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Integration of geriatric assessment into clinical oncology practice: A scoping review

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ABSTRACT

Sixty percent of newly diagnosed cancers occur in older adults and more complex planning is required to sustain quality care for older populations. Individualized care incorporating geriatric assessment can predict early mortality and treatment toxicity for older cancer patients. We mapped and summarized the available evidence on the integration of geriatric assessment into clinical oncology practice, and ascertained which domains have been implemented. We systematically searched bibliographic databases and trial registries for reports of clinical studies, clinical practice guidelines, systematic and non-systematic reviews, and grey literature published in English. We gathered data on study characteristics, geriatric domains and strategies evaluated, and relevant study objectives and findings. From a total of 10,124 identified citations, 38 articles met our eligibility criteria, 3 of which were clinical practice guidelines. Nearly half of these articles came from the United States. Domains of the geriatric assessment implemented in studies ranged from 1 to 12, with varied combinations. We identified 27 studies on strategies for implementing geriatric assessment and 24 studies on feasibility of implementing geriatric assessment, into clinical oncology practice. We also identified 3 main geriatric assessment models: 2 from the United States and 1 from Australia. Furthermore, we identified 2 reviews that reported varied components of geriatric assessment models. There is increasingly robust evidence to implement formal geriatric assessment in oncology practice. There remains a great

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deal of variation in the tools recommended to address each of the domains in a geriatric assessment, with only 1 guideline (American Society of Clinical Oncology guideline) settling on a specific best practice.
Protocol registration: Open Science Framework osf.io/mec93.

ARTICLE INFO

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Introduction

The population of older adults (≥65 years) worldwide has been increasing due to increasing life expectancy. Older age is a leading risk factor for the development of many cancers.[1] Adults ≥65 years old account for around 60% of newly diagnosed cancer patients, and cancer incidence in this population is up to 10 times greater compared with younger populations.[2,3]

Aging introduces changes in health, function, cognition, emotional and social status; it influences the treatment of cancer due to decreased life expectancy, variable tolerance to treatment, changing patient values, and potential inability to obtain treatment due to social barriers.[4] Needs become more complex with advancing age, and a more comprehensive approach to care can improve quality of life and reduce the risk of hospitalization.[5–7] It is therefore essential to integrate geriatric principles into oncology, including the importance of geriatric syndromes, incorporation of functional assessment, recognition of multiple chronic conditions, addressing social determinants of health, and integration of palliative care across the care continuum.[8] The response to this need has been the advent of the field of geriatric oncology.

Through a variety of cohort studies and randomized trials, evidence has accumulated that geriatric assessment in older adults with cancer receiving chemotherapy predicts prognosis and treatment toxicity, while discovering issues that alter chemotherapy decisions in 25%-30% of patients.[9,10] Comprehensive geriatric assessment (CGA) is the most commonly studied and most complete form of geriatric assessment. A CGA is "a multidimensional, multidisciplinary process which identifies medical, social and functional needs, and the development of an integrated/coordinated care plan to meet those needs (p. 149)."[11] Implementation of CGA and geriatric principles, in oncology care would seem intuitive, but there are multiple challenges. Completing a CGA in clinical practice requires approximately 30-60 minutes per patient and requires expertise in both conduct and interpretation.[12–15] Most oncologists lack training in geriatrics and the increasing number of cancer patients has been straining existing oncologic resources. These factors have slowed integration of geriatric principles into oncologic care. However, interest in integrating these principles has been increasing.[9,10,16,17] Due to this shifting dynamic, it is important to determine the existing evidence for implementing geriatric oncology principles in clinical practice.

We undertook a scoping review to identify and map the available evidence on strategies for integrating geriatric assessment into clinical oncology practice and ascertain which principles have been implemented in clinical oncology practice, while focusing on the main concepts and any gaps in knowledge.

Methods

We followed the Joanna Briggs Institute's methodological framework for the conduct of scoping reviews.[18] This framework includes defining and aligning the objective(s) and question(s) for

the review, developing and aligning the inclusion criteria with the review objective(s) and question(s), and describing the planned approach to evidence searching. It also includes selecting, extracting and charting of evidence, summarizing the evidence in relation to the objectives and questions, and consultation of information scientists, librarians, and/or experts throughout the process. As such, we developed and registered a scoping review protocol with the Open Science Framework prior to citation screening (Open Science Framework osf.io/mec93).[19] Further, we report our findings in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for scoping reviews guidelines.[20]

Search strategy and study selection process

A knowledge synthesis librarian designed a search strategy for the review in MEDLINE (Ovid). The search strategy was then peer-reviewed by a second, independent librarian using the PRESS checklist.[21] The peer-reviewed search strategy for MEDLINE (Supplementary Table) was then adapted for other literature database sources. We searched MEDLINE (Ovid), Embase (Ovid), CINAHL (EbscoHost), Scopus (Elsevier), AgeLine (EbscoHost), PsycINFO (Ovid), and the Cochrane Library (Wiley) up to July 2018. We also searched for grey literature and unpublished trials in Clinicaltrials.gov, the World Health Organization International Clinical Trials Registry Platform, American Society of Clinical Oncology (ASCO), European Society of Medical Oncology, Canadian Frailty Network, Cancer and Aging Research Group, and International Society of Geriatric Oncology (SIOG). Identified citations from the searches were managed in EndNote software version X9.

Two reviewers in pairs (G.N.O., F.R., O.L.T.L., V.K.R., and L.C.) independently screened the identified citations for eligibility using a specially designed Microsoft (MS) Access 2016 database (Microsoft Corporation, Redmond, WA) and a 2-stage sifting approach to review the abstract, and full-text articles. We included full-text publications of clinical studies, clinical practice guidelines, systematic and non-systematic reviews, and grey literature (must be full-text) in English reporting on the integration of geriatric principles into clinical oncology practice. Included studies had to include a focus on implementation or integration of interventions related to geriatric assessment, geriatric syndromes, geriatrics, or geriatric nursing in a population of patients diagnosed with cancer. We excluded non-English and non-full-text publications. We defined the geriatric population to be those aged 65 years or older. Where study participants included individuals less than 65 years old, we included the study if at least 90% of the study population was 65 years or older. We recorded the number of ineligible citations at the abstract screening stage, and both the number and reason for ineligibility at the full-text article screening stage. Disagreements during these screening stages were resolved through consensus or by involving a third reviewer if consensus could not be reached (M.S. and D.E.D.).

Data extraction

We created a data extraction spreadsheet in MS Excel 2016 (Microsoft Corporation, Redmond, WA) and 2 reviewers in pairs (G.N.O., F.R., O.L.T.L., V.K.R., and L.C.) piloted the spreadsheet on a small selection of studies (n = 5). Two reviewers in pairs (G.N.O., F.R., O.L.T.L., V.K.R., and L.C.) then independently extracted data from all included studies and compared extracted data for errors. Disagreements were resolved through consensus or by involving a third reviewer if consensus could not be reached (M.S. and D.E.D.). A third reviewer re-checked the agreed extracted data for completeness (D.E.D.). We extracted the following data: study details (first author, year(s) of study and year of publication, country, funding source, study type, objective relevant to our review), study population (number of study participants, mean age, age range, sex, cancer type), outcome (geriatric principle evaluated), and findings and/or conclusions relevant to our review.

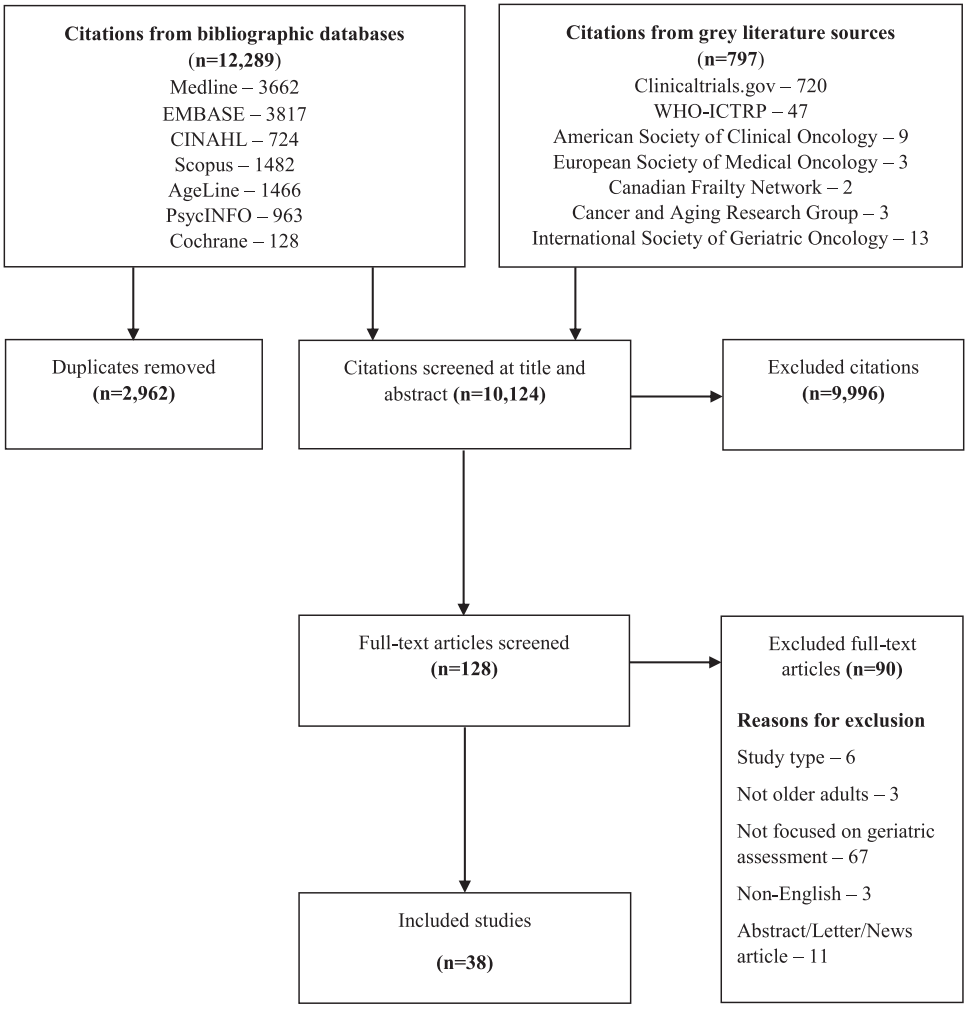

Fig. 1. Summary of literature search and screening process (modified PRISMA flow diagram). Cochrane DSR, Cochrane Database of Systematic Reviews; WHO-ICTRP, World Health Organization International Clinical Trials Registry Platform.

Mapping of evidence

We summarized evidence in relation to the review objectives and provided tabular descriptions of specific study characteristics, findings and/or conclusions.

Results

Out of 10,124 citations identified from the search results, 38 articles met our inclusion criteria (Fig 1). These articles were for 26 clinical studies,[12,13,15,22–44] 8 reviews,[14,45–51] 1 retrospective data analysis,[52] and 3 clinical practice guidelines.[9,10,16] Seventeen of these studies were conducted in the United States of America (USA),[10,12,13,15,24,27,30,33,35,36,39,43–47,49] 4 studies were conducted in Belgium,[9,23,32,34] 3 studies each were conducted in France,[22,38,48] Spain,[16,28,41]

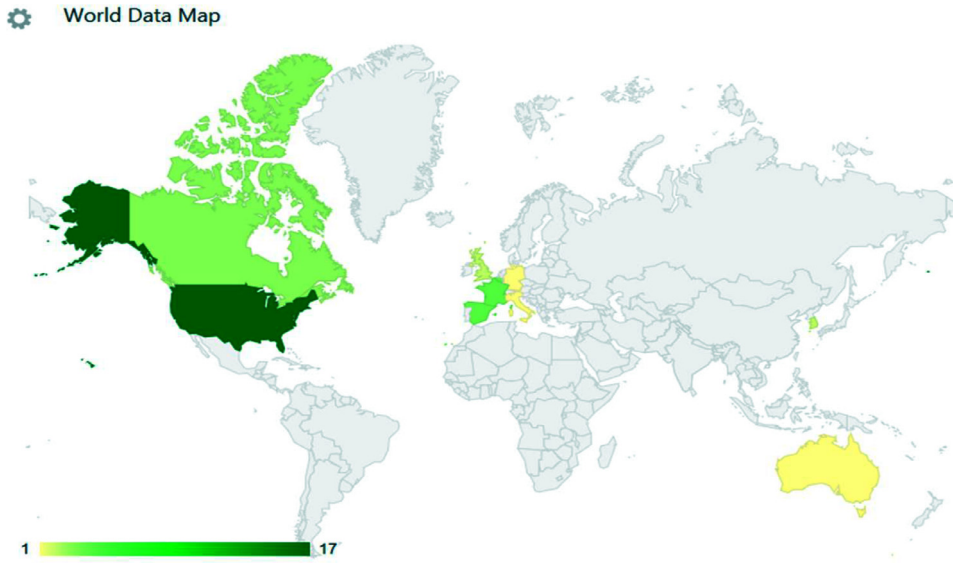

Fig. 2. Geographical heat map showing countries where the studies were conducted.

and Canada,[14,37,51] 2 studies each were conducted in the United Kingdom (UK)[26,31] and Republic of Korea,[40,52] and 1

study each was conducted in Germany,[25] Australia,[50] Italy,[42] and France and/or Spain.[29] Figure 2 is a geographical heat map to visualize the countries where the studies were conducted.

The year(s) of study for the clinical studies ranged from 1995 to 2015, although this was not reported in 6 studies. Overall, study publication year ranged from 2002 to 2018, with 4 studies each in 2018 and 2016, 6 studies each in 2017 and 2014, 5 studies in 2015 and 2011. Of the studies that provided information on funding, all but 1 study[29] was either funded by non-industry sources or not funded. Eleven studies did not report the number of participants. Of those that reported this information, the number ranged from 21 to 1550 patients. Figure 3 shows the types of cancers that were covered in the studies.

Objectives for the clinical studies were focused on geriatric assessment implementation and feasibility of assessment methods, while the objectives of the reviews and clinical practice guidelines varied, with most also focused on implementation and feasibility of geriatric assessment methods. Some studies reported on both implementation and feasibility. The number of geriatric assessment components examined in the studies varied significantly; ranging from 1 (polypharmacy) to 12 components (domains). Most commonly included were comorbidity, cognition, functional status, falls, nutritional status, psychosocial wellbeing and support, and polypharmacy. All the included studies' characteristics are summarized in Table 1.

Strategies for implementing geriatric assessment into clinical oncology practice

Twenty-seven studies (10 from the USA, 3 from each of France, Canada, and Belgium, 2 from each of the UK and Republic of Korea, and 1 from each of Germany, Spain, Italy, and France/Spain) reported various strategies for implementing geriatric assessment.[14,22–27,29-34,36–38,40–48,51,52] These studies focused on strategies including a self-administered questionnaire,[45] a questionnaire mailed to patient homes and returned during clinic appointment,[14] or a questionnaire administered by specialists.[14] The strategies investigated also included incorporation of simple,[24] or mini geriatric assessments,[38] a pharmacists-led indi-

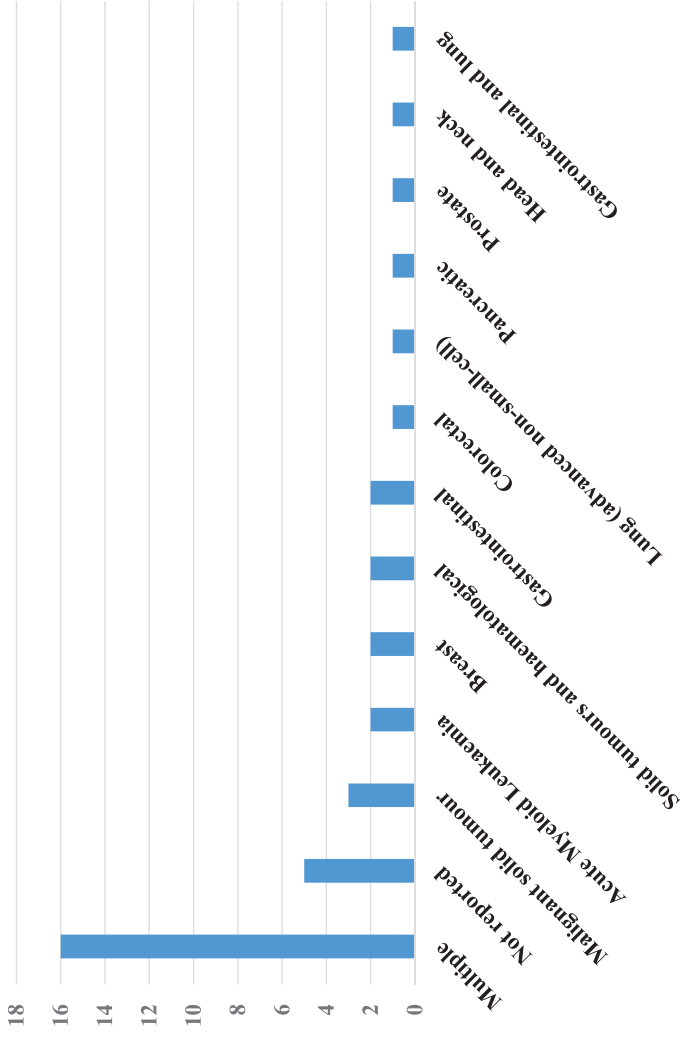

Fig. 3. Cancer types in included studies.

Table 1
Characteristics of included studies.

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Castel-Kremer 2018[22] (France)	Clinical study (2007-2014)	Pathologically diagnosed pancreatic cancer (73)	To evaluate the feasibility of standard of care oncologic treatments in this population, the accuracy of the geriatric evaluation to predict the ability of patients to tolerate the recommended treatments and to identify specific geriatric prognostic factors.	Autonomy and functional status, nutrition, comorbidities, cognitive and psychological status, polypharmacy, social conditions (n = 6)	Multidisciplinary care of older patients suffering from pancreatic adenocarcinoma, encompassing a CGA, is feasible in practice and useful in terms of predicting possible treatments in these patients. Age should no longer be a limiting criterion to propose standard of care oncologic treatments for older adults, but impairment in IADL, CIRS-G, and weight loss as prognostic factors for survival should be taken into consideration as an addition to the oncological criteria in the therapeutic decision-making process.
Girones Sarrió 2018[16] (Spain)	Clinical Practice Guideline (NR)	Any (NR)	To provide general recommendations as to the evaluation and therapeutic management of the older patient with cancer.	Functional, nutritional, cognitive, mood, socio-familiar, comorbidity, drug use, geriatric syndromes (n = 8)	*Spanish Society for Medical Oncology (SEOM) geriatric oncology task force's position statement* Training and the correct use of recommendations regarding treatment for comorbidities and geriatric syndromes, support care, and drug–drug interactions and toxicities, including those of antineoplastic agents, will ensure that older patients with cancer are properly managed.
Mohile 2018[10] (USA)	Clinical practice guideline (2005-2017)	Any (NR)	To examine how geriatric assessment should be used to guide management of older patients with cancer	Function, comorbidity, falls, depression, cognition, and nutrition (n = 6)	*The American Society of Clinical Oncology (ASCO) guideline* Brief, self-administered questionnaire in outpatient or inpatient setting is feasible for use and helps identify the need of geriatric oncology patients.
Loh 2018[45] (USA)	Review (NR)	Acute myeloid leukaemia (NR)	To review feasibility of geriatric assessment in geriatric acute myeloid leukaemia	Self-administered (comorbidity, health, medications, physical function, falls, emotional status, and social support) and healthcare professional administered (comorbidity, performance status, physical function, nutrition, and cognition) (n = 12)	Brief, self-administered questionnaire in outpatient setting is feasible for geriatric assessment in acute myeloid leukaemia patients. The time required to complete a cancer-specific geriatric assessment reported in the studies generally ranged from 15–30 minutes. Most assessments used self-administered validated surveys and may incorporate briefly administered tests such as a cognition screen or objectively measured physical function testing. For the objective assessments, any member of the healthcare team (most commonly a nurse or patient care technician) may perform the assessments with minimal training needed, depending on the resources available at the institution.

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Table 1 (*continued*)

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Glode 2017[46] (USA)	Review (NR)	Any (NR)	To summarize key elements from the National Comprehensive Cancer Network Guidelines and enhance topic areas with supplemental data to provide a broad overview of geriatric assessments and medication therapy management approaches to oncology in geriatric patients.	Functional status, comorbidities, psychosocial, cognition level, nutritional status, psychological status (n = 6)	While SIOG has determined that there is value in performing geriatric assessment in older patients with cancer, they have not specifically endorsed 1 tool over another. SIOG does provide recommendations for domains, which should be evaluated when a geriatric assessment is performed. These domains include functional status, comorbidity, cognition, mental health status, fatigue, social status and support, nutrition, and presence of geriatric syndromes.
Decoster 2017[23] (Belgium)	Clinical study (NR)	Breast cancer, CRC, lung cancer, ovarian cancer, prostate cancer, and hematologic Malignancies (937 patients)	To investigate the value of GA in older patients with CRC as well as its influence on cancer treatment decisions	Cognition, depression, nutritional status, comorbidities, polypharmacy, Functional status and living situation, pain, fatigue, fall history (n = 10)	There is a need to educate physicians treating CRC on the benefits of GA. In the absence of risk factors, GA may also prevent under treatment in fit patients. For this reason, integration of GA in routine clinical practice is of the utmost importance.
Wright 2017[24] (USA)	Clinical study (2015)	Hormone receptor positive early-stage breast cancer (24 patients)	To develop a multidisciplinary algorithmic approach to management of women aged ≥70 years with early-stage breast cancer, including geriatric assessments predicting life expectancy and the likelihood of functional decline in the near future	Health conditions, and functional status (n = 2)	The incorporation of simple geriatric assessments seems to have had a marked impact on decision making regarding both surgical and adjuvant therapies for women aged ≥70 years with hormone-positive early-stage breast cancer compared with historical patterns, with ≥75% omission of both SLNB and adjuvant RT in patients managed according to an institutional QI initiative.
Schmidt 2017[25] (Germany)	Clinical study (NR)	Any (100 patients)	To maintain HRQOL of older patients with cancer using an interdisciplinary care program based on CGA and patient-reported HRQOL comprising tailored supportive measures and telephone-based counseling during 6-month aftercare	Nutrition, mobility, mood/depression, cognition and self-care (n = 5)	Feasibility and potential benefit of the combination of CGA and HRQOL to complement standard assessments was shown.

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Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Whittle 2017[26] (UK)	Clinical study (2010-2013)	Urological, lung, colorectal, breast, and gynaecological (417 patients)	To select a sufficiently comprehensive tool to provide enough information about the patient to guide clinical decisions on need for further assessment or intervention	Physical function, comorbidities, medications, activities of daily living, mood, social situation, falls, nutrition, frailty, bladder and bowel problems (n = 10)	The CGA-GOLD was considered to be a feasible approach. Most participants (86.3%) reported to have completed the CGA-GOLD without assistance. Overall rate of missing responses was low (3.1%). Mean completion time was 11.7 min.
Nightingale 2017[27] (USA)	Clinical study (2014-2015)	Breast, colorectal, lung, pancreatic, prostate, lymphoma, myeloma, other (41 patients)	To assess feasibility of implementing a pharmacist-led individualized medication assessment and planning intervention	Polypharmacy (n = 1)	*Thomas Jefferson University's National Cancer Institute-designated Sidney Kimmel Cancer Centre experience* The pharmacist-led individualized medication assessment and planning intervention was shown to be feasible. The feasibility encompassed measures such as medication recommendation acceptance rate; intervention delivery time (patient contact); resources needed and utilized to deliver the intervention; barriers to deliver the intervention
Blanco 2016[28] (Spain)	Clinical study (NR)	Any malignant solid tumour (295 patients, 66 underwent CGA)	Feasibility of CGA and its impact of treatment choices	Comorbidity, polypharmacy, functional status, cognitive, emotional condition, nutritional & social deficits (n = 7)	CGA can modify the therapeutic plan, especially in the octogenarian population.
Lee 2016[52] (Republic of Korea)	Retrospective analysis (2009-2014)	Colorectal cancer (240 patients)	To identify the effectiveness of a preoperative comprehensive geriatric assessment (CGA) for predicting postoperative morbidity in older patients who underwent surgery for colorectal cancer	Comorbidity, polypharmacy, physical function, cognitive status, risk of postoperative delirium, depression, and nutritional status (n = 7)	Among the 8 domains in the CGA, the comorbidities and the ADL domains were significantly and independently associated with major postoperative complications. Thus, using the CGA to identify older colorectal-cancer patients who should be given more care during postoperative management may be clinically beneficial.
Corre 2016[29] (France and Spain)	Clinical study (2010-2013)	Advanced Non–Small-Cell Lung Cancer (NSCLC) (494 patients)	To study the impact on survival outcomes when CGA was integrated into the treatment allocation for older patients with advanced NSCLC	Functional status, comorbidities, medications, cognitive function, geriatric syndrome, depression/ mood, nutrition, mobility, situational assessment (n = 9)	In older patients with advanced NSCLC, treatment allocation on the basis of CGA failed to improve survival outcomes (TFFS or OS) but slightly reduced treatment toxicity. Consequently, the use of CGA in this setting cannot be routinely advised in clinical practice.

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Table 1 (*continued*)

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Hurria 2016[30] (USA)	Clinical study (NR)	Solid tumours or haematological malignancy (100 patients)	To evaluate the feasibility of a computer-based geriatric assessment via 2 methods of electronic data capture compared with paper-and-pencil data capture	Functional status, comorbidities, psychological state, social support, nutritional status, cognition, medications (n = 8)	Delivering a computer-based geriatric assessment is feasible, reliable, and valid. Feasibility was further demonstrated by only a small proportion of patients who needed help with the computer-based geriatric assessment (8%), skipped items completely (3%), or reported that they found the assessment difficult (7%). Furthermore, the majority of patients (67%) reported that they preferred the computer version to paper and pencil.
Parks 2015[31] (UK)	Clinical study (NR)	Primary operable breast cancer (47 patients)	To understand how CGA characteristics were associated with receipt of surgery or non-surgery in this cohort.	Functional impairment, number of falls, medications, physical health, nutritional status, mental health, social activities/support, mobility, cognition, (n = 9)	The feasibility of conducting CGA in a research setting was confirmed. This appeared to have value in assessing the studied patient population.
Klepin 2015[47] (USA)	Review (NR)	Any (NR)	To review some of the key considerations in caring for an older adult with cancer, including individualizing care for older adults with cancer through utilization of a geriatric assessment and considerations on when to refer to a geriatrician	Functional status, comorbidity, cognition, nutrition, psychological state and social support, medication review (n = 6)	Incorporation of geriatric assessment strategies can help individualize initial treatment decisions and inform management strategies during the course of treatment and survivorship. Incorporation of geriatric assessment strategies into clinical trial design will provide needed evidence to optimize therapy for vulnerable and frail older adults.
Baitar 2015[32] (Belgium)	Clinical study (2011-2012)	All tumour types (except non-melanoma skin cancer) and haematological malignancies (1550 patients)	To describe geriatric recommendations based on a geriatric assessment and to evaluate the implementation of these recommendations.	Social status, functional status, falls, fatigue, cognition, depression, nutrition (n = 7)	Geriatric recommendations were given in about three fourths of patients. At least 1 geriatric recommendation was performed in approximately half of these patients and about one third of all geriatric recommendations were performed after 1 month. A better understanding of the GA-based approach will allow improving its implementation in order to optimize its effectiveness.

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Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Goineau 2015[48] (France)	Review (NR)	Recently undergone prostatectomy for malignancy or with a biochemical relapse following prostatectomy (NR)	To propose a decision tree based on the International Society of Geriatric Oncology recommendations, with specific modifications for the management of older patients who have recently undergone prostatectomy for malignancy or with a biochemical relapse following prostatectomy	Comorbidities, independent living, nutritional status, cognitive functions, mobility, neuropsychological problems, polypharmacy, self-reported health compared to peers (n = 8)	The onco-geriatric assessment enables the development of an accurate picture, which represents the patient's overall condition. In the case of biochemical relapse following prostatectomy in patients over 70 years of age, and in routine practice for every older patient, a thorough assessment is time-consuming. The G8 screening questionnaire should be administered by the physician.
Korc-Grodzicki 2015[33] (USA)	Clinical study (2010-2011)	Any solid tumour (416 patients)	To describe the implementation of preoperative geriatric assessment (GA) in patients undergoing major cancer surgery and to determine predictors of postoperative delirium	Functional status, cognitive status, nutritional status and comorbidities, physical status, medications (n = 6)	It is possible and practical to evaluate older surgical patients preoperatively with an abbreviated GA, and this could be a crucial screening tool for risk of developing postoperative delirium.
Pottel 2014[34] (Belgium)	Clinical study (2010-2012)	Squamous cell carcinoma of the head and neck (100 patients)	Implementation of comprehensive geriatric assessment (CGA) to quantify functional age and to study the feasibility of serial CGA in this specific population	ADL, IADL, mini nutritional assessment, mini mental state examination, geriatric depression scale, balance and gait, cumulative illness rating scale for geriatrics (n = 7)	CGA performed at time of presentation is able to identify geriatric problems in patients receiving radiotherapy for head and neck cancer and enables classification of fit and vulnerable patients. Serial CGA identifies the evolution of multidimensional health problems.
Sattar 2014[14] (Canada)	Review (NR)	NR (NR)	To describe how to implement geriatric assessment in daily clinical practice for older adults with cancer in the oncology setting	Functional status, cognitive function, nutritional status, comorbidities, polypharmacy, and socioeconomic status (n = 6)	Different models of CGA implementation. Model 1: CGA for all patients based on a specific criterion; that is, age, administered by 1 or more health care providers, duration range 30-120 minutes. Model 2: CGA (as in model 1 but with a 2-step screening) filled out by health care provider or patient; range of duration (30-120 minutes); Model 3: Abbreviated CGA – patient fills out a questionnaire and depending on score, a full CGA may be required, range 5 - 10 minutes; Model 4: Cancer specific – patient fills out questionnaire in advance of appointment (tool sent to patient's home); range (27 minutes for self-assessment).

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Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Wildiers 2014[9] (Belgium)	Review (2010-2013)	NR (NR)	To develop consensus statements on the method for implementing geriatric assessment in clinical care	Social status, comorbidity, functional status, cognition, depression, nutrition, fatigue, polypharmacy, geriatric syndromes (n = 9)	*International Society of Geriatric Oncology (SIOG) recommendation* Identified 3 models of CGA implementation. Model 1: Creation of geriatric oncology units within selected general oncology hospitals. Model 2: To bring geriatric consultation teams to patients who remain under the supervision of their treating oncologists. Selected patients can also be referred to appropriate specific geriatric programs such as a geriatric day care centre, fall clinic, or memory clinic. Model 3: In settings where geriatric expertise is not nearby, CGA can be performed to identify high-risk patients who could be referred to geriatricians outside of the cancer centre or to members of a multidisciplinary team within the cancer centre. Concluded that preference should be given to models that fit with the local health care structure and setting.
Magnuson 2014[49] (USA)	Review (NR)	NR (NR)	To explore models of care in geriatric oncology	ADL, IADL inventory, fall history, sarcopenia questionnaire, comorbidity screen, medication list, social support inventory, nutritional screen, geriatric depression screen and worry scale (n = 9)	*The University of Rochester model* A model of CGA involving a multidisciplinary team. One week prior to arriving for appointment, patients are asked to complete a self-administered CGA questionnaire and worry scale. Assistance given on arrival to those who need help to complete the questionnaire, in addition to completing objective physical performance assessment. The entire team reviews the results of the CGA and identifies potential deficits. Review cancer specific details and proposed treatment options from the patient's primary oncologist. Suggestions are made regarding treatment regimen preferences and potential modifications and CGA guided interventions are developed based upon identified deficits. A clinical registered nurse trained in geriatrics and oncology is available for patient and family education, with a focus on geriatric-specific issues that occur commonly during cancer treatment.

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Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Williams 2014[15] (USA)	Clinical study (2009-2013)	Breast, lung, colorectal, lymphoma, leukaemia (1088 patients)	To determine the feasibility of performing geriatric assessment in community oncology clinics	Performance status, cognitive function, functional status, comorbidity, psychological state, social support, nutritional status, medications (n = 8)	Brief CGA can be performed in community oncology clinics. One portion to be completed by health care professionals and other by patients. Patients from community practices were more likely to return their portion, to complete the entire CGA and required more assistance to complete the questionnaire. Patient portion took more time to be completed in the community setting. The time to complete the professional assessments and patient self-assessments were similar in both community and hospital settings.
Chapman 2014[35] (USA)	Clinical study (2010-2012)	Breast, colorectal, lung, haematological cancers, upper gastrointestinal cancers (211 patients)	To develop a highly functional model for the establishment of a comprehensive multidisciplinary geriatric oncology centre in the setting of a university based designated cancer centre	Medication, patients, knowledge and adherence, mini nutritional assessment, functional status assessment, cognitive screening, depression and emotional distress, estimated life expectancy, risk of toxicity (n = 9)	*Thomas Jefferson University's National Cancer Institute-designated Sidney Kimmel Cancer Centre model* A model of CGA involving evaluation of patients by medical oncology, geriatric medicine, pharmacy, social work and nutrition specialist during an approximately 2-hour visit. The inter-professional team meets to review each case and formulate a comprehensive treatment plan. Prior to the visit, patients are asked to complete a Vulnerable Elders Survey (VES-13), and a functional screening tool. Challenges identified include: patient related issues, navigation, financial reimbursement, referral patterns, coordination of care in office.
McCarthy 2013[50] (Australia)	Review (2011-2012)	NR (NR)	To explore methodological and practical aspects of implementing the Princess Alexandra Hospital model	Comorbidities; social interactions; cognitive capacity; depression; basic activities of daily living; complex functional abilities; fall risk; Physical, psychological, social, financial and emotional responses to providing care (n = 8)	*Princess Alexandra Hospital model* A nurse trained in oncogeriatric assessment collects CGA data through a face-to-face or phone interview prior to the first oncologist visit, with the rest of the data collected at the first clinic appointment. The CGA nurse enters the data into the computerized oncology patient management system with a summary of objective and subjective data. Summary is sent to the treating doctor, the tumour stream coordinators, and relevant allied health personnel for multidisciplinary review. The model may overcome the logistic obstacle of overstretched health professional resources and is financially viable, given that a dedicated nurse trained in this procedure is clearly more cost-effective than a 2-hour assessment undertaken by an oncologist and further geriatrician consult.

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Table 1 (*continued*)

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
McCleary 2013[36] (USA)	Clinical study (2009-2011)	Gastrointestinal (37 patients)	To develop a computer-based comprehensive geriatric assessment that can be completed and scored via computer survey methodology and to assess administration feasibility	Functional status, cognitive function, nutritional status, comorbidities, polypharmacy, and socioeconomic status (n = 6)	Appreciably fewer patients were able to complete the CGA unassisted in comparison to the feasibility results of completing this assessment via paper/pencil format. 51% of patients independently completed the survey; 49% were unable to due to lack of computer familiarity. There was no indication of time constraints or assistance needed in reading or interpreting the survey questions or answers.
Horgan 2012[37] (Canada)	Clinical study (2009)	Gastrointestinal or lung cancer (30 patients)	To determine the feasibility and impact of CGA, from a consultative geriatric-oncology service, on treatment decisions in older cancer patients	Functional status, comorbidity, cognition, psychological status, social status and nutritional status, geriatric syndrome (n = 7)	Difficulty in interpretation of the results provided to the primary oncologist potentially impacted the lack of change in established treatment plans. Physician reluctance appeared largely driven by doubt regarding the added benefit of the CGA over standard assessments and PS. The impact of CGA in informing treatment decisions was modest but may be of value when the initial treatment decision is uncertain.
Puts 2012[51] (Canada)	Review (1996-2010)	NR (NR)	To examine the feasibility of using geriatric assessment instruments	Activities of daily living, instrumental activities of daily living, comorbidity, cognitive functioning, depression, nutritional assessment, performance status, fall risk assessment (n = 8)	Reviewed feasibility of the geriatric assessment, such as time needed to complete the assessment and/or who (study author, patient themselves, or others) conducted the assessment. In most studies, the assessment was done through a face-to-face interview and generally took 10-45 minutes. In 6 studies, CGA was done using self-administered surveys. Concluded that it is feasible to conduct a geriatric assessment in a hospital setting in older patients with cancer.
Aparicio 2011[38] (France)	Clinical study (2004)	Gastrointestinal cancer (21 patients)	To evaluate the feasibility of mini geriatric assessment (MGA) to adapt anticancer treatments in patients with digestive cancer.	Cognitive status, psychological status, functional status, nutritional status, comorbidities, medication, social support, physiological parameters (haemoglobin, creatinine, creatinine clearance) (n = 8)	A mini geriatric assessment is routinely feasible even in gastroenterologic consultation. It facilitates cancer treatment decisions and allows a majority of patients to complete treatment.

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Table 1 (*continued*)

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Klepin 2011[39] (USA)	Clinical study (2009-2010)	Acute Myelogenous Leukemia (54 patients)	To test the feasibility and utility of a bedside geriatric assessment (GA) to detect impairment in multiple geriatric domains	Cognition, psychological function, physical function, and comorbidity (n = 4)	Bedside GA is feasible and could be performed to detect impairment in multiple domains among older adults hospitalized for treatment of newly diagnosed AML
Kim 2011[40] (Republic of Korea)	Clinical study (2006-2008)	Any (65 patients)	Feasibility study of comprehensive geriatric assessment (CGA) in older patients with cancer and to study its ability to detect unsuspected health problems, predict survival, and predict tolerance to chemotherapy	Comorbidity, functional status, risk of falls, cognitive function, nutritional status, frailty, psychological state, (n = 7)	CGA was feasible and could detect multiple unsuspected health problems including functional impairment and malnutrition in Korean older patients with cancer receiving chemotherapy.
Molina-Garrido 2011[41] (Spain)	Clinical study (2005-2007)	Tumors (99 patients)	To develop a brief non-self-administered cancer-specific geriatric assessment and to determine its feasibility	Risk of frailty, cognitive status, risk of malnutrition, grade of medication consumption, social risk, functional status (n = 6)	*University General Hospital, Elche, Alicante, Spain experience* CGA considered to be feasible. Time taken to answer the CGA was 12.87 minutes (9.50-20.50 minutes). A total of 69.7% (n = 69) of patients indicated that the difficulty associated with responding to all levels of the CGA was acceptable.
Hurria 2011[13] (USA)	Clinical study (2008-2009)	Breast, lung, colorectal, lymphoma (85 patients)	To evaluate the implementation of a geriatric assessment tool with a patient and health care professional portions in a trial setting	Functional status, comorbidities, psychological state, social support, nutritional status, cognition, medications (n = 7)	Patients took a longer time to complete their portion than the health care professionals. 87% of patients completed their portion of the assessment tool without assistance. Most of the patients (92%) were satisfied with the questionnaire length and 95% said there were no difficult questions.

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Table 1 (*continued*)

Study (Country)	Study type (Year)	Cancer type (No. patients)	Relevant objective	Geriatric principles examined (number)	Key findings or conclusions
Arnoldi 2007[42] (Italy)	Clinical study (2004-2005)	Any (153 patients)	To apply geriatric assessment to select patients eligible for oncological treatment or supportive care only	Functional status, psychological, cognitive and comorbidities (n = 4)	CGA was able to identify patients at higher risk of death. Results confirm the importance of cancer geriatric assessment for the clinical evaluation of oncological patients.
Hurria 2007[43] (USA)	Clinical study (NR)	Breast, lymphoma, gynaecological or genitourinary, gastrointestinal (245 patients)	To determine the feasibility of offering a self-administered, brief, yet comprehensive questionnaire consisting of measures of geriatric assessment to patients before their oncology appointment	Functional status, comorbidities, psychological state, social support, nutritional status, cognition, medications (n = 7)	*Memorial Sloan-Kettering Cancer Centre Study experience* The brief, comprehensive, self-administered questionnaire was feasible for use in the outpatient oncology setting and helped identify the needs of geriatric oncology patients. Most patients (78%) completed the questionnaire on their own and reported acceptance of questionnaire length (91%), no difficult questions (94%), no upsetting questions (96%), and no missing questions (89%). Mean time to completion was 15 minutes, median of 12.5 minutes (standard deviation 10, range 2-60).
Rao 2005[44] (USA)	Clinical study secondary subset analysis (1995-1999)	Any (excluding non-melanoma skin cancers) (99 patients)	To determine whether frail older patients with cancer might have better quality of life outcomes if cared for in a geriatric inpatient unit.	Medical history, geriatric syndromes, functional status, cognition, nutritional status, caregiver capability, social situation, physical performance (n = 8)	Comprehensive geriatric assessment using geriatric evaluation and management on inpatient units impacts quality of life, in particular, in the management of pain or mental and emotional health. Effects were achieved with no increase in hospitalization or cost of care over the year of the study.
Ingram 2002[12] (USA)	Clinical study (1999-2000)	Genitourinary, head and neck, lung, lymphoma, leukaemia, colorectal, breast, melanoma (103 patients)	To assess the ability of cancer patients to complete a comprehensive assessment tool in their own homes and return the surveys during follow-up clinic appointment	Comorbidities, activities of daily living, functional status, pain, financial well-being, social support, emotional state, spiritual well-being (n = 8)	The study demonstrated the feasibility of obtaining comprehensive assessment information using a mailed, self-administered instrument from older patients with cancer who attend an oncology clinic. Absolute survey response rate (64%) and clinic attendee response rate (76%).

CGA, comprehensive geriatric assessment; NR, not reported; n-RCT, non-randomized controlled trial; OS, overall survival; RCT, randomized controlled trial; TFFS, treatment failure free survival.

vidualized medication assessment and planning of interventions,[27] and use of a computer-based geriatric assessment via 2 methods of electronic data capture compared with traditional paper-and-pencil data capture approach.[30]

Feasibility of implementing geriatric assessment into clinical oncology practice

Twenty-four studies (11 from the USA, 3 from Canada, 2 from each of France, Spain and the UK, and 1 from each of Germany, Belgium, Republic of Korea, and France/Spain) reported on the feasibility of approaches to geriatric assessment implementation into clinical oncology practice and other care settings.[12-15,22,25–31,33–41,43,45,51] The studies reported on the feasibility of using self-administered geriatric assessment questionnaires,[45] computer-based assessments in outpatient and/or inpatient settings or prior to clinic appointment,[43,45] type of clinic (whether community or tertiary hospital),[15] a pharmacist-led individualised medication assessment and planning intervention,[27] maintenance of standard of care treatments,[22] use of varied instruments,[51] serial geriatric assessment,[34] mini geriatric assessment,[38] bedside assessment,[39] time required to complete an assessment,[15,26,43] and the proportion of patients who completed the assessment.[30] All studies evaluating feasibility found the tested procedure feasible, except 2,[35,37] which found that feasibility depended on other available resources.

Models and guidelines for implementation of geriatric assessment in clinical oncology practice

Four papers (2 from the USA and 1 each from Australia and Canada) reported models for implementation of geriatric assessment in clinical oncology practice that were described comprehensively enough to facilitate implementation of a geriatric oncology clinical service,[14,35,49,50] while 3 papers reported on guidelines (1 each from the USA, Belgium and Spain).[9,10,16]

The University of Rochester (USA) model describes a multidisciplinary team approach in which, 1 week prior to arriving for medical appointment, patients are asked to complete a self-administered CGA questionnaire and worry scale.[49] At their appointment, assistance is given to those requiring help in completing their questionnaire or the objective physical performance assessment. The entire multidisciplinary team then reviews the results of the assessment and identify areas of potential deficit. They also review cancer specific details and propose treatment options from the patient's primary oncologist.

The Thomas Jefferson University's (USA) National Cancer Institute-designed Sidney Kimmel Cancer Centre model also uses a multidisciplinary team (medical oncologist, geriatric physician, pharmacist, social worker and nutritionist) approach.[35] Prior to their appointment, patients are asked to complete a Vulnerable Elders Survey (VES-13) and a functional screening tool. At their appointment, the CGA is conducted by the multidisciplinary team. Similar to the University of Rochester's approach, the multidisciplinary team meet to review each case following assessment and formulate a comprehensive treatment plan.

The Princess Alexandra Hospital (Australia) model differs from the previous models in that a skilled nurse trained in oncogeriatric assessment collects the CGA data through a face-to-face interview or by phone with each patient prior to their first oncologist visit, with the rest of the data collected personally at the first clinic appointment.[50] The nurse then summarizes the assessment data and sends the summary to the treating doctor and relevant allied health personnel for multidisciplinary review.

The paper from Canada was a review of various strategies for implementing geriatric assessment in clinical oncology practice, and the review informed the development of a model for implementation.[14] The paper from Belgium was also a review of various strategies for implementing geriatric assessment in clinical oncology practice, with the aim of informing the International SIOG guidelines and recommendation.[9] These reviews respectively suggested 4 and 3 potential models which share some of the characteristics of the models developed by the University of

Rochester, the Thomas Jefferson University, and the Princess Alexandra Hospital. Furthermore, the paper from Spain was a general review of geriatric assessment practices in clinical oncology, with the aim of informing the Spanish Society for Medical Oncology general recommendations for the management of older patients with cancer.[16]

The review that provided the clearest and most implementable recommendations was the ASCO guideline evaluating "Practical Assessment and Management of Vulnerabilities in Older Patients Receiving Chemotherapy."[10] These guidelines recommend a minimum assessment of function, comorbidity, falls, depression, cognition and nutrition. For specific tools: instrumental activities of daily living to assess function, simply asking about falls, history for comorbidity, the Geriatric Depression Scale to screen depression, unintentional weight loss for nutrition, and either Mini-Cog or Blessed Orientation-Memory-Concentration to screen for cognition. To supplement geriatric assessment, specific tools are recommended to predict chemotherapy toxicity and life expectancy.

Discussion

Our scoping review reveals a reasonable literature base for planning strategies and models for implementation of geriatric assessment. The most common manifestation of geriatric assessment in the literature is the CGA, which is the cornerstone intervention in geriatrics and serves to both evaluate and guide interventions for older adults. In older adults with cancer, results of a CGA correlate with finding issues not identified during routine oncologic assessment, survival, likelihood of chemotherapy toxicity, outcomes post cancer surgery, and admissions to hospital.[53] Typically, a CGA includes assessment of comorbidity, physical performance, function, cognition, nutrition, polypharmacy, emotional status, and social supports and/or living environment.[54] In our review, the geriatric assessments applied did not necessarily address all domains of a CGA. Assessments of comorbidity, cognition, functional status, and nutrition were each included in a majority of the included studies but excluded in a few. Assessments of falls, physical testing, and psychosocial wellbeing were excluded more often. This variation suggests that there have been substantial differences in the geriatric assessments being implemented both in the literature and in clinical practice. Comorbidity and functional status, the 2 domains most consistently included (36 and 33 studies respectively) are areas already addressed in oncological assessment, and the inconsistency in which additional domains were included may contribute to uncertainty about what constitutes an appropriate geriatric assessment.

A further obstacle to consistent implementation of geriatric oncology principles is that each group appears to use its own combination of tools to assess the CGA domains. If different tools have equivalent efficacy, the advantage of this type of variation is that each jurisdiction could construct a local standard CGA using whichever validated tools are available to them. The challenge, however, is that different tools likely have variable sensitivity and specificity for identifying deficits within a domain, suggesting greater implementation simplicity if organizations that produce guidelines for management of older adults with cancer (eg, SIOG or ASCO) created a gold standard CGA. In 2014, SIOG's consensus guidelines on geriatric assessment were unable to endorse a specific CGA model.[9] The ASCO Guideline by Mohile et al provide the most specific guidance on what should constitute a geriatric assessment in their recent guideline.[10]

In our review, some groups used a self-administered version of the CGA, others a computer-assisted version, and yet others an approach completed in hospital. Some studies included a screening tool, like the Vulnerable Elders Survey 13 (VES-13), while others used either patient characteristics or referral to a geriatric oncology clinic to select patients for CGA. This further variation in evidence creates uncertainty, but also opportunities to tailor implementation for jurisdictions aiming to improve support for, and evaluation of older adults with cancer. Fortunately, self-administered approaches to CGA are promising for broader implementation because they save time, reduce human resource requirements, and reduce cost.[10,55,56] Most attempts to implement self-administered CGAs have shown high completion rates without help from staff, with assistance sometimes being necessary depending on literacy level and cognitive

ability.[9,10,13] Availability of these tools in various languages can be a hurdle. Nevertheless, partially or fully self-administered CGAs are likely an important component of implementation for jurisdictions currently lacking established geriatric oncology services.

Even if self-administered versions of the CGA or other domain assessments are implemented, supporting older adults with cancer using multidimensional geriatric services remains resource intensive. The papers included in this review do not really address the necessity of available financial resources, personnel trained to administer assessments, time constraints, and personnel with the expertise to interpret assessment results and recommend therapeutic changes. Recommendations to address this last component include an oncologist with additional training in geriatrics, or a geriatrician and oncologist working together, or extended practice nursing staff with training in geriatrics.[10,14] Physical space for a geriatric oncology clinic would also be a necessity. Overall, implementation of geriatric assessment is a substantial but important undertaking.

Currently, the USA appears to be leading the world in publication of models and integration into practice. This leadership is partially explained by the legacy of Dr Arti Hurria, who both transformed clinical practice and mentored a generation of health care professionals on the importance of geriatric oncology before sadly passing in late 2018. Since the completion of our search, a brief paper describing the challenges Belgium faced attempting to improve the care of older adults with cancer and another study from Germany focusing on what might be needed to implement geriatric approaches in haematology clinic have been published.[57,58] Neither significantly alters the findings in our review.

Implementation science suggests that successful integration often requires years and continuous efforts in quality assessment and improvement.[59–61] The ability to access evidence for an intervention like the CGA, evidence appraisal skills, and time to appraise evidence all constitute common barriers to the implementation of knowledge in individual clinical practices. Beyond this, lack of local guidelines, variation in national/international guidelines recommendations, and financial disincentives can all reduce implementation of interventions beneficial to patients.[62–65] Fortunately, despite the gaps in existing evidence, there has been increasing interest in geriatric oncology principles as reflected in an increasing number of publications on the topic, and efforts to integrate geriatric principles into oncology practice. With the growing number of older adults, we expect this topic to become increasingly important and jurisdictions that have not yet started incorporating geriatric principles can look to the experience of programs that have published their implementation experience, primarily in the USA, to guide their efforts. We hope our review can serve to provide an overview of the available evidence to assist such efforts.

The main strength of our study is the comprehensiveness of our search, acquiring references through 7 electronic databases and pre-publication sources such as important conferences. In contrast, the main weakness of our study is the difficulty of allocating whether some articles focused on implementation or validation of specific tools, feasibility, implementation models, or some combination of these. We mitigated this weakness by ensuring multiple reviewers for titles, abstracts, and full text articles.

Conclusions

Based on the focus of the existing literature, there is increasingly robust evidence to implement formal geriatric assessment in oncology practice. There remains a great deal of variation in the tools recommended to address each of the domains in a geriatric assessment, with the ASCO Guideline providing a good starting point for programs planning to implement geriatric oncology services.

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Declaration of Competing Interest

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Authors contributions

Conceptualisation (M.S. and D.E.D.), Study design (G.N.O., M.S., A.M.A.S. and D.E.D.), Protocol development (G.N.O., M.S., A.M.A.S. and D.E.D.), Data acquisition (G.N.O., F.R., O.L.T.L., V.K.R., and L.C.), Data analysis (G.N.O. and D.E.D.), Data interpretation (G.N.O., T.H., A.M.A., D.E.D.), Draft manuscript (G.N.O. and D.E.D.), Final manuscript (G.N.O., M.S., F.R., O.L.T.L., V.K.R., L.C., T.H., A.M.A.S., D.E.D.).

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Supplementary materials

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