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Review Article

Three Decades of Comprehensive Geriatric Assessment: Evidence Coming From Different Healthcare Settings and Specific Clinical Conditions

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A B S T R A C T

Comprehensive geriatric assessment (CGA) is a multidisciplinary diagnostic and treatment process that identifies medical, psychosocial, and functional capabilities of older adults to develop a coordinated plan to maximize overall health with aging. Specific criteria used by CGA programs to evaluate patients include age, medical comorbidities, psychosocial problems, previous or predicted high healthcare utilization, change in living situation, and specific geriatric conditions. However, no universal criteria have been agreed upon to readily identify patients who are likely to benefit from CGA. Evidence from randomized controlled trials and large systematic reviews and meta-analyses suggested that the healthcare setting may modify the effectiveness of CGA programs. Home CGA programs and CGA performed in the hospital were shown to be consistently beneficial for several health outcomes. In contrast, the data are conflicting for posthospital discharge CGA programs, outpatient CGA consultation, and CGA-based inpatient geriatric consultation services. The effectiveness of CGA programs may be modified also by particular settings or specific clinical conditions, with tailored CGA programs in older frail patients evaluated for preoperative assessment, admitted or discharged from emergency departments and orthogeriatric units or with cancer and cognitive impairment. CGA is capable of effectively exploring multiple domains in older age, being the multidimensional and multidisciplinary tool of choice to determine the clinical profile, the pathologic risk and the residual skills as well as the short- and long-term prognosis to facilitate the clinical decision making on the personalized care plan of older persons.

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Comprehensive Geriatric Assessment: Definition

The observations of high rates of institutionalization in the frail older population and the inadequacy of provision for readily recognisable and remedial problems in this high-risk group led to the development of one of the cornerstones of modern geriatric care: comprehensive geriatric assessment (CGA).[1,2] The concept is that the early identification of individuals at greatest risk for complications and unfavorable outcomes would enable a more adequate treatment plan and a better allocation of the resources available to the multidisciplinary team.[3] CGA is defined as a multidimensional, interdisciplinary diagnostic process focused on determining the medical, psychological, and functional capabilities of a frail elderly person to develop a coordinated and integrated plan for treatment and long-term follow-up.[4] CGA, indicated to effectively explore these multiple domains of health, is indeed the multidimensional and multidisciplinary tool of choice to determine the clinical profile, pathologic risk, residual skills, and short- and long-term prognosis to define the personalized therapeutic and care plan of the functionally compromised and frail older individual so as to facilitate clinical decision making. CGA differs from the standard medical evaluation because of its concentration on frail older people with complex problems, emphasis on functional status and quality of life, use of interdisciplinary teams, and quantitative assessment scales. Moreover, CGA can vary in intensity from screening assessment (focused on identifying older persons' problems performed by primary care/community health workers) to thorough diagnostic assessment and management of these problems carried out by a multidisciplinary team with geriatric training and experience. In the present review article, we considered the body of evidence coming from the last 3 decades of clinical research devoted to the systematic implementation of CGA programs in different healthcare settings and specific clinical conditions, analyzing the benefits that come from the application of the broad principles of CGA in these scenarios with a focus on multidimensional geriatric assessment and clinical decision making.

Methods

A literature database search was performed electronically via OVID (MEDLINE and SCOPUS), combining the term "comprehensive geriatric assessment" with the following keywords: "mortality," "death," "outcome," "hospital," "nursing home," "randomized controlled trial," "review," and "meta-analysis". The search was restricted to articles published in the English language until June, 2016.

In addition, a manual check on the reference lists in the articles and reviews identified was also conducted to seek any additional sources of information. The criteria for including the articles in this scoping review were randomized controlled trials (RCTs), observational clinical studies, and systematic review/meta-analysis on the use of CGA in older people, independently from settings and conditions. The exclusion criteria were certain types of publication (letters to editors or single case reports) and patients with a mean age below 60 years.

The Key Components of CGA

CGA is sometimes termed geriatric evaluation and management, particularly when geriatric assessment programs combine geriatric evaluation with management.[5] The key components of different models of CGA include a coordinated multidisciplinary assessment, geriatric medicine expertise, identification of medical, physical, social, and psychological problems, and the formation of a plan of care including appropriate rehabilitation.[6]

The core domains of CGA are functional status, mobility, gait speed, cognition, mood and emotional status, nutritional status, comorbidities and polypharmacy, geriatric syndromes (fall risk, delirium, urinary incontinence, dentition, visual, or hearing impairments), disease-specific rating scales (ie, parkinsonism, dementia), goals of care, and advanced care planning. A patient's social and environmental situation also is evaluated, with a focus on the social interactions network, social support needs and resources, financial concerns, and environmental adequacy and safety. CGA uses validated geriatric scales and tests to produce an inventory of health problems, which can then serve to develop an individualized geriatric intervention plan. In many settings, CGA process relies on a core team consisting of a physician (usually a geriatrician), a nurse, and a social worker. When appropriate, specialists in several other disciplines either take part in the basic assessment or act as consultants with an "extended" team of physical and occupational therapists, nutritionists, pharmacists, psychiatrists, psychologists, dentists, audiologists, podiatrists, and opticians. Program setting, goals of assessment, availability of resources, and caseload influence the size of the core and extended team.[4] At present, CGA programs are moving toward a "virtual team" concept in which members are included as needed, assessments are conducted at different locations on different days, and team communication is completed via telephone or electronically.[7]

CGA in Different Healthcare Settings

During the last 30 years, the clinical geriatric models based on CGA have evolved in different healthcare settings to meet differing needs becoming the foundation of "progressive" geriatric care, including acute hospital care, day hospitals, rehabilitation units, nursing homes, and home-care services.[8] In progressive geriatric care, CGA is performed at varying levels of intensity in different settings, and its content may vary with the healthcare setting (ie, hospital, post-hospital discharge/nursing home, or community/home) (Table 1).

In 1993, a seminal meta-analysis on different service-based interventions for older people provided a framework for the definition of inpatient and outpatient models of CGA.[6] Inpatient CGA was divided into 2 types. The first was delivered by a team in a discrete ward, with control over the delivery of the multidisciplinary team recommendations, and these are sometimes known as a geriatric evaluation and management units (GEMU) and acute care for elders (ACE) units. Older people requiring inpatient CGA services can be considered along a continuum, where ACE units provide for the immediate short-term acute health needs and GEMUs provide for subacute health needs requiring longer periods of rehabilitation and restorative care. The second type of inpatient CGA was a multidisciplinary team assessing patients and delivering recommendations to the physicians caring for older patients, and this is known as the inpatient geriatric consultation service (IGCS). Outpatient CGA was divided into 3 types.[6] The first was the home assessment service (HAS) with in-home CGA for community-dwelling older persons. The second was the hospital home assessment service (HHAS) with in-home CGA for patients recently discharged from hospital. The last type was the outpatient assessment service (OAS) with CGA provided in an outpatient setting.

Hospital

In 1981, Rubenstein et al[5] published some hospital-based observational findings coming from a GEMU showing that after 1 year of CGA, treatment, and rehabilitation major improvements occurred in several outcome areas (better placement location, improved functional status, previously unmade diagnoses of treatable disorders, and reduced unnecessary medications), although these pre–post data did not prove causality. A RCT conducted on 123 older patients from the same GEMU confirmed the pre–post data also showing new and unanticipated outcomes, (ie, reduced mortality, re-hospitalization rates, and improved high functioning survival).[29] These exciting findings were confirmed, among others, also by a RCT of a GEMU in a private U.S. rehabilitation

Table 1
Principal Studies and Meta-Analyses on CGA in Different Healthcare Settings: Hospital, Posthospital Discharge/LTC, and Community/Outpatient Consultation

Author, Year, Reference	Setting	Type of Study	Number of Participants/ Trials with General Characteristics	Role of the CGA Intervention	Comments
Stuck et al, 1993[6]	In and outpatients	Meta-analysis	13,447 individuals aged 65 years and older	Reduction in short-term mortality, institutionalization and readmission, improved cognitive functioning and improved physical functioning (only in certain models)	Inpatients CGA: a) GEMUs b) IGCS Outpatients CGA: a) home assessment service b) hospital home assessment service c) outpatient assessment service
Applegate et al, 1990[9]	Hospital	RCT	155 functionally impaired elderly patients with mean age of 78.8 years	Less institutionalization	No difference between the groups in the mean number of days spent in healthcare facilities
Rubenstein et al, 1991[4]	Hospital	Meta-analysis	15 RCTs	Reduction of 39% of mortality for inpatients from IGCSs and a 37% reduction of mortality for inpatients from GEMUs/ACEs	
Landefeld et al, 1995[10]	Hospital	RCT	651 patients aged >70 years	Higher functional independence at discharge, less frequent discharge to a nursing home, shorter and less expensive hospitalization	
Nikolaus et al,1999[11]	Hospital	RCT	545 older patients with acute illnesses	Improvement in functional status the length of the initial hospital stay and subsequent readmissions; reduction in the rate of nursing home admissions	No improvement in survival
Asplund et al, 2000[12]	Hospital	RCT	190 patients aged 70 years and older	Reduction in the length of hospital stay and the need for long-term institutional living	
Counsell et al, 2000[13]	Hospital	RCT	1531 community-dwelling patients, aged 70 years or older, admitted for an acute medical illness	Less ADL decline and nursing home placement after the discharge and during the year following hospitalization	Higher satisfaction rates among patients, family members, physicians, and nurses
Cohen et al, 2002[14]	Hospital	RCT	1388 patients aged 65 years and older	Greater improvements in quality of life, ADL, and physical performance	No effect on survival or hospital costs
Baztán et al, 2009[15]	Hospital	Meta-analysis	11 studies (5 RCTs, 4 nonrandomized trials, and 2 case-control studies)	Lower risk of functional decline and more probability to live at home after discharge	No differences in case fatality
Bachmann et al, 2010[16]	Hospital	Meta-analysis	17 trials with 4780 older people	Multidisciplinary programs were associated with improvement in functional status and decreased nursing home admission and mortality	Postacute geriatric wards in combination with orthogeriatric rehabilitation units
Van Craen et al, 2010[17]	Hospital	Meta-analysis	7 studies (4759 patients)	Less functional decline at discharge from the GEMU and a lower rate of institutionalization 1 year after discharge	

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Table 1 (*continued*)

Author, Year, Reference	Setting	Type of Study	Number of Participants/ Trials with General Characteristics	Role of the CGA Intervention	Comments
Deschodt et al, 2013[18]	Hospital	Meta-analysis	12 studies (4546 participants)	IGCS is beneficial for short-term survival but no effect on functional status, readmission, or length of stay	
Ellis et al, 2011[19,20]	Hospital	Meta-analysis	22 RCTs (10,315 participants)	Patients who received CGA were more likely to be alive and in their own homes at the end of the scheduled follow-up and less likely to be living in residential care compared with usual care	CGA insight the acute ward units appeared to be more effective compared with CGA carried-out by mobile team units
Arbaje et al, 2010[21]	Hospital	RCT	717 hospitalized patients aged 70 years and older on 4 general medicine services	Not significantly higher quality care transitions and greater patient satisfaction with inpatient care	
Siu et al, 1996[22]	Post-hospital discharge	RCT	354 frail patients older than 65 years	No difference between treatment and control arms in reducing mortality, hospital readmission, or long-term care placement after 60 days	
Naylor et al, 1999[23]	Post-hospital discharge	RCT	363 patients (186 in the control group and 177 in the intervention group) older than 65 years	No difference in postdischarge acute care visits, functional status, depression, and patient satisfaction after 24 weeks	Those randomly assigned to the intervention were less likely to be readmitted to the hospital compared with the control group, with also a reduction in cost
Naylor et al, 2011[24]	Post-hospital discharge	Systematic review	21 RCTs	Discharge management programs with in-home follow-up led to a reduction in readmission rates	
van Haastregt et al, 2000[25]	Community-dwelling	Systematic review	6 studies included	No differences in falls and mobility outcomes between the intervention and usual care groups	
Elkan et al, 2001[26]	Community-dwelling	Meta-analysis	15 RCTs	Significant reduction in mortality and admissions to LTC in the general older population	
Huss et al. 2008[27]	Community-dwelling	Meta-analysis	21 RCTs	Multidimensional home CGA programs were effective in reducing functional decline if a clinical examination was conducted and in reducing mortality in patients age ≤77 years old	However, the home visits did not significantly prevent nursing home admissions
Kuo et al, 2004[28]	Outpatients consultation	Meta-analysis	9 studies consisting of 3750 persons	No benefit of outpatient CGA on survival, with tests for heterogeneity showing consistency between RCT data	

ADL, activities of daily living.

hospital.[9] An initial meta-analysis of 6-month mortality on 15 subsequent published RCTs demonstrated a 39% reduction of mortality for inpatients from IGCSs and a 37% reduction of mortality for inpatients from GEMUs/ACEs.[4] Another meta-analysis with a wide range of outcomes including 28 RCTs confirmed that across all CGA programs (GEMU/ACE units, IGCS, HAS, HHAS, and OAS), there was an 18% reduced mortality risk for patients in CGA programs, a 25% increased likelihood of living at home at follow-up, a 41% increase in cognitive improvement, and overall a 12% reduced hospital readmission risk. GEMUs/ACE unit and IGCS programs had more benefit than others; in particular, functional improvement was only significant for patients in the GEMUs/ACE units.[6]

Since this meta-analysis, a number of studies have reported RCTs of hospital-based CGA programs (Table 1).[10–14] In these RCTs, care in GEMUs/ACE units was associated with greater functional independence at discharge, less frequent discharge to a nursing home, shorter and less expensive hospitalization,[10] as well as higher satisfaction rates among patients, family members, physicians, and nurses.[13] Moreover, there have been a number of systematic reviews and meta-analyses of various hospital-based subgroups of CGA (Table 1).[15–18] One meta-analysis looked specifically at ACE units, including also nonrandomized trials and case-control studies, and showing that compared with older people admitted to conventional care units those admitted to ACE units had a lower risk of functional decline at discharge and were more likely to live at home after discharge.[15] A meta-analysis of 17 RCTs evaluating a subgroup of postacute geriatric wards in combination with orthogeriatric rehabilitation units found that inpatient multidisciplinary programs were associated with improvement in all outcomes at discharge, including better functional status, decreased nursing home admission, and reduced mortality (Table 1).[16] Another meta-analysis that evaluated GEMUs alone showed less functional decline at GEMU discharge and a lower rate of hospitalization after 1 year.[17] A meta-analysis of RCTs of IGCS found benefit for short-term survival but no effect on functional status, readmission, or length of stay,[18] substantially confirming 2 previous meta-analyses of IGCS for CGA showing little benefit (Table 1).[6,19,20] As a result, IGCS has largely been abandoned except in teaching settings. All these meta-analyses were limited by wide variability in interventions across collected RCTs.

A subsequent and updated systematic review and meta-analysis of all these subgroups including 22 RCTs of 10,315 participants in 6 countries with inpatient CGA by mobile teams (general ward setting) or in designated wards (GEMUs, ACE units, or rehabilitation wards), found that patients who received CGA were more likely to be alive and in their own homes at the end of the scheduled follow-up and less likely to be living in residential care compared with usual care.[19,20] Moreover, CGA carried out on acute wards appeared to be more effective than CGA carried out by mobile team units. A reduction in the combined outcome of death or functional decline and an improved cognitive functioning was also demonstrated, with a number needed to treat of 17 to avoid 1 unnecessary death or deterioration compared with general medical care (Table 1).[19,20] Finally, some CGA programs have attempted to recreate the core elements of ACE units for hospitalized older persons who are located on general medicine services to improve their hospital care and their transitions to postacute settings.[21] These geriatric-focused models of inpatient care staffed by geriatricians and others trained in delivering care for older adults have been associated with better outcomes, such as reduced risk of institutionalization and functional decline.[15,30] Whether these "virtual" units are as effective as ACE units is unknown. The lack of a consistent nursing staff that is trained in the care of older persons may diminish the effectiveness of this model. In particular, 1 matched cohort study indicated that benefits of the mobile acute care of the elderly service, a novel model of care designed to deliver specialized interdisciplinary care to hospitalized older adults, may include lower rates of adverse events, shorter hospital stays, and better satisfaction of patients.[31]

Posthospital Discharge/Long-Term Care

Posthospital discharge CGA/HHAS usually is initiated 1 to 2 days before hospital discharge aiming to reduce hospital length of stay, unplanned readmission to hospital, and improving the coordination of services following discharge from hospital. This intervention includes targeting criteria to identify vulnerable patients, a program of multidimensional assessment, a comprehensive discharge planning, and home follow-up with nurses trained in geriatric care who visit the patients during the hospitalization and at least twice during the weeks following discharge. The postdischarge home visits are supplemented by telephone calls and eventual additional visits by physical therapy, occupational therapy, social work, and/or home nursing services.

RCTs of CGA have found inconsistent benefit for posthospital discharge/HHAS programs (Table 1).[6,22–24,32] In particular, the meta-analysis of Stuck et al[6] found for HHAS programs only an increased likelihood of living at home after hospital discharge vs death or nursing home placement, with no effects on mortality risk, hospital readmission, and physical and cognitive function. More recently, a systematic review of 21 RCTs on discharge management programs with in-home follow-up reported a reduction in readmission rates, for up to 12 months in some clinical trials (Table 1).[24] Another systematic review conducted on RCTs mainly involving older patients in a variety of settings found that many of the components of CGA were parts of care transition interventions that were effective in reducing rehospitalizations and emergency department (ED) visits.[32]

The development of the Resident Assessment Instrument (RAI) Minimum Data Set (MDS)[33] in 1987 and its introduction in 1991 was prompted by long-term care (LTC) reforms endorsed by the United States (U.S.) government, requiring that all LTC residents undergo a CGA on a regular basis, on admission to a facility, each quarter, and following a significant change in health or functional status. The interRAI network, an international consortium of researchers and clinicians from over 30 countries, was formed to promote and guide the use of the RAI-MDS instrument. In 1995, a revised version of the RAI-MDS, the RAI-MDS 2.0, was developed, resulting in over 400 data elements, with improved reliability.[34] More recently, a new version of the LTC assessment instrument, the interRAI LTC facility, and an adaption of the RAI-MDS 2.0, the RAI-MDS 3.0, were released. At present, the MDS 3.0 has been implemented in the U.S. only, whereas in other countries the RAI-MDS 2.0 continues to be the instrument of choice for collection of assessment data in LTC settings. This CGA-based instrument enables detection of residents' strengths, needs, and potential risks to inform individualized care planning and monitoring. Data collected from residents in LTC is aggregated to produce indicators of the quality of care provided [ie, quality indicators, (QIs)]. One study examined 38 chronic care QIs, of which strong evidence for the validity of 12 of the QIs was found.[35] A systematic review on observational studies conducted in "real world" conditions tested the validity and/or reliability of individual QIs (falls, depression, depression without treatment, urinary incontinence, urinary tract infections, weight loss, bedfast, restraint, pressure ulcer, and pain) with mixed results. This systematic review revealed the potential for systematic bias in reporting, with under-reporting of some QIs (pain, falls, and depression) and over-reporting of others (urinary tract infections).[36] In 30 urban Canadian nursing homes with a total of 94 care units, an observational study showed the necessity of facility-level and unit-level measurement when calculating QIs derived from RAI-MDS 2.0 data for pressure ulcer, antipsychotic with no diagnosis of psychosis, and pain.[37] Furthermore, RAI-MDS can be a valuable tool in targeting residents for a transition program from LTC to community. Secondary

data from RAI-MDS assessments for an annual cohort of first-time admissions to nursing homes suggested that at 90 days the majority of residents showed a preference or support for community discharge and many had health and functional conditions predictive of community discharge or low-care requirements.[38] However, a validation study of the RAI-MDS conducted in 4 U S. states suggested that the accuracy for identifying hospitalization events and payment sources in LTC of this CGA-based tool varied across the study states, and should be evaluated carefully with regard to the intended uses of the data.[39] In a longitudinal cohort study on newly admitted Icelandic nursing home residents, several RAI-MDS 2.0 variables and scales were significant predictors of mortality, including age, sex, place admitted from, functional status, health stability, and social engagement.[40]

Community/Outpatient Consultation

Older patients assessed at home are usually followed for at least 1 year, and home CGA/HAS programs focus primarily on preventive rather than rehabilitative services. Most home CGA/HAS programs include a visiting nurse trained in geriatrics, as well as a physical therapist, social worker, psychologist, and specialty referrals when appropriate. In addition to home visits, telephone follow-up is routinely performed. A substantial body of evidence based on multiple meta-analyses suggested that home assessments appeared to be consistently effective in reducing functional decline and overall mortality(Table 1).[6,25–27,41] In particular, a systematic review, using also formal techniques to pool the data, reported that home visiting was associated with a significant reduction in mortality and admissions to LTC in the general older population (Table 1).[26] In 2002, a meta-analysis carried out through a meta-regression to find program elements associated with greater benefit showed that preventive home visit programs appeared to be effective on the risk of LTC admission, provided the interventions are based on multidimensional CGA, including multiple follow-up home visits and targeting persons at lower risk for death.[41] More recently, a meta-analysis of 21 RCTs found that multidimensional home CGA programs were effective in reducing functional decline if a clinical examination was conducted and in reducing mortality in patients age $\leq$77 years old. However, the home visits did not significantly prevent nursing home admissions,[27] and, like other meta-analyses for home CGA, this analysis was limited by heterogeneity across studies for all outcomes (Table 1).

For outpatient CGA consultation/OAS, a first meta-analysis of 4 RCTs did not demonstrate benefit from outpatient CGA consultation in terms of hospital admission, nursing home placement, or physical/cognitive function.[6] More recently, in another meta-analysis of 9 RCTs evaluating mortality, there was no benefit of outpatient CGA on survival, with tests for heterogeneity showing consistency between RCT data.[28] However, more complex CGA programs addressing adherence to program recommendations and treating patients at higher risk of hospitalization have led to improved outcomes,[42–44] with 1 notable exception.[45] In fact, in a large, cluster-randomized trial of multidimensional CGA followed by either geriatric team management or the primary care clinician alone, there were no differences between the groups in hospitalization, admission to other institutions, and quality of life.[45]

Some innovative approaches to outpatient CGA/OAS have proposed a specialized team management with some of the more successful components of older models adapted to programs within primary care practices. One such approach is the geriatric resources for assessment and care of elders, including home-based CGA and LTC management by a nurse practitioner and social worker who collaborate with the primary care physician and a geriatrics interdisciplinary team. In a RCT of low income older patients, those randomly assigned to the geriatric resources for assessment and care of elders intervention had better health-related quality-of-life and fewer ED visits compared with those assigned to usual care. A subgroup of patients at high risk of hospitalization had also fewer admissions in the second year.[46] Guided care (GC) is an enhanced model of primary care integrating a nurse intensively trained in chronic care into primary care physician practices to provide CGA and chronic care management to older at-risk patients with multiple chronic conditions and complex needs. In a RCT on multimorbid older patients, those randomly assigned to GC reported improved satisfaction rates and had less health care utilization compared with those randomly assigned to usual care at 8 months.[47] Among health maintenance organization patients, the GC intervention also reduced the number of skilled nursing facility admissions and days of hospitalization.[48]

CGA in Specific Settings or Clinical Conditions

Among innovative approaches to outpatient CGA/OAS, practice redesign approaches focus on specific geriatric conditions for assessment and management by physicians or nurse practitioners. However, a series of particular settings or specific clinical conditions were the object or recent interest for tailored CGA programs in older frail patients (Table 2).

Emergency Department

There are a few RCTs addressing the emergency care of older people, mainly focusing on postdischarge support,[49,65] with relatively few addressing the care of older people inside the ED itself.[51,66] In a systematic review with meta-analysis, there was no clear evidence of benefit for CGA interventions in this population in terms of mortality or readmissions or for subsequent institutionalization, functional ability, quality-of-life, or cognition (Table 2).[49] However, some CGA programs for patients discharged to home from the ED were found to be effective at reducing ED visits and hospital admission.[65] One RCT, evaluating the impact of a specialist geriatric assessment in hospital acute medical admission units, did not demonstrate significant improvements in days spent at home (in preference to institutional care), mortality, or other secondary outcomes (Table 2).[50] This RCT, however, did not use full multidisciplinary teams to evaluate patients and, in this respect, may not represent full CGA. Recently, CGA delivered into 1 ED was associated with a statistically significant improved discharge rates from the ED and reduction in hospital readmissions in older people especially in those aged 85 + years.[51]

Orthogeriatrics

Orthogeriatrics was primarily involved in the care and management of fragility hip fractures, but it has recently been expanded to provide specialist care to patients admitted with other various fractures. While CGA-based IGCS has shown little benefit,[6,18–20] comanagement with a geriatrician may be beneficial for hip fracture patients in reducing complications, mortality, readmissions, and delirium.[67–69] Models range from a limited consultation or liaison service through integrated orthogeriatric units. A systematic review conducted on 56 studies suggested that age and cognitive impairment were the best CGA-based predictors of LTC placement after hip fracture.[70] Predictors of increased mortality in LTC residents after hip fracture were age, male sex, disability, coronary artery disease, presurgery anemia, pressure ulcers, and pneumonia, whereas predictors of subsequent fracture were higher function level, previous fracture, and previous falls.[70] Few orthogeriatric care models have been evaluated in RCTs, and the heterogeneity of interventions, outcomes, and populations makes it difficult to draw conclusions regarding the superiority of 1 particular model. However, a systematic review and meta-analysis conducted on 18 RCTs on various orthogeriatric care models (routine geriatric consultation, geriatric ward with orthopedic consultation,

Table 2
Principal Studies and Meta-Analyses on CGA in Specific Settings or Clinical Conditions

Author, Year, Reference	Settings/Clinical Condition	Type of Study	Number of Participants/ Trials with General Characteristics	Main Findings of the CGA Intervention	Comments
Conroy et al, 2011[49]	ED (postdischarge support)	Meta-analysis	5 trials with 2287 participants	No clear evidence of benefit for CGA interventions in terms of mortality or readmissions or for subsequent institutionalization, functional ability, quality-of-life or cognition	
Edmans et al, 2013[50]	Hospital acute medical admission units	RCT	433 patients aged 70 or older who were discharged within 72 hours of attending an acute medical assessment unit and at risk of decline	Not significant improvements in days spent at home (in preference to institutional care), mortality, or other secondary outcomes	Possible bias from the lack of full multidisciplinary teams
Conroy et al, 2014[51]	ED (postdischarge support)	RCT	2063 participants aged more than age 85 years	Significant reduction in admissions and readmissions in people aged 85+ following discharge from the ED	
Grigoryan et al, 2014[52]	Orthogeriatrics	Meta-analysis	18 RCTs	Significant reduction of in-hospital and long-term mortality, length of stay was also significantly reduced, particularly in the shared care model, although heterogeneity limited this interpretation	
Partridge et al, 2014[53]	Preoperative assessment	Systematic review	5 trials	CGA reduced postoperative complications by 11.8% and the time to be "fit for discharge" by 0.5 days, while total costs were unchanged	No study of intervention
Oresanya et al, 2014[54]	Preoperative assessment	Systematic review	56 trials	Cognitive impairment was associated with postoperative delirium, whereas frailty was associated with a 3- to 13-fold increased risk of discharge to a nursing home	No study of intervention
Caillet et al, 2014[55]	Solid cancers	Systematic review	29 studies	CGA identified a large number of unrecognized health problems capable of interfering with cancer treatment, CGA results influenced 21%–49% of treatment decision-making processes, and the CGA domains most often reported as predicting mortality and chemotoxicity were functional impairment, malnutrition, and comorbidities	

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Table 2 (*continued*)

Author, Year, Reference	Settings/Clinical Condition	Type of Study	Number of Participants/ Trials with General Characteristics	Main Findings of the CGA Intervention	Comments
McCorkle et al, 2000[56]	Cancer treated surgically	RCT	375 patients aged 60 to 92 years	Significant survival gains with home care by advanced practice nurses	
Goodwin et al, 2003[57]	Cancer treated surgically	RCT	335 women (166 control and 169 intervention) aged 65 years and older newly diagnosed with breast cancer	Improved appropriateness of treatment strategies with nurse case management	
Hempenius et al, 2013[58]	Elective surgery for solid cancer	RCT	260 patients included	No decrease the occurrence of postoperative delirium, other complications, or death	
Kalsi et al, 2015[59]	Cancer treated with chemotherapy	RCT	135 (70 treated vs 65 controls, with standard oncologic therapy)	Improved chemotherapy tolerance	
Stuck et al, 1993[6]	Cognitive impairment	Meta-analysis	28 trials with 4959 persons allocated to 1 of 5 CGA types and 4912 controls	CGA increased the chance of detecting cognitive impairment of 41%	
Ellis et al, 2011[19,20]	Cognitive impairment	Meta-analysis	22 RCTs (10,315 participants)	A reduction in the combined outcome of death or functional decline and an improved cognitive functioning was demonstrated, with a number needed to treat of 17 to avoid one unnecessary death or deterioration compared with general medical care	
Ganz et al, 2010[60]	Dementia	RCT	200 patients (108 intervention, 92 control)	Improvements in quality of care for dementia, falls, and urinary incontinence	Model of nurse practitioner comanagement for 5 geriatric conditions (falls, urinary incontinence, dementia, depression, and heart failure)
Reuben et al, 2013[61]	Dementia	RCT	485 patients aged 75 years and older	Better quality of care for geriatric conditions	
Watne et al, 2014[62]	Cognitive status in people with hip fracture	RCT	329 patients	No evidence that cognitive function was improved 4 months after surgery	
Gallucci et al, 2014[63]	Cognitive impairment	Observational (prospective)	340 outpatients	MPI was effective in detecting the risk of all-cause mortality and hospitalization	
Pilotto et al, 2009[64]	Dementia	Observational (prospective)	262 patients	MPI was effective in detecting the risk of short and long all-cause mortality	

MPI, multidimensional prognostic index.

and shared care) found that orthogeriatric collaboration was associated with a significant reduction of in-hospital and long-term mortality; length of stay was also significantly reduced, particularly in the shared care model, although heterogeneity limited this interpretation (Table 2).[52] A recent review on the optimal setting and care organization in the management of older adults with hip fracture reported that differences in the trials interventions, populations, and outcomes hamper the ability to define which model, setting, and care organization may be optimal or better than the others in terms of short- and long-term outcomes. Patients receiving a CGA-based approach, however, demonstrated better overall outcomes compared with patients receiving a traditional non-CGA based approach.[71] On the other hand, it should be emphasized that there is still insufficient evidence to draw conclusions about how effective these models may be for patients with prefracture cognitive decline or severe disability.[72]

Preoperative Assessment

Geriatric conditions are often associated with adverse surgical outcomes. Therefore, goals, priorities, and life expectancy need to be assessed in frail older adults to determine whether surgical management is preferable to alternative approaches. A systematic review on 5 studies evaluating the impact of preoperative assessment on postoperative outcomes in older patients undergoing elective surgery showed that CGA reduced postoperative complications by 11.8% and the time to be "fit for discharge" by 0.5 days, whereas total costs were unchanged (Table 2).[53] Another systematic review on this issue identified 54 studies of older patients, with a substantial heterogeneity in study methods, measures, and outcomes. The absolute risk and risk ratios relating preoperative clinical conditions to mortality varied widely: 10% to 40% for cognitive impairment, 10% to 17% for malnutrition, and 11% to 41% for institutionalization. Preoperative cognitive impairment was associated with postoperative delirium, whereas frailty was associated with a 3- to 13-fold increased risk of discharge to a LTC facility (Table 2).[54] Therefore, individualized preoperative optimization strategies for older persons should target CGA-based functional, cognitive, and nutritional conditions and communication of realistic risk estimates are essential to guide individualized clinical decision making.

Cancer

The U.S. National Comprehensive Cancer Network, International Society of Geriatric Oncology, and European Organization for Research and Treatment of Cancer recommend a CGA-based approach for older patients with cancer[73] for detecting unrecognized health problems that may interfere with cancer treatment and/or compete with cancer as a cause of death. A systematic review on 29 studies describing CGA findings in older patients with solid malignancies showed that all types of CGA identified a large number of unrecognized health problems capable of interfering with cancer treatment, CGA results influenced 21%–49% of treatment decision-making processes, and CGA domains most often reported as predicting mortality and chemotoxicity were functional impairment, malnutrition, and comorbidities.[55] Very few RCTs have assessed the potential effect on patient outcomes of CGA-based management and follow-up of health problems in older patients with cancer (Table 2).[55] Two RCTs in older postsurgical patients with cancer showed significant survival gains with home care by advanced practice nurses[56] or improved appropriateness of treatment strategies with nurse case management (Table 2).[57] In a more recent RCT in older patients undergoing elective surgery for solid cancer, an individualized geriatric intervention plan based on patient-related risk factors for delirium failed to decrease the occurrence of postoperative delirium, other complications, or death (Table 2),[58] confirming the need for further RCTs of patient outcomes after CGA-based geriatric interventions. On the other hand, a comparative study of 2 cohorts of older patients (aged 70 + years) undergoing chemotherapy demonstrated that geriatrician-led CGA interventions were associated with improved chemotherapy tolerance suggesting that standard oncology care should shift toward modifying coexisting conditions to optimize chemotherapy outcomes for older people (Table 2).[59]

Cognitive Impairment/Dementia

The first meta-analysis of Stuck et al[6] showed that across all CGA programs, there was a 41% increased chance of cognitive improvement. These findings were substantially confirmed also in the large meta-analysis of Ellis et al[19,20] in which older patients were more likely to experience improved cognition in the CGA group (Table 2). Several studies with a practice redesign intervention conducted in different settings confirmed these meta-analytic findings. In a preliminary study within an academic geriatrics practice, a model of nurse practitioner comanagement for 5 geriatric conditions (falls, urinary incontinence, dementia, depression, and heart failure) resulted in improvements in quality of care for dementia, falls, and urinary incontinence compared with a wait list control group (Table 2).[60] Similar findings with the same model of comanagement have been demonstrated in community-based practices for quality of care for dementia, falls, and urinary incontinence.[61] On the other hand, a RCT of patients with a hip fracture found no evidence that cognitive function 4 months after surgery was improved in patients treated with pre- and postoperative orthogeriatric care provided in an acute geriatric ward, compared with usual care in an orthopedic ward. The intervention had only a positive effect on mobility in patients not admitted from LTC (Table 2).[62] Recently, a CGA-based multidimensional prognostic index was effective in assessing the risk of all-cause mortality and hospitalization in 340 outpatients evaluated in a tertiary care center for cognitive impairment[63] and short- and long-term mortality in 262 hospitalized demented patients aged 65 years and older (Table 2).[64]

Multidimensional Geriatric Assessment and Clinical Decision Making

A large and increasing body of evidence indicated that the prognosis of older patients was strongly related to the presence of concomitant diseases and to the degree of physical, cognitive, biological, and social impairment.[74] CGA, capable of effectively exploring these multiple domains of health, is indeed the multidimensional and multidisciplinary tool of choice to determine the prognosis of the functionally compromised and frail older patient [ie, multidimensional geriatric assessment (MGA)].[75] These new multidimensional instruments include several items exploring different domains and reassuming them in a single, standardized, numerical score, assessing the global impairment of the patient that expressed the risk of health negative outcomes such as institutionalization, hospitalization, or death. Examples of these cumulative CGA-based indices are the Frailty Index-CGA[76] and the Multidimensional Prognostic Index (MPI)[77] that could be useful in identifying high-risk older patients, predicting low, moderate, and severe risk of all-cause mortality. These tools are mainly based on a list of risk factors that are mentioned to be of great importance to the concept of CGA, including the physical dimension (nutritional status, physical activity, mobility, strength, and energy), the psychological dimension (cognition and mood), and the social dimension (lack of social contacts and social support).

A large systematic review identified a small number of prognostic indices for mortality meeting the requirements of accuracy and calibration required to be used in a clinical setting involving hospitalized older patients (8 indices), living in nursing homes (2 indices), and living in their own homes (6 indices).[78] Among the 8 indices selected in the hospital-based setting, the MPI was the only 1 CGA-based predictive tool to be included in this list, with a good discrimination as well as an accuracy that is maintained both at 1 month and 1 year of follow-up.[78] In addition, a prospective multicenter study involving over 2000 hospitalized older patients recruited in 20 ACE units has shown that MPI was a significantly more accurate predictor of short- and long-term all-cause mortality than other 3 frailty indices commonly used in clinical practice,[79] including the Frailty Index-CGA. Recently, multicenter prospective studies showed that MPI was also an independent predictor of in-hospital mortality and the length of hospital stay,[80] as well as a tool sensitive to clinical changes of patients' health status during hospitalization suggesting that MPI may be used to monitor the clinical evolution of acutely ill geriatric patients admitted to the hospital.[81] Modified versions of the MPI, based on information collected during home-based CGA assessments, have

been validated in very large populations of Italian community-dwelling frail older persons who underwent the CGA to access to home-care services or nursing home admission,[82] as well as in a population-based cohort of Swedish older individuals living at home or in institution[83] demonstrating very good accuracy and excellent calibration in predicting life expectancy and length of hospital stay during a follow-up ranging from 3 to over 12 years. Similarly, a modified MPI based on a CGA including 8 domains demonstrated good accuracy in predicting 3-year and 5-year mortality in both community-dwelling and hospitalized older patients living in Korea.[84]

However, there is currently no clear evidence that incorporating prognosis in clinical practice may improve patients' care and outcomes. For example, older patients with poor long-term prognosis frequently received routine cancer screening[85]; conversely, adequate cancer screening was not carried-out in healthy older adults with a long life expectancy who may benefit from a cancer screening program.[86] Very recently, the CGA-based MPI have been implemented in older people to evaluate if a different individual prognostic profile was associated with a different mortality rate after treatments for specific disorders (ie, statins in older patients with diabetes mellitus[87] or coronary artery disease[88] and anticoagulants in older patients with atrial fibrillation).[89] These studies suggested that with full access to prognostic information derived from CGA-based predictive tools, physicians are better equipped to make clinical decisions that are aligned with their patients' needs in terms of safety and efficacy. Despite clinical recommendations to incorporate patients' prognosis in clinical decisions, a recent observational study of primary care practitioners demonstrated that several barriers (ie, uncertainty in predicting prognosis, difficulty in discussing prognosis, and concern about patients reactions) may limit the implementation of these recommendations.[90]

Conclusions

A systematic CGA of older adults may identify a variety of treatable health problems and lead to better health outcomes. Healthcare settings or specific clinical conditions may modify the effectiveness of CGA programs. Home and hospital CGA programs were shown to be consistently beneficial for several health outcomes, including mortality, disability, and cognitive functions. Ongoing studies explore the clinical usefulness of CGA programs in older frail patients who are candidates for surgery, admitted to EDs and orthogeriatric units, and diagnosed with cancer or cognitive impairment. Multidimensional impairment is strongly related to the prognosis of older patients. CGA-based accurate and calibrated prognostic tools could help clinical decision making in both diagnostics and therapeutics of older people. Future studies are needed to test the ability of CGA-based prognostic tools in tailoring appropriate interventions and improving clinical outcomes of older adults.

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