for Frailty

Frailty is potentially reversible if diagnosed early. Team-based and multimodal care which emphasizes physical exercise and treatment of protein-calorie malnutrition improves outcomes for frail older adults [86]. Physical exercise provides benefit to frail persons. However, the type of exercise, such as strength training, resistance, and/or aerobic exercises, and the optimal duration remains unclear [87]. Inclusion of palliative care services is also important for patients who are moderately to severely frail to establish patient-centered goals of care and provide support and symptom management.

Many questions regarding frailty remain to be answered by the field, from the best screening and measurement tools to the most effective interventions. Tools to screen and measure frailty need to be easy to administer, reliable, objective, and validated in the population specific to the patient. Identification of frailty or pre-frailty biomarkers is a rapidly developing area of investigation with the goal to standardize diagnoses, improve prognostication, and monitor the response to interventions. Pharmaceutical drugs are being developed and investigated in preclinical models that can potentially reverse frailty or halt its progression. Clinical trials are needed to evaluate the impact of "prehabilitation" on surgical outcomes in older adults with frailty. The optimal strategy for anesthesia on patients who are frail remains to be defined with the goal to reduce postoperative delirium and cognitive impairment.

Conclusion

A geriatrician's assessment integrates goals setting, prior functional assessment, and identification of complicating geriatric syndromes into the usual perioperative assessment. Many geriatric conditions and syndromes have multiple causes and contributors that lead to weakness, unintentional weight loss, poor endurance with reduced physiologic reserve, and heightened vulnerability to disability and/or death. Improving the standard of care for these vulnerable patients requires multimodal and interdisciplinary care. Reducing disability and frailty will substantially impact patient quality of life, improve patient-centered outcomes, and reduce health-care utilization and costs.

References

1. Leipzig RM, Sauvigné K, Granville LJ, Harper GM, Kirk LM, Levine SA, et al. What is a geriatrician? American geriatrics society and association of directors of geriatric academic programs end-of-training entrustable professional activities for geriatric medicine. J Am Geriatr Soc. 2014;62(5):924–9.
2. Besdine R, Boult C, Brangman S, Coleman EA, Fried LP, Gerety M, et al. Caring for older Americans: the future of geriatric medicine. J Am Geriatr Soc. 2005;53(6 Suppl):S245–56.
3. Warshaw GA, Bragg EJ, Fried LP, Hall WJ. Which patients benefit the most from a geriatrician's care? Consensus among directors of geriatrics academic programs. J Am Geriatr Soc. 2008;56(10):1796–801.
4. Kristjansson SR, Nesbakken A, Jordhøy MS, Skovlund E, Audisio RA, Johannessen HO, et al. Comprehensive geriatric assessment can predict complications in elderly patients after elective surgery for colorectal cancer: a prospective observational cohort study. Crit Rev Oncol Hematol. 2010;76(3):208–17.
5. Kristjansson SR, Jordhøy M, Nesbakken A, Skovlund E, Bakka A, Johannessen H, Wyller T. Which elements of a comprehensive geriatric assessment (CGA) predict post-operative complications and early mortality after colorectal cancer surgery? J Geriatr Oncol. 2010;1(2):57–65.
6. Turrentine FE, Wang H, Simpson VB, Jones RS. Surgical risk factors, morbidity, and mortality in elderly patients. J Am Coll Surg. 2006;203(6):865–77.

7. Elkan R, Kendrick D, Dewey M, Hewitt M, Robinson J, Blair M, et al. Effectiveness of home based support for older people: systematic review and meta-analysis. BMJ. 2001;323(7315):719–25.
8. Stuck AE, Egger M, Hammer A, Minder CE, Beck JC. Home visits to prevent nursing home admission and functional decline in elderly people: systematic review and meta-regression analysis. JAMA. 2002;287(8):1022–8.
9. Stuck AE, Siu AL, Wieland GD, Adams J, Rubenstein LZ. Comprehensive geriatric assessment: a meta-analysis of controlled trials. Lancet. 1993;342(8878):1032–6.
10. Ellis G, Whitehead MA, O'Neill D, Langhorne P, Robinson D**.** Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev. 2011;(7):CD006211.
11. Tinetti ME, Inouye SK, Gill TM, Doucette JT. Shared risk factors for falls, incontinence, and functional dependence. Unifying the approach to geriatric syndromes. JAMA. 1995;273(17):1348–53.
12. Inouye SK, Bogardus ST, Charpentier PA, Leo-Summers L, Acampora D, Holford TR, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. N Engl J Med. 1999;340(9):669–76.
13. Inouye SK, Bogardus ST, Williams CS, Leo-Summers L, Agostini JV. The role of adherence on the effectiveness of nonpharmacologic interventions: evidence from the delirium prevention trial. Arch Intern Med. 2003;163(8):958–64.
14. Chow WB, Rosenthal RA, Merkow RP, Ko CY, Esnaola NF, Program ACoSNSQI, et al. Optimal preoperative assessment of the geriatric surgical patient: a best practices guideline from the American College of Surgeons National Surgical Quality Improvement Program and the American Geriatrics Society. J Am Coll Surg. 2012;215(4):453–66.
15. (U.S.) MPAC. Report to the Congress : issues in a modernized Medicare program. Washington, DC: Medicare Payment Advisory Commission; 2005. https://www.balch.com/-/media/files/insights/publications/2008/05/report-to-congress-issues-in-a-modernizedmedicare/ files/report-to-congress-issues-in-a-modernized-medicare/fileattachment/report-to-congress-issues-ina-modernized-medicare.pdf.
16. Lee SJ, Leipzig RM, Walter LC. Incorporating lag time to benefit into prevention decisions for older adults. JAMA. 2013;310(24):2609–10.
17. Walter LC, Covinsky KE. Cancer screening in elderly patients: a framework for individualized decision making. JAMA. 2001;285(21):2750–6.
18. Lee S SA, Widera E, Yourman L, Schonberg M, Ahalt C (2012). *Eprognosis*. URL: http://eprognosis.ucsf.edu/index.php. Accessed on 31 Aug 2016.
19. Yourman LC, Lee SJ, Schonberg MA, Widera EW, Smith AK. Prognostic indices for older adults: a systematic review. JAMA. 2012;307(2):182–92.
20. Lee SJ, Lindquist K, Segal MR, Covinsky KE. Development and validation of a prognostic index for 4-year mortality in older adults. JAMA. 2006;295(7):801–8.
21. Oresanya LB, Lyons WL, Finlayson E. Preoperative assessment of the older patient: a narrative review. JAMA. 2014;311(20):2110–20.
22. Fried LP, Guralnik JM. Disability in older adults: evidence regarding significance, etiology, and risk. J Am Geriatr Soc. 1997;45(1):92–100.
23. Boyd CM, Landefeld CS, Counsell SR, Palmer RM, Fortinsky RH, Kresevic D, et al. Recovery of activities of daily living in older adults after hospitalization for acute medical illness. J Am Geriatr Soc. 2008;56(12):2171–9.
24. Brown CJ, Friedkin RJ, Inouye SK. Prevalence and outcomes of low mobility in hospitalized older patients. J Am Geriatr Soc. 2004;52(8):1263–70.
25. Brown CJ, Roth DL, Allman RM, Sawyer P, Ritchie CS, Roseman JM. Trajectories of life-space mobility after hospitalization. Ann Intern Med. 2009;150(6):372–8.
26. Gill TM, Allore HG, Gahbauer EA, Murphy TE. Change in disability after hospitalization or restricted activity in older persons. JAMA. 2010;304(17):1919–28.
27. Hirsch CH, Sommers L, Olsen A, Mullen L, Winograd CH. The natural history of functional morbidity in hospitalized older patients. J Am Geriatr Soc. 1990;38(12):1296–303.
28. Covinsky KE, Palmer RM, Fortinsky RH, Counsell SR, Stewart AL, Kresevic D, et al. Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: increased vulnerability with age. J Am Geriatr Soc. 2003;51(4):451–8.
29. Sager MA, Rudberg MA, Jalaluddin M, Franke T, Inouye SK, Landefeld CS, et al. Hospital admission risk profile (HARP): identifying older patients at risk for functional decline following acute medical illness and hospitalization. J Am Geriatr Soc. 1996;44(3):251–7.
30. Inouye SK, Wagner DR, Acampora D, Horwitz RI, Cooney LM, Hurst LD, et al. A predictive index for functional decline in hospitalized elderly medical patients. J Gen Intern Med. 1993;8(12):645–52.
31. Mehta KM, Pierluissi E, Boscardin WJ, Kirby KA, Walter LC, Chren MM, et al. A clinical index to stratify hospitalized older adults according to risk for new-onset disability. J Am Geriatr Soc. 2011;59(7):1206–16.
32. Covinsky KE, Pierluissi E, Johnston CB. Hospitalization-associated disability: "she was probably able to ambulate, but I'm not sure". JAMA. 2011;306(16):1782–93.
33. Lin JS, O'Connor E, Rossom RC, Perdue LA, Eckstrom E. Screening for cognitive impairment in older adults: a systematic review for the U.S. preventive services task force. Ann Intern Med. 2013;159(9):601–12.
34. Petersen RC. Clinical practice. Mild cognitive impairment. N Engl J Med. 2011;364(23):2227–34.
35. Borson S, Scanlan JM, Chen P, Ganguli M. The Mini-Cog as a screen for dementia: validation in a population-based sample. J Am Geriatr Soc. 2003;51(10):1451–4.
36. Galvin JE, Roe CM, Powlishta KK, Coats MA, Muich SJ, Grant E, et al. The AD8: a brief informant interview to detect dementia. Neurology. 2005;65(4):559–64.
37. Adults AGSEPoPDiO. American Geriatrics Society abstracted clinical practice guideline for postoperative delirium in older adults. J Am Geriatr Soc. 2015;63(1):142–50.
38. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med. 1988;319(26):1701–7.
39. Cameron ID, Gillespie LD, Robertson MC, Murray GR, Hill KD, Cumming RG, et al. Interventions for preventing falls in older people in care facilities and hospitals. Cochrane Database Syst Rev. 2012;(12):CD005465.
40. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142–8.
41. Huisman MG, van Leeuwen BL, Ugolini G, Montroni I, Spiliotis J, Stabilini C, et al. "Timed Up & Go": a screening tool for predicting 30-day morbidity in onco-geriatric surgical patients? A multicenter cohort study. PLoS One. 2014;9(1):e86863.
42. Robinson TN, Wu DS, Sauaia A, Dunn CL, Stevens-Lapsley JE, Moss M, et al. Slower walking speed forecasts increased postoperative morbidity and 1-year mortality across surgical specialties. Ann Surg. 2013;258(4):582–8. discussion 8-90
43. Beijer HJ, de Blaey CJ. Hospitalisations caused by adverse drug reactions (ADR): a meta-analysis of observational studies. Pharm World Sci. 2002;24(2):46–54.
44. Gokula M, Holmes HM. Tools to reduce polypharmacy. Clin Geriatr Med. 2012;28(2):323–41.
45. Niehoff KM, Rajeevan N, Charpentier PA, Miller PL, Goldstein MK, Fried TR. Development of the tool to reduce inappropriate medications (TRIM): a clinical decision support system to improve medication prescribing for older adults. Pharmacotherapy. 2016;36(6):694–701.

46. Steinman MA, Hanlon JT. Managing medications in clinically complex elders: "There's got to be a happy medium". JAMA. 2010;304(14):1592–601.
47. Davies EA, O'Mahony MS. Adverse drug reactions in special populations – the elderly. Br J Clin Pharmacol. 2015;80(4):796–807.
48. Best O, Gnjidic D, Hilmer SN, Naganathan V, McLachlan AJ. Investigating polypharmacy and drug burden index in hospitalised older people. Intern Med J. 2013;43(8):912–8.
49. Payne RA, Abel GA, Avery AJ, Mercer SW, Roland MO. Is polypharmacy always hazardous? A retrospective cohort analysis using linked electronic health records from primary and secondary care. Br J Clin Pharmacol. 2014;77(6):1073–82.
50. Bemben NM. Deprescribing: an application to medication management in older adults. Pharmacotherapy. 2016;36(7):774–80.
51. Bushardt RL, Massey EB, Simpson TW, Ariail JC, Simpson KN. Polypharmacy: misleading, but manageable. Clin Interv Aging. 2008;3(2):383–9.
52. Johansson T, Abuzahra ME, Keller S, Mann E, Faller B, Sommerauer C, et al. Impact of strategies to reduce polypharmacy on clinically relevant endpoints: a systematic review and meta-analysis. Br J Clin Pharmacol. 2016;82(2):532–48.
53. Keijsers CJ, van Doorn AB, van Kalles A, de Wildt DJ, Brouwers JR, van de Kamp HJ, et al. Structured pharmaceutical analysis of the systematic tool to reduce inappropriate prescribing is an effective method for final-year medical students to improve polypharmacy skills: a randomized controlled trial. J Am Geriatr Soc. 2014;62(7):1353–9.
54. Jansen J, Naganathan V, Carter SM, McLachlan AJ, Nickel B, Irwig L, et al. Too much medicine in older people? Deprescribing through shared decision making BMJ. 2016;353:i2893.
55. Page AT, Clifford RM, Potter K, Schwartz D, Etherton-Beer CD. The feasibility and effect of deprescribing in older adults on mortality and health: a systematic review and meta-analysis. Br J Clin Pharmacol. 2016;82(3):583–623.
56. Mohanty S, Rosenthal RA, Russell MM, Neuman MD, Ko CY, Esnaola NF. Optimal perioperative management of the geriatric patient: a best practices guideline from the American College of Surgeons NSQIP and the American Geriatrics Society. J Am Coll Surg. 2016;222(5):930–47.
57. Kennedy JM, van Rij AM, Spears GF, Pettigrew RA, Tucker IG. Polypharmacy in a general surgical unit and consequences of drug withdrawal. Br J Clin Pharmacol. 2000;49(4):353–62.
58. Pass SE, Simpson RW**.** Discontinuation and reinstitution of medications during the perioperative period. Am J Health Syst Pharm. 2004;61(9):899–912; quiz 3–4.
59. Reeve E, Shakib S, Hendrix I, Roberts MS, Wiese MD. Review of deprescribing processes and development of an evidence-based, patient-centred deprescribing process. Br J Clin Pharmacol. 2014;78(4):738–47.
60. Panel BAGSBCUE. American geriatrics society 2015 updated beers criteria for potentially inappropriate medication use in older adults. J Am Geriatr Soc. 2015;63(11):2227–46.
61. Hilmer SN, Mager DE, Simonsick EM, Cao Y, Ling SM, Windham BG, et al. A drug burden index to define the functional burden of medications in older people. Arch Intern Med. 2007;167(8):781–7.
62. Gallagher P, Ryan C, Byrne S, Kennedy J, O'Mahony D. STOPP (Screening tool of older person's prescriptions) and START (Screening tool to alert doctors to right treatment). Consensus validation. Int J Clin Pharmacol Ther. 2008;46(2):72–83.
63. Lapane KL, Hughes CM, Daiello LA, Cameron KA, Feinberg J. Effect of a pharmacist-led multicomponent intervention focusing on the medication monitoring phase to prevent potential adverse drug events in nursing homes. J Am Geriatr Soc. 2011;59(7):1238–45.
64. Mercado DL, Petty BG. Perioperative medication management. Med Clin North Am. 2003;87(1):41–57.
65. El-Menyar A, Zubaid M, Sulaiman K, AlMahmeed W, Singh R, Alsheikh-Ali AA, et al. Atypical presentation of acute coronary syndrome: a significant independent predictor of in-hospital mortality. J Cardiol. 2011;57(2):165–71.
66. O'Mahony R, Murthy L, Akunne A, Young J, Group GD. Synopsis of the national institute for health and clinical excellence guideline for prevention of delirium. Ann Intern Med. 2011;154(11):746–51.
67. McDowell JA, Mion LC, Lydon TJ, Inouye SK. A nonpharmacologic sleep protocol for hospitalized older patients. J Am Geriatr Soc. 1998;46(6):700–5.
68. National Institute on Deafness and Other Communication Disorders (December 7, 2016). *Age-related hearing loss*. URL: https://www.nidcd.nih.gov/health/age-related-hearing-loss. Accessed on 30 Dec 2016.
69. American Foundation for the Blind (January 2013). *Special report on aging and vision loss*. URL: http://www.afb.org/info/blindness-statistics/adults/special-report-on-aging-and-vision-loss/235. Accessed on 30 Dec 2016.
70. Kaiser MJ, Bauer JM, Rämsch C, Uter W, Guigoz Y, Cederholm T, et al. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. J Am Geriatr Soc. 2010;58(9):1734–8.
71. Rubenstein LZ, Harker JO, Salvà A, Guigoz Y, Vellas B. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). J Gerontol A Biol Sci Med Sci. 2001;56(6):M366–72.
72. Preyde M, Brassard K. Evidence-based risk factors for adverse health outcomes in older patients after discharge home and assessment tools: a systematic review. J Evid Based Soc Work. 2011;8(5):445–68.
73. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. J Am Geriatr Soc. 2012;60(8):1487–92.
74. Morley JE, Vellas B, van Kan GA, Anker SD, Bauer JM, Bernabei R, et al. Frailty consensus: a call to action. J Am Med Dir Assoc. 2013;14(6):392–7.
75. Campisi J. Aging, cellular senescence, and cancer. Annu Rev Physiol. 2013;75:685–705.
76. Baker DJ, Childs BG, Durik M, Wijers ME, Sieben CJ, Zhong J, et al. Naturally occurring p16(Ink4a)-positive cells shorten healthy lifespan. Nature. 2016;530(7589):184–9.
77. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146–56.
78. Mitnitski AB, Graham JE, Mogilner AJ, Rockwood K. Frailty, fitness and late-life mortality in relation to chronological and biological age. BMC Geriatr. 2002;2:1.
79. Ritt M, Bollheimer LC, Sieber CC, Gaßmann KG. Prediction of one-year mortality by five different frailty instruments: a comparative study in hospitalized geriatric patients. Arch Gerontol Geriatr. 2016;66:66–72.
80. Revenig LM, Canter DJ, Kim S, Liu Y, Sweeney JF, Sarmiento JM, et al. Report of a simplified frailty score predictive of short-term postoperative morbidity and mortality. J Am Coll Surg. 2015;220(5):904–11.e1.
81. Buigues C, Juarros-Folgado P, Fernández-Garrido J, Navarro-Martínez R, Cauli O. Frailty syndrome and pre-operative risk evaluation: a systematic review. Arch Gerontol Geriatr. 2015;61(3):309–21.
82. Mosquera C, Spaniolas K, Fitzgerald TL. Impact of frailty on surgical outcomes: the right patient for the right procedure. Surgery. 2016;160(2):272–80.
83. McDonald VS, Thompson KA, Lewis PR, Sise CB, Sise MJ, Shackford SR. Frailty in trauma: a systematic review of the surgical literature for clinical assessment tools. J Trauma Acute Care Surg. 2016;80(5):824–34.

84. Afilalo J, Karunananthan S, Eisenberg MJ, Alexander KP, Bergman H. Role of frailty in patients with cardiovascular disease. Am J Cardiol. 2009;103(11):1616–21.
85. Newman AB, Gottdiener JS, Mcburnie MA, Hirsch CH, Kop WJ, Tracy R, et al. Associations of subclinical cardiovascular disease with frailty. J Gerontol A Biol Sci Med Sci. 2001;56(3):M158–66.
86. Tarazona-Santabalbina FJ, Gómez-Cabrera MC, Pérez-Ros P, Martínez-Arnau FM, Cabo H, Tsaparas K, et al. A multicomponent exercise intervention that reverses frailty and improves cognition, emotion, and social networking in the community-dwelling frail elderly: a randomized clinical trial. J Am Med Dir Assoc. 2016;17(5):426–33.
87. de Labra C, Guimaraes-Pinheiro C, Maseda A, Lorenzo T, Millán-Calenti JC. Effects of physical exercise interventions in frail older adults: a systematic review of randomized controlled trials. BMC Geriatr. 2015;15:154.