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REVIEW ARTICLE

Geriatric assessment for the practicing clinician: The why, what, and how

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Abstract

Older adults with cancer heterogeneously experience health care, treatment, and symptoms. Geriatric assessment (GA) offers a comprehensive evaluation of an older individual's health status and can predict cancer-related outcomes in individuals with solid tumors and those with hematologic malignancies. In the last decade, randomized controlled trials have demonstrated the benefits of GA and GA management (GAM), which uses GA information to provide tailored intervention strategies to address GA impairments (e.g., implementing physical therapy for impaired physical function). Multiple phase 3 clinical trials in older adults with solid tumors and hematologic malignancies have demonstrated that GAM improves treatment completion, quality of life, communication, and advance care planning while reducing treatment-related toxicity, falls, and polypharmacy. Nonetheless, implementation and uptake of GAM remain challenging. Various strategies have been proposed, including the use of GA screening tools, to identify patients most likely to benefit from GAM, the systematic engagement of the oncology workforce in the delivery of GAM, and the integration of

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technologies like telemedicine and mobile health to enhance the availability of GA and GAM interventions. Health inequities in minoritized groups persist, and systematic GA implementation has the potential to capture social determinants of health that are relevant to equitable care. Caregivers play an important role in cancer care and experience burden themselves. GA can guide dyadic supportive care interventions, ultimately helping both patients and caregivers achieve optimal health.

KEYWORDS
aging, geriatric assessment, geriatric oncology, treatment-related toxicity

INTRODUCTION

In an aging global population, the intersection of oncology and geriatrics becomes increasingly important. Older adults with cancer present a complicated set of medical, social, economic, and physical circumstances, necessitating personalized approaches. The aging process is a heterogeneous experience, and chronologic age alone has proven an unreliable surrogate for functional and health status for older adults, particularly those with cancer considering treatment.

Traditionally, oncology studies have incorporated brief measures of functional health status, most commonly the Eastern Cooperative Oncology Group performance status (ECOG PS)[1] or the Karnofsky performance scale.[2] Reliance on these conventional measures of function, however, does not provide a nuanced picture of an older adult's overall health status, which can lead to an unreliable prediction of how a patient will tolerate cancer therapy.[3] These performance scales consist of a user-dependent numeric estimation of physical function and are subject to both bias and variability based on the observer.[4,5] Although a poor ECOG PS correlates well with abnormalities in physical function, it correlates only moderately well with impaired physical performance, cognition, and psychological assessments; and it does not reflect other domains, including nutritional status, social environment, and comorbidities.[4,6] Biases have been observed in physician assessments of performance status, whereby older adults are assigned worse scores than younger counterparts despite equivalent physical capacities.[7] Accurate assessment of health status is critical for clinical decision making for cancer treatment and for eligibility for clinical trials; a more comprehensive assessment of health status is clearly needed.[8]

Geriatric assessment (GA) utilizes measures that evaluate clinically relevant domains in older adults, including physical performance, functional status, comorbidity, polypharmacy, nutrition, cognition, social support, and psychological status.[9,10] In older adults with cancer, integration of GA into oncology care is now guideline-recommended to inform decision making and improve outcomes. In 2014, the International Society of Geriatric Oncology (SIOG) advocated a standardized assessment of geriatric domains, such as function, comorbidity, social support, nutrition, and geriatric syndromes (i.e., clinical syndromes that increase the risk of adverse outcomes in older adults)[11]; at that time, however, the expert SIOG panel could not recommend specific tools due to insufficient evidence. Over the last 10 years, SIOG has summarized the evidence for GA in treatment decision making for many solid tumor malignancies, including breast cancer,[12] bladder cancer,[13] and renal cell carcinoma.[14] More recently, SIOG has recommended the integration of GA into the care of older adults with hematologic malignancies, including acute myelogenous leukemia,[15] acute promyelocytic leukemia,[16] and chronic lymphocytic leukemia.[17] The American Society of Clinical Oncology (ASCO)[18] and the National Comprehensive Cancer Network[19] have concluded that GA measures could predict adverse outcomes from cancer therapy in older adults and thus have recommended their use for treatment decision making. In 2023,[10] An ASCO expert panel summarized data from randomized controlled studies demonstrating the benefits of GA and GA management (GAM) for older patients with cancer; in GAM care-delivery models, GA guides therapeutic decision making and evidence-based, aging-sensitive management interventions to address geriatric impairments (e.g., physical therapy for an older adult who is falling). The ASCO panel proposed the adoption of a practical GA (PGA) designed to guide management and overcome barriers to implementation in clinical practice, including low-resource settings.[20]

Herein, we summarize the evidence supporting the utility of GA in the prediction of treatment-related toxicity and data supporting GAM care-delivery models to improve communication, reduce treatment-related toxicity, and enhance quality of life. We also provide evidence for the feasibility of integrating GA into oncology care, the utility of screening tools as a mechanism to identify older patients with cancer who would benefit from GA, and practical suggestions to overcome barriers to the implementation of a GAM care-delivery model. Furthermore, we discuss recommendations for future work to optimize GA for diverse populations and dyadic GAM interventions for patients and caregivers. The goal of this review is to stress the ways that GAM can help their older patients and their caregivers challenged by cancer and provide the information needed to champion this important care-delivery model in their practices.

GA PREDICTIVE MODELS FOR TREATMENT-RELATED TOXICITY IN OLDER ADULTS WITH CANCER

Several predictive models based on GA domains have been created to guide management for older adults with cancer (Table 1). The Cancer and Aging Research Group (CARG) model was developed and subsequently validated by Hurria et al.[21] to predict the risk of severe

TABLE 1 Models for predicting severe chemotherapy toxicity in solid tumor malignancies.

Predictive model	Cancer type	Variables predictive of chemotherapy toxicity	Website
Cancer and Aging Research Group (CARG)	Solid tumor malignancies	Age, cancer type of GI or GU malignancy, standard chemotherapy dosing, polychemotherapy regimen, anemia, reduced renal function, hearing impairment, history of fall in past 6 months, limited ability in walking one block, needing assistance taking medications, decreased social activities because of health	www.mycarg.org
Chemotherapy Risk Assessment for High-Age Patients (CRASH)	Solid tumor malignancies, lymphoma	*Hematologic toxicity prediction:* Lymphocyte level, AST, IADL, LDH, diastolic blood pressure, and Chemotox score (classification of treatment regimen type) *Nonhematologic toxicity prediction:* Anemia, reduced renal function, albumin, self-rated health ECOG PS, Mini-Mental Status score, Chemotox score	https://www.mdcalc.com/calc/10425/chemotherapy-risk-assessment-scale-high-age-patients-crash-score
CARG-Breast Cancer	Localized breast cancer	Anthracycline use, stage II or III disease, planned treatment duration >3 months, abnormal liver function, anemia, history of fall in past 6 months, limited ability to walk one block, and lack of social support	www.mycarg.org

Abbreviations: AST, aspartate aminotransferase; ECOG PS, Eastern Cooperative Oncology Group performance status; GI, gastrointestinal; GU, genitourinary; IADL, instrumental activities of daily living; LDH, lactate dehydrogenase.

chemotherapy toxicity (i.e., clinician-rated grade 3–5 adverse events according to the Common Terminology Criteria for Adverse Events). Using core clinical variables (e.g., age, renal function, tumor and treatment characteristics) and GA measures (e.g., fall history, social activities, hearing loss) for older adults with any stage solid tumor malignancies starting a new chemotherapy regimen, this model stratifies patients into low-risk, medium-risk, and high-risk categories for severe chemotherapy toxicity, and it is superior to the clinician-rated Karnofsky performance scale for identifying older adults at risk.[3,21] The CARG measure takes less than 5 minutes to administer and facilitates patient–provider discussions about the relative risk of serious toxicities across various therapy regimens. A modified CARG measure can help identify patients at high risk of toxicity-related hospitalizations[22] and falls.[23] Although the CARG toxicity tool has been validated in other populations (e.g., a multiethnic Asian population in Singapore[24] and older adults in Japan[25]) and in patients with specific cancer types,[26,27] some studies suggest that the CARG toxicity tool may not be equally predictive of toxicity in all populations.[28] These differences may be related to how treatment decisions occur in different health care systems, highlighting the need to understand the value of the tool in disparate populations.

The CARG breast cancer tool was specifically tailored for patients with localized breast cancer and considers specific factors for breast cancer therapies in addition to the comprehensive clinical and GA variables.[29] This risk-prediction model allows for a more targeted estimate of chemotherapy toxicity in this population subset. Studies indicated that higher risk groups had higher rates of hospitalization during the course of therapy as well as reduced dose intensity,[29] which compromised treatment efficacy.[30]

The Chemotherapy Risk Assessment Scale for High-Age Patients (CRASH) is another model that focuses on predicting severe chemotherapy toxicity and determining the appropriateness of chemotherapy in older adults.[31] Developed by Extermann et al., CRASH assigns patients with hematologic and nonhematologic malignancies to four risk categories (i.e., low, mid-low, mid-high, and high) based on age-related factors and GA parameters (e.g., cognition, nutritional status, and instrumental activities of daily living [IADLs]). This battery is slightly longer, because it incorporates full measures rather than individual question items, averaging 20–30 minutes to administer and calculate.[31] The CRASH model included older patients with hematologic malignancies, as opposed to the CARG model, which only included those with solid tumors during its development.[32]

These three prediction models vary in scope, variables considered, and target population. The CARG tool evaluates general factors like age, sex, and performance status and applies to a broad range of patients with solid tumor malignancies. Subsequent studies also found that the CARG tool may predict toxicities in lymphoma and multiple myeloma.[33] The CARG breast cancer model focuses on patients with localized breast cancer receiving adjuvant or neoadjuvant regimens. The CRASH model applies to older patients with both solid tumor and hematologic malignancies. Despite their differences, each model identifies GA variables as useful predictors for treatment toxicity.[34] Similar GA domains were associated with treatment toxicity across all models, such as fall history and physical function. Each model was developed and validated in independent, unique cohorts for predictive performance, and clinicians should choose a model for toxicity prediction that is the most appropriate for the specific characteristics of their patients (Table 1).

GA FOR PREDICTING OUTCOMES IN OLDER ADULTS WITH SPECIFIC HEMATOLOGIC MALIGNANCIES

It is well established that GA can predict the outcomes of older adults with various hematologic malignancies (Table 2).[35–45] Given variability in disease course and treatment regimens in hematologic malignancies, several risk-prediction scores using GA variables have been developed (Table 3).[41,43,46–58] In each setting, GA variables help to better discriminate risk versus treatment benefit. Across studies, the importance of assessing function and comorbidity is consistently demonstrated, although specific measures and outcomes may differ by disease setting or treatment intensity. For example, the Fondazione Italiana Linfomi incorporated GA into the International Prognostic Index to generate the Elderly Prognostic Index, which better predicts outcomes among older patients with diffuse large B-cell lymphoma

TABLE 2 Selected studies of geriatric assessment and associated outcomes in hematologic malignancies.

Reference(s)	Design	Cancer and setting	No. of patients	Age group included and median/mean ages if provided	Geriatric assessment variables associated with outcomes	Associated outcomes
Klepin 2013[35]	Prospective	AML, inpatient induction	74	≥60 years; mean, 70 years	Physical function (SPPB), cognition (modified MMSE)	Overall survival
Min 2022[36]	Prospective	AML, inpatient induction	105	60–75 years; median, 64 years	Physical function (SPPB, gait speed, sit-and-stand speed), cognition (MMSE-KC), depressive symptoms (SGDS-K)	Nonfatal toxicities (infections, acute kidney failure, prolonged hospitalization), overall survival
Saad 2020[37]	Prospective	AML, before consolidation	40	≥60 years; median, 68.7 years	Physical function (SPPB) Depression (Center for Epidemiologic Studies depression scale)	Overall survival
Molga 2020[38]	Prospective	MDS	98	≥65 years; median, 77 years	Physical function (IADL, timed up and go), cognition (MMSE), comorbidities (CCI)	Treatment duration, overall survival
Evens 2018[39]	Prospective	Hodgkin lymphoma, Bv-AVD	48	≥60 years; median, 69 years	Comorbidities (CIRS-G), physical function (IADL)	Progression-free survival
Nabhan 2012[40]	Retrospective	Non-Hodgkin lymphoma	303	≥80 years; median, 83–84 years	Physical function (ADL)	Progression-free survival, overall survival
Tucci 2015[41]	Prospective	DLBCL	177	>69 years; median, 77 years	Physical function (ADL, IADL), comorbidities (CIRS-G)	Overall survival
Johnson 2023[42]	Prospective (as part of a phase 3 RCT)	CLL, bendamustine and rituximab (BR) vs. ibrutinib and BR vs. ibrutinib alone	369	≥65 years; median, 71 years	Social activities (MOS-SS), nutritional status (weight loss)	Overall survival
Palumbo 2015[43]	Prospective	Multiple myeloma	869	Median, 74 years	Physical function (ADL, IADL), comorbidities (CCI)	Overall survival, treatment discontinuation, risk of toxicity
Olin 2020[44]	Registry	All hematologic malignancies, before allogeneic HSCT	330	≥50 years; median, 63 years	Cognition (BOMC), comorbidities (HCT-CI)	Nonrelapsed mortality, overall survival
Muffly 2014[45]	Prospective	All hematologic malignancies, before allogeneic HSCT	203	≥50 years; median, 58 years	Physical function (IADL, walk speed), comorbidities (HCT-CI), psychological health (Short Form 36 mental component summary)	Overall survival

Abbreviations: ADL, activities of daily living; AML, acute myeloid leukemia; BOMC, Blessed Orientation Memory Concentration; Bv-AVD, brentuximab vedotin with standard doxorubicin, vinblastine, and dacarbazine; CCI, Charlson Comorbidity Index; CIRS-G, Cumulative Illness Rating Scale-Geriatric; CLL, chronic lymphocytic leukemia; DLBCL, diffuse large B-cell lymphoma; HADS, Hospital Anxiety and Depression Scale; HCT-CI, Hematopoietic Cell Transplant-Comorbidity Index; HSCT, hematopoietic stem cell transplantation; IADL, instrumental activities of daily living; MDS, myelodysplastic syndrome; MMSE, Mini-Mental State Examination; MMSE-KC, Mini-Mental State Examination in the Korean version of the Consortium to Establish a Registry for Alzheimer's Disease assessment packet; MOS-SS, Medical Outcomes Study-social activities; RCT, randomized controlled trial; SGDS-K, Korean version of the short form of geriatric depression scales; SPPB, Short Physical Performance Battery.

TABLE 3 Selected risk stratification models specific to various hematologic malignancies using geriatric assessment variables.

Hematologic malignancies	Risk stratification system/score (reference[s])[a]	Variables included	Outcomes	Website
AML	AML-composite model (Sorror 2017, 2019[46,47])	Age, cytogenetic/molecular risk per ELN, comorbidities	Overall survival	http://www.amlcompositemodel.org/
MDS	Revised 15-item MDS-specific frailty scale (Wan 2020[48])	Fatigue, 4-meter walk test, meal preparation in IADL, BMI, and various laboratory values	Overall survival, hospitalization, cost of care (Mozessohn 2023[49])	https://qxcalc.app.link/mdsfrailty
	42-item MDS-specific frailty scale (Starkman 2020[50])	BMI, nine comorbidities, fatigue, IADL, EQ-5D-3L, various laboratory values, grip strength, 4-meter walk test, 10x chair sits test	Overall survival	—
MM	Revised Myeloma Comorbidity Index (Engelhardt 2017[51])	KPS, nine comorbidities, disability, frailty, pain, cytogenetics	Overall survival	http://www.myelomafrailtyscorecalculator.net/
	IMWG frailty score (Palumbo 2015[43])	Age, CCI, ADL, IADL	Overall survival, treatment discontinuation, risk of toxicity	—
	Simplified IMWG score (Facon 2020[52])	Age, CCI, ECOG PS	Progression-free survival, overall survival, adverse events	—
DLBCL	Fondazione Italiana Linfomi simplified GA (Tucci 2015[41])	ADL, IADL, CIRS-G, age	Overall survival	—
	Elderly Prognostic Index (Merli 2021[53])	ADL, IADL, CIRS-G, age, stage, ECOG PS, LDH level, number of extranodal site	Overall survival	—
	Geriatric-8 (Oiwa 2021,[54] Lee 2021[55])	Food intake, weight loss, mobility, neuropsychological conditions, BMI, number of prescription drugs, self-rated health, age	Treatment intensity, treatment toxicity, overall survival	https://www.mdcalc.com/calc/10426/g8-geriatric-screening-tool
	Age, Comorbidities, and Albumin (ACA) index (Miura 2017[56])	Age, CCI, albumin	Overall survival, treatment intensity, treatment discontinuation, treatment toxicity	—
HSCT	Hematopoietic cell transplantation-comorbidity index (Sorror 2005[57])	17 comorbidities	Overall survival, nonrelapsed mortality	http://www.hctci.org/
Several hematologic malignancies (AML, MDS, MM, CLL)	Geriatric assessment in hematology (De La Rubia 2023[58])	Number of drugs, frailty, ADL, nutrition, mental status, comorbidities	Treatment toxicity	—

Abbreviations: ADL, activities of daily living; AML, acute myeloid leukemia; BMI, body mass index; CCI, Charlson Comorbidity Index; CIRS-G, Cumulative Illness Rating Scale-Geriatric; CLL, chronic lymphocytic leukemia; DLBCL, diffuse large B-cell lymphoma; ECOG PS, Eastern Cooperative Oncology Group performance status; ELN, European LeukemiaNet; EQ-5D-3L, three-level version of the EuroQol Group five-dimensional quality-of-life questionnaire; GA, geriatric assessment; HSCT, hematopoietic stem cell transplantation; IADL, instrumental activities of daily living; IMWG, International Myeloma Working Group; KPS, Karnofsky performance scale; LDH, lactate dehydrogenase; MDS, myelodysplastic syndrome; MM, multiple myeloma.

[a]Includes at least one geriatric assessment variable.

(DLBCL).[53] Specifically, the Elderly Prognostic Index incorporates age, comorbidities, functional status, and disease-specific features (e.g., stage, lactate dehydrogenase level, number of extranodal sites) and categorizes patients into three risk groups: low, intermediate, and high. The higher risk categories are associated with worse overall survival. In myelodysplastic syndrome (MDS), specific frailty indices have been developed.[48,50] For example, the 15-item MDS-specific frailty index incorporates variables such as fatigue, assistance with food preparation, and 4-meter walk time, and greater frailty is associated with worse overall survival. In multiple myeloma, one common risk

classification is the International Myeloma Working Group frailty score, which incorporates age, comorbidities, and functional status to categorize patients as fit, intermediate, or frail. Risks of toxicity and mortality were higher in the frail group, followed by the intermediate and fit groups.[43] Other risk-prediction scores generally focus on comorbidities (e.g., the Hematopoietic Cell Transplantation Comorbidity Index, the Acute Myeloid Leukemia-Composite Model)[57] or adapt existing frailty indices, which may or may not include additional variables, such as functional status or disability, to increase disease specificity (e.g., the revised Myeloma Comorbidity Index).[51,59] Efforts are ongoing to incorporate GA into some established comorbidity indices to improve risk stratification.[60] In practice, routine collection of activities of daily living (ADLs), IADLs, and comorbidity burden can facilitate the implementation of several risk-prediction models for older adults with hematologic malignancies.

GA FOR TREATMENT DECISION MAKING

GA is useful when considering cancer-directed treatment or selecting patients in certain risk categories for innovative treatment approaches. In a systematic review of 61 studies, it was observed that GA changed the treatment course in 31% of patients (range, 7%–56%), typically to a less intensive option.[61] This process has been studied in several cancer types, including lung cancer, pancreatic cancer, acute myeloid leukemia, and lymphoma.[62–65] In lung cancer, the Elderly Selection on Geriatric Index Assessment study (ESOGIA-GFPC 08-02) randomly assigned adults aged 70 years and older with an ECOG PS of 0–2 and stage IV nonsmall cell lung carcinoma to GA-guided treatment versus standard of care.[62] Survival was not different between arms, but those who received GA-guided treatment had lower rates of toxicities. In addition, the patients who received GA-guided treatment had a longer treatment failure-free survival (time until treatment discontinuation for any reason, including disease progression, treatment toxicity, or early death). In lymphoma, the R-CHOP versus R-mini-CEOP in Elderly Patients with DLBCL (ANZINTER3) study (ClinicalTrials.gov identifier NCT01148446) selected patients older than 65 years with an ECOG PS of 0–3 and stage II−-IV DLBCL who were fit based on ADLs, comorbidities, and the presence/absence of geriatric syndromes.[63] Patients were randomly assigned to standard-dose R-CHOP (rituximab, cyclophosphamide, doxorubicin, vincristine, and prednisone) or the less intensive R-mini-CEOP (rituximab plus cyclophosphamide, etoposide, vincristine, and prednisone). Outcomes were similar between groups; those older than 72 years with low-risk disease had better outcomes with the less intensive approach.[63] Other studies investigating GA-guided treatment approaches are ongoing.[66]

GAM TO IMPROVE OUTCOMES

Older adults often prioritize outcomes like physical function, cognition, and quality of life over longevity.[67–69] The utility of GA is not limited to informing therapeutic decision making; it can also guide management interventions to mitigate identified vulnerabilities, because these vulnerabilities are often what older adults care most about. For example, a patient who has falls with decreased physical function on GA could be referred for balance training with a physical therapist; if the home environment is suspected to be unsafe, a home evaluation could be initiated with recommendations for environment modification. A systematic review of 61 studies found that nononcologic interventions were recommended in over 70% of patients receiving GA, most commonly with a focus on social supports, nutrition, and polypharmacy.[61] A positive effect on treatment completion was seen in the majority of studies, and treatment-related toxicities and complications were reduced with the use of GA. In addition, GA improved communication and led to more goals-of-care conversations. In a systematic review and meta-analysis of 17 randomized controlled trials (RCTs) of GAM, it was found that the risk of treatment toxicity was significantly lower in the intervention group.[70] However, no differences in mortality risk, hospitalization, or modification of cancer therapy (early treatment discontinuation or dose reduction) were observed.[70] The model of GAM care delivery varied across studies; different models of care are discussed further below.

Two general approaches are used to integrate GAM with oncology care: (1) direct involvement of geriatric specialists with either a co-management model or multidisciplinary case review to inform recommendations, and (2) automatically generated recommendations tailored to GA impairments (i.e., independent of a geriatrics professional) provided to oncology teams for review and implementation. Variability among models of GAM is inevitable, and the *best* model will depend on clinical setting, available resources, and other factors. Below, we review studies that have evaluated GAM, describing the specifics of trial design, intervention delivery, and outcomes (Table 4).[71–78] Collectively, these studies indicate the value of GAM for identifying and addressing medical, functional, and psychosocial issues that could otherwise go unnoticed by oncology care teams, enabling clinical teams to proactively intervene to optimize treatment outcomes and enhance quality of life.

Direct geriatric specialist involvement

The Geriatric Assessment-Driven Intervention (GAIN) study (ClinicalTrials.gov identifier NCT02517034) was a single-center, randomized clinical trial of patients aged 65 years and older initiating a new chemotherapy regimen ($N = 605$) for solid tumors of any stage with a primary outcome evaluating whether a GA-driven intervention can reduce chemotherapy-related toxic effects in older adults with cancer.[71] Patients underwent initial GA and were then randomized (2:1) to either the intervention (GAIN) or usual care. In the intervention arm, the GA was reviewed by a geriatrics-trained multidisciplinary team, including an oncologist, nurse practitioner, social worker, physical/occupational therapist, nutritionist, and pharmacist, and GA-guided interventions were implemented based upon predetermined thresholds for GA domain impairments. In the usual care group, GA results were shared with the oncology teams, but interventions were not

TABLE 4 Selected studies of geriatric assessment intervention and associated outcomes in solid tumor malignancies.

Reference	Design	Cancer and setting	Treatment	No.	GAM model	Associated outcomes in the intervention versus control groups
Li 2021[71]	Prospective RCT	Solid tumor malignancies, single academic center	Chemotherapy (including combination regimens with targeted therapy)	605	Direct involvement by geriatric APP with referrals facilitated by study team based upon predetermined thresholds on GA; APP followed longitudinally during study	- Reduction in grade 3–5 chemotherapy toxicity - Increase in advanced care directive completion - No difference in ER visits, hospitalization, cancer therapy modifications, or overall survival
Lund 2021[72]	Prospective RCT	Colorectal cancer, single academic center	Adjuvant or palliative chemotherapy	142	GA management recommendations offered to patients at baseline and followed after 2 months	- Higher rates of planned treatment completion - Improved QoL - Improved mobility
Soo 2022[73]	Prospective RCT	Solid tumor malignancies, lymphoma, or myeloma; multicenter academic clinics	Chemotherapy, immunotherapy, or targeted therapy	154	Geriatrician consultation at baseline and follow-up with personalized management plan	- Maintenance of social functioning in intervention group compared with control group - Lower health care use - Reduced early treatment discontinuation
Orum 2021[74]	Prospective RCT	Solid tumor	Any treatment	301	Summary of GA results and interventions initiated in both groups, but intervention arm received longitudinal treatment follow-up with tailored GA interventions for 90 days	- No difference in ability to complete planned cancer therapy, daily life activities, physical performance, or hospitalization
Puts 2023[75]	Prospective RCT	Solid tumor malignancies, lymphoma, or myeloma; multicenter academic settings	Chemotherapy, immunotherapy, or targeted therapy	350	Summary of GA results and predefined recommendations deemed relevant by study team and patient implemented; study team RN followed patient longitudinally during study	- No difference in QoL, ER visits, or hospitalizations, functional status, patient satisfaction, cancer therapy modifications, or overall survival
Paillaud 2022[76]	Prospective RCT	Head and neck cancer; multicenter, including academic and community-based clinics	Any treatment	499	Direct geriatrician involvement in cancer care team, including GA and management recommendations, and longitudinal geriatrician involvement during study	- No improvement in overall survival, functional status, or nutritional status
Mohile 2021[77]	Prospective RCT	Incurable solid tumor malignancies and lymphomas; multicenter, community-based oncology clinics	High-risk cancer regimen (≥50% risk of toxicity)	718	Summary of GA and management recommendations (based upon algorithm with predetermined thresholds) provided to oncologist and patient	- Reduction in grade 3–5 chemotherapy toxicity - Reduction in falls and reduction in polypharmacy - Reduced treatment intensity, but no difference in overall survival

(Continues)

TABLE 4 (Continued)

Reference	Design	Cancer and setting	Treatment	No.	GAM model	Associated outcomes in the intervention versus control groups
Mohile 2020[78]	Prospective RCT	Incurable solid tumor malignancies and lymphomas; multicenter community-based oncology clinics	Any cancer treatment, including (but not limited to) hormonal treatment, chemotherapy, monoclonal antibody, or targeted therapy	541	Summary of GA and management recommendations (based upon algorithm with predetermined thresholds) provided to oncologist and patient	- Increase in patient and care partner satisfaction with communication about aging-related concerns; increase in number of aging-related conversations, no difference in QoL

Abbreviations: APP, advanced practice provider; ER, emergency room; GA, geriatric assessment; GAM, geriatric assessment and management; QoL, quality of life; RCT, randomized controlled trial; RN, registered nurse.

facilitated by the study team. Most patients were female (59%) with advanced solid tumor malignancies (stage IV, 71.4%). The GAIN intervention significantly reduced severe chemotherapy toxicity by 10.1% (grade 3–5 toxicity in 50.0% of the intervention group vs. 60.6% of the control group; $p = .20$) and increased advance directive completion (28.4% vs. 13.3%, respectively; $p < .001$). Of note, no differences in overall survival or hospitalizations were observed.

The Effect of Geriatric Intervention in Frail Elderly Patients Receiving Chemotherapy for Colorectal Cancer (GERICO) study (ClinicalTrials.gov identifier NCT02748811) was a single-center, randomized, phase 3 study evaluating the benefit of GA with targeted interventions in adults aged 70 and older ($N = 142$) receiving adjuvant or first-line palliative chemotherapy for colorectal cancer on chemotherapy completion (primary outcome).[72] Importantly, the GERICO study limited inclusion to older patients with a Geriatric-8 (G8; a screening tool) score of ≤14, thus representing a more vulnerable/frail population. All patients underwent baseline GA at the time of treatment initiation, and the intervention group received GA-targeted interventions based upon predetermined GA domain thresholds, including medication adjustment (62%), nutrition referral (51%), and physiotherapy (39%). A higher proportion of patients in the intervention arm completed their chemotherapy regimen compared with the control arm (45% vs. 28%; $p = .04$). Severe toxicity occurred in 39% of patients in the control group versus 28% in the intervention group ($p = .16$). Overall improvements in quality of life (as measured by decreased burden of illness) and mobility were observed in the intervention group ($p = .048$ and $p = .008$, respectively). No difference in overall survival was observed.

The Integrated Geriatric Assessment and Treatment Effectiveness (INTEGRATE) trial (Australian New Zealand Clinical Trials Registry number ACTRN12614000399695) was a multicenter RCT examining the effect of integrated geriatrician consultation and support for adults aged 70 and older with solid tumor malignancies or DLBCL initiating a new line of chemotherapy, targeted therapy, or immunotherapy ($N = 154$), with a primary outcome evaluating intervention effects on health-related quality of life (as measured by the Elderly Functional Index, which focuses on functional domains).[73] Patients in the intervention group received GA with integrated oncogeriatric care, in which a geriatrician consulted at baseline, 12 weeks, 24 weeks, and as needed. The intervention delivery was a personalized management plan and was not predefined by study protocol. Patients in the control arm received educational information and encouragement about exercise/nutrition but did not receive integrated oncogeriatric care. The intervention group had improved Elderly Functional Index scores over a 24-week period (overall main effect of group, $p = .04$) as well as fewer unplanned hospitalizations (multivariable-adjusted incidence rate ratio, 0.60; $p = .007$) and a lower frequency of early treatment discontinuation due to toxicity on exploratory analysis ($p = .001$). There were no differences in treatment modification or overall survival.

Other smaller, randomized trials have not demonstrated a benefit from GAM. Orum et al.[74] conducted an RCT evaluating the benefit of a tailored GA intervention follow-up by a geriatric multidisciplinary care team (geriatrician and geriatrics-trained nurse) for 90 days after initial GA among patients with head and neck, lung, upper gastrointestinal, or colorectal cancer ($N = 363$), with a primary outcome evaluating adherence to cancer treatment. All participants received GAM recommendations at baseline; subsequently, patients classified as vulnerable or frail were randomized to receive the tailored GA intervention follow-up versus no tailored follow-up. The tailored follow-up consisted of periodic visits (in person or on the phone) with the geriatric multidisciplinary care team, during which new interventions could be initiated or prior interventions adapted, including pharmacologic, nutritional, physical, or social modifications (i.e., GAM). There were no differences noted between groups in adherence to cancer treatments, rates of hospitalization, or functional decline. One potential explanation is that the effect of the GAM-tailored follow-up was limited because all participants received GAM after the baseline GA and before randomization.

The Comprehensive Geriatric Assessment and Management for Canadian Elders with Cancer study (5C Trial; ClinicalTrials.gov identifier NCT03154671) evaluated the impact of GAM on outcomes in adults aged 70 years and older with solid tumor malignancy, lymphoma, or myeloma receiving first-line or second-line chemotherapy and/or immunotherapy ($N = 350$), with a primary outcome evaluating quality of life.[75] The GAM intervention was a standardized protocol aligning with the ASCO geriatric oncology guidelines, in which a clinical team completed the GA and implemented predefined,

evidence-based interventions deemed relevant by the intervention team together with the participant. The 5C Trial did not observe differences in quality of life, unplanned hospitalizations, toxicity, or survival with GAM, although investigators noted that most participants received GAM recommendations on or after treatment initiation, which may have mitigated any differences in effects. In addition, the study was conducted during the coronavirus disease 2019 (COVID-19) pandemic, which may have influenced the primary outcome of quality of life for this study.

Randomized trials focusing specifically on hematologic malignancies are limited. One RCT evaluated the impact of an embedded geriatric consultation in conjunction with a hematologic oncologist versus usual care for patients aged 75 years and older with lymphoma, leukemia, or multiple myeloma ($N = 160$), with a primary outcome assessing overall survival.[79] Only frail patients and those deemed at risk for frailty, as determined by deficit accumulation and phenotypic frailty approaches, were subsequently randomized. No prespecified interventions were required, although recommendations could be communicated to the patient's primary care physician, including referrals to psychiatry or physical therapy. There was no difference in 1-year overall survival between the intervention and usual care groups. However, those in the intervention arm had increased end-of-life goals-of-care discussions. Hematologists were surveyed about the benefits of geriatric consultation, and the majority rated the consultation as useful in the management of several geriatric domains.

GAM interventions independent of a geriatric clinician

The Geriatric Assessment for Patients 70+ study (GAP70+; ClinicalTrials.gov identifier NCT02054741) led by Mohile et al. was a cluster-randomized trial conducted in community oncology practices.[77] Patients aged 70 years and older with advanced solid tumor malignancy or lymphoma were enrolled across 40 community oncology practice sites in the United States. Eligible patients were initiating a high-risk cancer regimen (any line, ≥50% risk of toxicity) and had at least one GA domain impaired. Practice sites were randomized to intervention or usual care. Although all patients underwent GA, only those at intervention sites had the results and GA-guided management recommendations shared with the oncology team (Figure 1). GA-guided recommendations were determined by an algorithm and offered when a patient's scores met predetermined thresholds. Oncology teams were responsible for prioritizing and implementing recommendations. Patients in the control arm (i.e., usual care) did not receive a GA summary or recommendations, although oncologists received alerts for positive screens for impaired mood or cognition. The primary outcome was clinician-rated toxicities, which were markedly reduced in the intervention arm (50%) compared with the control arm (70%). Patient-reported toxicities were also reduced.[80] No changes in overall survival were observed, but patients in the intervention arm had fewer falls and improvements in polypharmacy (i.e., more medications discontinued, as measured by a medication log completed by staff). Patients in the intervention arm were more likely to have a primary dose reduction (e.g., initial cycle administered at reduced dose)[81]; nevertheless, no difference in overall survival between the two groups was observed.[77] Figure 1 depicts the GAM care delivery intervention used in the GAP70+ study, which is particularly relevant for clinicians who do not have access to geriatrics experts in their practice; the management recommendations were implemented only for patients with an impairment in that specific geriatric domain.

The Communication on Aging and Cancer Health study (COACH; ClinicalTrials.gov identifier NCT05349227) had a GA intervention design similar to that of the GAP70+ study and evaluated the influence of GAM on aging-related communication and satisfaction with care.[78] This trial enrolled patients aged 70 and older who had advanced solid tumor malignancy or lymphoma and at least one GA domain impairment from 31 community oncology practice sites in the United States. The COACH study demonstrated that the GA intervention improved communication about aging-related conditions in the context of oncology care, both quantitatively, through improved patient and care partner satisfaction with communication, and qualitatively, through analyses of clinical encounter transcripts demonstrating an increase in conversations about aging-related concerns.

Practical GA

In 2023, the ASCO guidelines for the care of older adults with cancer receiving systemic therapy were updated to reflect the latest evidence about GAM from large RCTs.[10,71,77,78] These studies clearly demonstrated that serious toxicities from systemic therapy can be reduced without compromising overall survival. GAM leads to decreased falls, more medications discontinued, higher rates of advance directive completion, and improved patient and caregiver satisfaction. The new guidelines reflected these findings by recommending GAM as the standard of care for older adults starting new therapies (chemotherapy, targeted therapy, and immunotherapy), specifying that GAM must assess the essential geriatric domains (physical function, cognitive performance, emotional health, comorbid conditions, polypharmacy, nutrition, and social support). In short, all adults older than 65 years should have their management guided by GA to implement better decision making and to appropriately offer aging-sensitive supportive care interventions as part of routine care to avoid both undertreatment (of fit older adults) and overtreatment (of frailer older adults).

Unfortunately, the uptake, implementation, and integration of GA in oncologic care remains low.[20,82] A recent large international survey revealed that as few as 22% of oncology providers regularly used d GA in the management of older adults with cancer.[20] Greater than 75% of providers agreed that GA was important, that evidence supported its use, and that it should be used to assess older adults. However, they identified barriers to implementation that precluded its use, including lack of support staff, time, and knowledge and

Domain	Assessment Tool	Description	Definition of Impairment	Common GA-Guided Management Recommendations
Physical Performance	TUG	Assesses mobility over 3 meters	> 13.5 s	1. Frequent toxicity checks 2. Fall counseling 3. Exercise information/prescription 4. Hand-out on energy conservation 5. Medication review 6. Treatment modification of dose or type 7. Referrals to physical/occupational therapist, vision specialist 8. Personal emergency response system
	SPPB	Assesses balance, gait, speed, strength	≤ 9 points (range 0-12)	
	Falls History	Assesses number of falls	Any falls in prior 6 months	
	OARS Physical Health	Assesses any limitation in activities due to health	Any answer of "a lot"	
Functional Status	ADL	Assesses difficulty bathing, dressing, eating, getting in/out of bed/chairs, walking, toileting	Any deficit	1. Frequent toxicity checks 2. Fall counseling 3. Exercise information/prescription 4. Medication review 5. Treatment modification of dose or type 6. Referrals to physical/occupational therapist, vision specialist 7. Personal emergency response system 8. Physical exam
	IADL	Assesses independence using phone, transportation, shopping, preparing meals, housework, taking meds, managing money	Any deficit	
Comorbidity	OARS Comorbidity	Assesses presence of 13 illnesses, visual, and hearing impairments and how they interfere with activities	Has 3 illnesses OR 1 that interferes "a great deal"	1. Contact PCP 2. Modify treatment options as applicable 3. Modify dosage/schedule 4. Provide smoking cessation counseling
Cognition	BOMC	Assesses orientation, memory, and concentration	≥ 11 points (range 0-28)	1. Provide explicit and written instructions 2. Medication review 3. Assess decision-making capacity 4. Delirium risk counseling 5. Referral to memory care specialist
	Mini-Cog	Assesses word recall, clock drawing	0 words OR 1-2 words, abnormal clock	
Nutrition	Body Mass Index	Divide weight (kg) by height (m^2)	< 21kg/ m^2	1. Frequent toxicity checks 2. Nutrition and/or mucositis hand-out 3. Use caution with emetogenic treatments 4. Aggressive anti-emetic therapy 5. Referrals to nutritionist, dentist, swallow therapy
	Weight Loss	Assesses weight change over 6 months	> 10% change in weight	
	MNA	Assesses nutritional status using 6 items	≤ 11 points (range 0-14)	
Social Support	Medical Social Support	Can someone (1) help if confined to bed, (2) take you to the doctor, (3) prepare meals, (4) help with chores	Any answer "some of the time," "a little of the time," "none of the time"	1. Confirm documented health care proxy 2. Modify treatment choice and/or dosage 3. Referrals to social work, home health aide, transportation service
Polypharmacy	Medications	Assesses number of regularly scheduled meds, presence of high-risk meds, kidney function	≥ 5 prescriptions OR any high-risk medication OR creatinine clearance < 60	1. Medication review/reduce regimen 2. Synchronize medication refills 3. Drug counseling with pharmacist 4. Recommend pillbox, medication calendar 5. Hand-out on polypharmacy
Psychological Status	GDS	Assesses depression with 15 items	≥ 5 points (range 0-15)	1. Contact PCP 2. Referrals to counseling, social work, psychiatry 3. Pharmacologic therapy if appropriate 4. Connect with community resources
	GAD-7	Assesses anxiety with 7 items	≥ 10 point (range 0-21)	

FIGURE 1 Geriatric assessment domains, tools, and most common management recommendations from the GAP70 study. ADL indicates activities of daily living; BOMC, Blessed Orientation-Memory-Concentration test; GA, geriatric assessment; GAD-7, Generalized Anxiety Disorder-7; GDS, Geriatric Depression Scale; GAP70, Geriatric Assessment for Patients 70+; IADL, instrumental activities of daily living; MNA, Mini Nutritional Assessment; OARS, Older Americans Resources and Services; PCP, primary care physician; s, seconds; SPPB, short physical performance battery; TUG, timed up and go.

uncertainty about which GA tool(s) to use. These concerns fall into two general areas: (1) concerns about knowledge or training and (2) concerns about resources or time. Although all providers expressed concerns about the latter, those providers who were unfamiliar with the ASCO guidelines expressed much greater concerns about the former. Fortunately, both types of barriers can be addressed.

To overcome barriers, the Older Adults Task Force of the ASCO Health Equity and Outcomes Committee (Task Force) proactively created tools, trainings, and strategies to accompany the release of the guidelines. To minimize resource constraints and burdens on providers, the Task Force developed a PGA tailored for use in routine clinical practice by oncologists informed by focus groups with

community-based providers. Based on previously published formal consensus development work on the necessary domains of GA in oncology, the Task Force created a simplified and predominantly patient-reported tool using a consensus development approach in collaboration with CARG.[83] Multiple validated tools for each GA domain were compiled and reviewed for inclusion in the new simplified tool, and ultimately those best-suited for routine clinical care were chosen. The chosen instruments were compiled, reviewed, and approved by CARG membership and the Science and Education Committee of SIOG. The resulting PGA (Table 5)[3,21,29] is a set of patient-reported measures and four additional items completed by providers or staff that takes only 10–25 minutes to complete. Specific score cutoffs are provided as is an action chart, which ties the tools to appropriate actions to be taken (e.g., referrals, dosing considerations). These elements ensure that outcomes will be meaningfully affected by the PGA, optimizing care by avoiding overtreatment and undertreatment.[84] Management recommendations based on identified impairments were included in the most recent ASCO guideline update.[10,85] Whether it will improve uptake of GA in general oncology practice will require future validation and follow-up.

TABLE 5 Summary of practical geriatric assessment from the American Society of Clinical Oncology guideline update.

Practical geriatric assessment: Summary			
	Domain	**Measures and brief description**	**No. of items**
Patient self-reported measures	Function	Falls	1
		- No. of falls in the last 6 months	
		Activities of daily living	5
		Questions on ability to:	
		- Walk one block	
		- Climb one flight of stairs	
		- Get in and out of bed	
		- Dress and undress	
		- Bath or shower	
		Instrumental activities of daily living	6
		Questions on ability to:	
		- Travel/take transportation	
		- Shop for groceries or clothes	
		- Prepare meals	
		- Do housework	
		- Take medicines	
		- Manage money	
	Social activities	MOS social activity survey	1
		Single question on how much physical or emotional health interfere with social activities	
	Mood-anxiety	PROMIS anxiety (short form)	4
		- Four questions related to self-reported anxiety in the last 7 days	
	Mood-depression	GDS 5-item	5
		- Five questions to assess depression in older adults	
	Social support	MOS social support survey	8
		- Four questions on instrumental support	
		- Four questions on emotional support	
	Comorbidity	OARS comorbidity tool	15
		- 13 items related to different comorbid conditions	
		- One item on hearing	

(Continues)

TABLE 5 (Continued)

Practical geriatric assessment: Summary			
	Domain	**Measures and brief description**	**No. of items**
		- One item on vision	
	Nutrition	Weight loss in the past 3 months	1
Measures completed by nonprovider care team	Cognition	Mini-Cog	4
		- Three-item word-recall test	
		- Clock drawing test	
	Physical performance	Gait speed (time to normally walk 4 meters)	1
	Risk for chemotherapy toxicity	CARG toxicity tool (Hurria 2011,[3] 2016[21]; for all patients older than 65 years who are starting chemotherapy)	11
		Five items included in the PGA questions noted above	
		CARG-BC toxicity tool (Magnuson 2021[29]; for patients older than 65 years with stage I–III breast cancer starting chemotherapy: one item included in the PGA questions noted above)	8

Abbreviations: BC, breast cancer; CARG, Cancer and Aging Research Group; GDS, Geriatric Depression Scale; MOS, Medical Outcomes Study; OARS, Older Americans Resources and Services; PGA, practical geriatric assessment; PROMIS, Patient-Reported Outcomes Measurement Information System.

STRATEGIES TO OVERCOME IMPLEMENTATION BARRIERS

Barriers to routine GA implementation include lack of knowledge of guidelines supporting GA implementation, lack of time, staff turnover, and competing institutional priorities.[20,86] Lack of effective referral pathways to multidisciplinary care professionals to support GA and help address identified concerns are also obstacles to GA implementation.[87,88] Because patients are often overwhelmed at initial diagnosis and treatment planning, they may not be willing to set up the additional appointments that may be needed to implement GA recommendations.[89]

Despite these challenges, a growing body of literature demonstrates the feasibility of integrating GA into routine oncologic practice. Even in busy and diverse oncology practices, GA can be adapted for practical use,[10] even under circumstances in which treatment decisions need to be made quickly, such as in acute myeloid leukemia.[90–92] Most older patients can complete the self-administered assessments without assistance. In a study evaluating the feasibility of a cancer-specific GA in the academic oncology setting, the mean time to completion was 27 minutes, and most patients were satisfied with the length of the questionnaires.[9] The feasibility of incorporating GA into community oncology clinics[93] and oncology clinical trials, including within cooperative group settings,[92,94] has also been demonstrated. Below, we discuss evidence-based strategies for GAM implementation.

GA screening tools

As discussed above, the PGA is a brief but comprehensive measure that community oncologists at ASCO believe can be more easily implemented than longer GAM interventions tested in RCTs. Nevertheless, because the uptake of GA in the oncology setting has remained limited despite mounting evidence, researchers have attempted to identify brief screening mechanisms that can identify those vulnerable older adults with cancer who are most likely to derive benefit from GA. A recent systematic review of 12 screening tools determined that the G8[95] and the Vulnerable Elders Survey-13 (VES-13)[96] were the measures with the greatest evidence supporting their use; the G8 showed higher sensitivity and the VES-13 showed greater specificity for identifying patients who would benefit most from a full GA.[97] The VES-13 is self-reported, whereas the G8 can be both self-reported or administered by a provider.[95,98] They both require 5 minutes or less to complete.[99] In addition to identifying patients who may benefit from a more comprehensive GA, these screening tools have been shown to predict risks of toxicity, functional decline, and decreased progression-free and overall survival in various hematologic and solid tumor malignancies.[54,100,101] There is growing evidence that screening tools may be less effective at guiding care delivery than full GA,[102] but these tools remain options for oncologists who are not trained in geriatrics and practice in resource-limited settings.

Engaging the oncology workforce to deliver GAM

Strategies and initiatives to improve the implementation of GAM and its principles into practice have been published. However, most of the reported examples have consisted of the experiences of individuals at their own institutions[103,104] or larger initiatives like those summarized by the Latin America Cooperative Oncology Group,[105] each working to overcome unique barriers and challenges to implementation. Overcoming implementation barriers requires strategies that address the capability, opportunity, and motivation of clinical teams, leading to behavior change, also called the *COM-B model of*

behavior.[106] Guided by the behavioral change wheel,[106] we suggest strategies to overcome common implementation barriers (see Table S1). The implementation barriers and strategies discussed below do not represent an exhaustive list and are often used in combination.

Education on GA and guidelines overcomes several barriers by addressing psychological capability and reflective motivation. A common barrier is lack of awareness of guidelines supporting routine GA implementation for patients aged 65 years and older who are considering systemic therapy. Education about GA can also address the misconception that GA is too time-intensive by focusing on the actual time required to assess its various components. During the education session, the learner is pushed to reflect on how restructuring an initial patient assessment to include GA may have a minimal impact on time. When GA education is embedded into routine onboarding procedures, this strategy also addresses the barrier of staff turnover.

Training on GAM addresses implementation barriers by imparting knowledge about the importance of GA implementation, which increases physical and psychological capability. As clinical teams become more comfortable with GA administration, scoring, and interpretation, the amount of time required to do these steps will decrease. As comfort increases, the belief that the amount of time required to implement GA is too great will also decrease. Incorporating routine training on GA and GA-guided management recommendations also addresses staff turnover.

Restructuring the electronic health record (EHR) can affect the clinical workflow and create physical opportunities to implement GA. EHR modifications include prompts, templated notes or data collection forms, and clinical decision supports to identify GA-guided recommendations. These EHR modifications address the barrier of time by making GA administration, scoring, and interpretation more automatic, and they serve as reminders to the clinical teams to implement GA. A study by Harmon et al.[107] demonstrated success with this strategy; patients completed a self-reported, web-based GA before their appointment, and any impairments, along with recommended interventions, were displayed in the patients' EHR; >75% of patients (n = 266) completed the web-based GA before their clinic appointment. We discuss this strategy in more detail below.

Reworking the clinical workflow enables clinical teams to implement GA into their existing workflow in a manner best suited to the setting. Implementation strategies that serve as enablement interventions work by addressing clinical teams' physical capability, psychological capability, automatic motivation, and physical and social opportunities. To rework the clinical workflow, it is also important to identify clinical champions who represent the various team members, including physicians, advanced practice providers, nurses, medical assistants, and administration. We and others have utilized clinical workflows that have engaged multiple members of the clinical team (Figure 2).

Identifying/training clinical champions and forming implementation teams address barriers around the lack of support staff, which also contributes to the barrier of time. Clinical champions then need to form an implementation team to work through the phases of implementation: (1) exploration, (2) preparation, (3) implementation, and (4) sustainment. During the *exploration* phase, implementation teams review existing assessments and clinical algorithms for their patients. For instance, cancer centers may already routinely assess the risk of falls to identify patients who may need additional assistance during the clinic visit. However, they may not be routinely counseling patients and their care partners more broadly about falls prevention. The implementation team can then raise awareness of this service gap. During the *preparation* phase, the implementation team sets up education and training for the initial roll-out and, as part of future onboarding, makes EHR modifications, proposes a new clinical workflow with integrated GA implementation, and obtains feedback from clinical teams and administration. During the preparation phase, implementation teams need to have routine communication with frontline staff and administration. During the *implementation* phase, the implementation team needs to monitor the implementation process using audit and feedback and continuously modify processes accordingly. They must track whether GA and GA-guided recommendations are being routinely implemented. During the *sustainment* phase, the implementation team monitors the impact of implementing GA on key outcomes. They may need to take additional steps to expand clinical teams and coordinate across service lines to realize the full benefits of GA implementation.

Resources are available to help, such as the Clinical Implementation Core (CIC), which is part of CARG.[108] Although the CIC's focus is on providing a framework for geriatric oncology care delivery, it also provides an opportunity for practitioners to bring their individual inquiries, at any phase of implementation, to the CIC for advice and collaboration. Other organizations, such as SIOG and the Association of Community Cancer Centers, also provide opportunities for education and strategies for implementation. All of these organizations have resources that can be accessed through their websites.

GA and technology

New frontiers in data science and technology could enable easier collection and analysis of GA data; improve care access and communication pathways between older patients, caregivers, and clinicians; and facilitate integration of GA data with other data sources (e.g., the EHR, claims data, sensors from wearable devices) to create a trove of real-world data to address the *evidence gap* in older adults with cancer.[109] Although the paper-and-pencil format of GA has primarily been evaluated, the feasibility of a computer-based GA has also been demonstrated.[110] One of the oft-cited barriers to technology use in the care of older adults is the *digital divide*, whereby older adults report less access, usage, and facility with digital information and communication technologies (ICTs) than younger adults.[111] However, this gap is closing, accelerated by increased reliance on ICTs during the COVID-19 pandemic,[112] and the aging of successive generations with increasing digital literacy is likely to

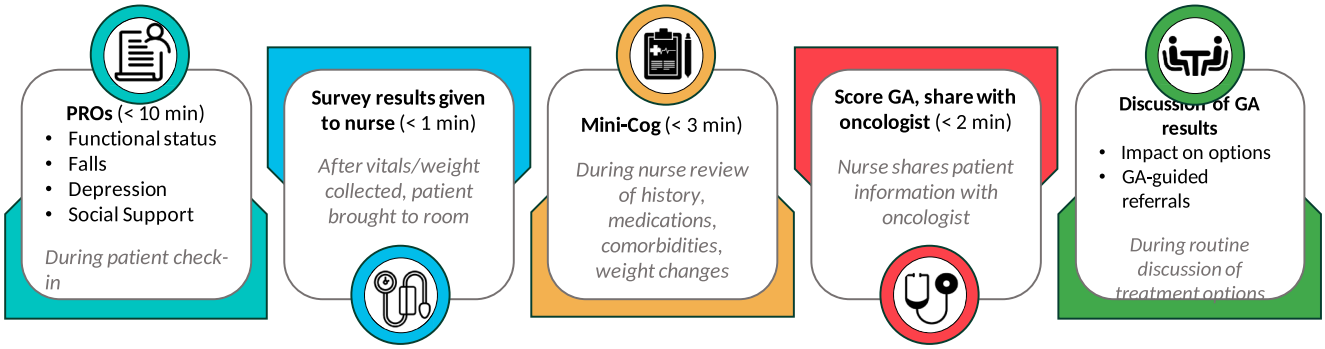

FIGURE 2 Proposed workflow for GA implementation. This figure outlines how components of GA can be incorporated into routine clinical workflow (in italics). Additional time needed to integrate GA into existing workflow is indicated for each step. GA indicates geriatric assessment; PROs, patient-reported outcomes.

further reduce this barrier. Adoption of ICTs is increasing rapidly in older adults: from 2012 to 2021, the percentage of adults older than 65 years who owned a smartphone increased from 13% to 61%, and ownership of tablet computers increased from 6% to 44%.[113] Most older adults (75%) report using the internet regularly, and 64% report having broadband connections.[114] Patient portal[115] and mobile application use[116] have also increased rapidly in older adults.

Increased ICT access and utilization among older adults with cancer offers opportunities to capture patient-reported GA data digitally and remotely. Successful platforms often have a patient and clinician interface, questions are brief and simple, and functionality is co-designed with stakeholders to ensure feasibility and usability.[107,117–120] In addition to the collection of GA data, these platforms provide interpretations and recommendations, often for clinicians and occasionally for patients, to facilitate shared decision making and supportive care interventions. Resources (e.g., staff, education) to support the completion of GA electronically are critical to implementation. Digital capture of discrete, structured data elements from GA (such as numeric scores and responses) with integration into the EHR facilitates clinical review and decision making as well as the creation of larger data sets for research. One example of such successful implementation is at the University of Rochester Medical Center, which uses EHR-integrated GA tools with autoscoring and interpretation, where feasible.[121] The patient-reported elements of GA are distributed as surveys through the EHR patient portal before patients appointments.

GA and telemedicine

The use of telemedicine to deliver GA is an effective approach and has been explored across various health care settings.[122–126] Telemedicine can help to overcome barriers to access and implementation for GAM as well.[107,122,127] Telemedicine facilitates completion of GA (e.g., virtual Short Physical Performance Battery, Short Orientation-Memory-Concentration Test),[128] enables clinicians to communicate recommendations to patients and caregivers remotely, and promotes access to supportive care interventions (e.g., dietitians, physical therapists).[128,129] Telemedicine provides flexibility for GA to be completed asynchronously (e.g., a pharmacist may conduct a medication assessment before or after the GA clinical visit). GA through telemedicine is especially attractive for settings in which access to geriatric specialists is limited, such as in community oncology practices, and for patients who face barriers to care, such as long-distance travel.[122–124] Hybrid telemedicine models have also been tested in which GA is completed remotely, and subsequent clinical visits consist of a mix of in-person and virtual consultations.[127,130] Telemedicine can also facilitate oncogeriatric tumor or other multidisciplinary team meetings.[131]

GA and mobile health

In addition to telemedicine, other digital data sources can augment care and decision making for older adults with cancer. An increasing number of wearable health technologies passively capture and analyze data reflecting activity level, gait, vital signs, and sleep. Patients can actively track nutrition, symptoms, activity, and other patient-reported measures through mobile applications or other electronic devices, and recommendations can be provided based on these data.[132–135] For example, several studies have demonstrated the feasibility of measuring physical activity levels using a smartphone, activity tracker, or accelerometer; and these data can be used to identify chemotherapy toxicity and various symptoms as well as to deliver personalized exercise recommendations.[133–135] Older patients tracking patient-reported measures can trigger alerts indicating moderate or severe symptoms, allowing for subsequent management; such interventions have been shown to improve quality of life and health care utilization.[136]

Advanced data analytics for older adults with cancer

In recent years, rapid advances have taken place in both computational capacity and data-analytic approaches. Large leaps in high-performance computing (e.g., computer chips, networking

technology, and distributed computing) have enabled broader access to the technology needed to perform advanced analytics, including machine learning and artificial intelligence (ML/AI) approaches. The most advanced ML/AI approaches, such as deep learning, require vast data sets and high-performance hardware. These approaches can simultaneously incorporate and analyze all the data we are now able to collect from older patients with cancer, including data from GA, the EHR, claims, sensors, and self-report; images, documents in natural language, and audio data could also be accommodated using these methods. ML/AI methods are already being used to generate predictive and prognostic models for older adults with cancer.[137,138] These models are likely to become more powerful and informative as well as updateable with new information. One of the feasible future applications using these methods is the *digital twin*: a digital simulation of an individual older patient, incorporating all known information, could be used to simulate the effect of treatments, predict outcomes, and remotely monitor symptoms for that patient.[139]

A main barrier to achieving these breakthroughs is the lack of infrastructure to support them. Although the federal government is attempting to enforce FAIR (*findable*, *accessible*, *interoperable*, *and reusable*) data in health care,[140,141] it is challenging to assemble the large, multisource data sets needed to create digital twins or other large predictive models.[139] For example, data sharing and merging between EHR systems is still inadequate, even between systems that use the same EHR vendor. In addition, vast investment and effort will be needed to make sure the data are accurate, timely, consistent, and secure. Ethical concerns also arise around the use of data and ML/AI methods encompassing privacy and equity (e.g., algorithmic bias, access to AI technologies, and lack of transparency/interpretability).[142]

GA FOR DIVERSE POPULATIONS

The older adult population in the United States continues to increase in racial and ethnic diversity, with the number of older Black adults expected to triple and the number of older Latino adults expected to quadruple by 2060.[143] Nevertheless, pervasive structural racism continues to result in higher mortality among minoritized populations.[144] The balance of cancer treatments, systemic causes of inequities, and social drivers of health need to be carefully evaluated because of their synergistic negative effects on clinical outcomes among marginalized populations.[145–153] Social inequity drives increased psychosocial stress, the effects of which compound over time and contribute to health inequities in minoritized populations.[154,155] GA has the potential to formalize the assessment of social determinants of health, which is critical for clinical decision making.

Equitable implementation of GA among minoritized older adults

Although clinical trials implementing GA have resulted in increased patient enrollment[71,77] and wider geographic distribution,[78] racial diversity in these trials remains insufficient. In large academic center studies of older adults with cancer receiving GA-guided care across various stages of cancer and tumor types, 76%–87% were White.[71,77] Of 500 older patients enrolled in community clinical sites across 15 states who received GA, 89% were White.[78]

There is a particular need for practical approaches to the implementation of GA in rural, under-resourced, and isolated areas that serve vulnerable patients. In some practices, greater than 20% of older adults with cancer travel at least an 1 hour each way to receive care.[156] Further studies on GA implementation should consider neighborhood-level and community-level social determinants of health, including transportation security, housing security, and rurality. Examples of resources that evaluate these factors are the Community Need Index[157] the Area Deprivation Index,[158] and the Social Vulnerability Index.[159]

Language barriers among minoritized older adults with cancer

A significant challenge faced by diverse older adults is a language barrier, which can result in poor or absent patient–provider communication critical to treatment planning and coordination and poor quality of care, poor adherence to treatment, and safety concerns.[144,160] About 26 million people in the United States report speaking English less than *very well* or have limited English proficiency (LEP) and thus experience inequities in accessing and using health services because of language; notably, greater than one third are aged 55 years and older.[161] Latino and Asian-origin populations make up the majority of the LEP population; these are also the patients likely to experience linguistic and cultural barriers that can impede timely treatment and care.[161] The COVID-19 pandemic highlighted the significant gap between English-proficient patients, who were able to pivot to telemedicine for their cancer care, and Asian-origin and Spanish-speaking patients, who experienced significantly lower odds of telemedicine use.[162,163]

Equitable access to quality language services remains incremental and fragmented, regardless of modality.[164,165] A 2023 review exploring cancer treatment decision making among older adults with LEP found that medical mistrust and perceived discrimination by providers were the primary drivers of differences in treatment decisions among patients with LEP.[166] In addition, this review found that respondents expressed concerns about language barriers, financial burden, and insurance. These barriers can lead to gaps in obtaining and acting on critical information from their providers.[167] GA interventions can potentially ensure that patient preferences are clearly established within the context of social, clinical, and personal factors that are key for patient-centered care.[10] In the COACH trial, communication between patients and their providers improved after GAM.[78] Although those participants were primarily White and English-proficient, tailored GA recommendations may also improve communication for older adults with LEP.

To address persistent and compounded inequities, representation in clinical research is vital to ensuring that the aging-related needs of racially, ethnically, culturally, and linguistically minoritized

older adults with cancer are appropriately addressed.[155,168] A recent scoping review analyzing 59 publications on health disparities among older adults with cancer who belonged to minoritized groups found that, although research in this area is increasing, the literature is largely descriptive rather than solution-driven.[169] Future work on social factors and the importance of integrating social needs in cancer care must require greater inclusion of more diverse populations. In a recent publication by the National Academy Press, a committee dedicated to greater integration of these factors proposed five tasks to strengthen social care in health systems to address social determinants of health among patient populations: *awareness*, *adjustment*, *assistance*, *alignment*, and *advocacy*.[170] The implementation of GAM for diverse populations may require a similar approach. Equitable implementation requires *awareness*, *adjustment*, and *assistance* to occur within health care systems to integrate social measures while implementing GAM into oncology care.[171–174]

ADDRESSING THE NEEDS OF CAREGIVERS OF OLDER ADULTS WITH CANCER

In the United States, most caregivers of older adults with cancer are female family members who spend nearly 33 hours per week on average providing care.[175,176] Their responsibilities range from treatment decision making to managing end-of-life care and frequently include delivering nursing care without training.[177] Caregivers also assist with patient self-care, provide emotional support, and manage household tasks with limited social support.[175]

Multiple studies have demonstrated that cancer caregiving affects caregiver psychological health and physical well-being.[178,179] Caregiver burden is defined as the extent to which caregivers perceive the adverse effect that caregiving has on their emotional, social, financial, and physical functioning.[180] Given the level of care that is required by older adults with cancer, who often have comorbidities and aging-related conditions, caregivers experience substantial physical and emotional challenges that can lead to caregiver burden.[181,182] Caregivers of patients with GA impairments in ADLs and/or IADLs report greater emotional distress.[176,178,182] Caregivers of older adults with cancer also tend to be older (aged 63–66 years on average) with their own health issues and geriatric syndromes.[181–183] Compared with noncaregivers of the same age, caregivers of older adults with cancer are more likely to experience deterioration in physical health, have poor health-related behaviors, and are less likely to engage in preventive care.[184–187] Caregiver burden is associated with negative caregiver health effects, including increased all-cause mortality, and affects the caregiver's ability to provide care, resulting in increased risk of patient hospitalization and more intensive and/or inappropriate end-of life care.[185,188,189]

Validated caregiver distress screening tools are available,[190,191] and Shaffer et al. observed that administering the CancerSupportSource-Caregiver, a validated electronic distress screening program for cancer caregivers, was feasible and well accepted.[192] However, only limited implementation of these tools into clinical practice has occurred. Kadambi et al. recently demonstrated that it is feasible to administer GA to assess the health and supportive care needs of older caregivers of older adults with cancer.[183] GA helped to identify aging-related conditions that might influence caregiving ability and guide supportive care interventions.

There have also been numerous supportive care intervention studies for cancer caregivers, both in-person and virtual, targeting caregivers and their families, that have focused on interpersonal interventions, problem solving or skill building, psychoeducational interventions, subspecialty palliative care, and supportive therapy.[193–195] Although most studies have been small, included mainly younger White caregivers, and had limited diversity, they demonstrated small to medium beneficial effects on caregiver burden, coping, self-efficacy, and quality of life. A recent systematic review of these studies noted that the interventions were not designed in a way that is easy to translate into clinical practice.[193] A recent report of a caregiver stakeholder workshop involving 15 cancer caregivers identified five main supportive care areas: (1) information and training about cancer and treatment, (2) caregiver integration into the patient's health care delivery system, (3) assistance with navigating the health care system, (4) focus on caregiver health and well-being, and (5) policy reform to address caregivers' unmet needs.[196] Future research should focus on how to address the needs of caregivers of older adults with cancer through appropriate assessment of caregiver burden and through care coordination with GAM with the goal of improving outcomes of both caregivers and patients.

Summary

The field of geriatric oncology has made tremendous strides over the past few decades to improve outcomes for older adults with cancer. The field has demonstrated the importance of GA in identifying aging-related impairments that influence cancer-related outcomes and the feasibility of incorporating GA into routine clinical practice. More recently, using GA to intervene with GAM has been shown to reduce treatment-related toxicity, falls, and polypharmacy as well as improving quality of life, communication, and advance care planning. Although the implementation of GAM across oncology settings remains challenging, the PGA may facilitate its use in routine cancer care settings. In addition, systematic engagement of the oncology workforce and integration of technology-based approaches may enhance further penetration of GA/GAM in cancer care to improve outcomes of older patients and caregivers. Finally, it is essential to prioritize health equity in geriatric oncology research and explore how GAM may reduce inequities in cancer care delivery for underserved and marginalized populations.

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CONFLICT OF INTEREST STATEMENT

Melody K. Schiaffino owns stock in Moderna and AstraZeneca. Grant R. Williams reports personal/consulting fees from Takeda Oncology outside the submitted work. The remaining authors disclosed no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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