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SYSTEMATIC REVIEW

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The value and effectiveness of geriatric assessments for older adults with cancer: an umbrella review

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Abstract

Purpose This umbrella review aimed to summarise and synthesize the evidence on the outcomes reported and used to assess the value and or efficacy of geriatric assessments (GAs) for older adults with cancer.

Methods Six electronic databases, PsycINFO, MEDLINE, Embase, CINAHL, Cochrane Library and Web of Science databases, were searched to identify systematic reviews with or without meta-analyses that described the value or outcomes of GAs for older adults with cancer.

Results Twenty-six systematic reviews were included, of which six included a meta-analysis of the data. Thirteen associations and or outcomes were identified. Overall geriatric impairments predicted or were associated with majority of identified outcomes. However, the type of domains associated with outcomes differed within and across reviews. Only treatment toxicity was statistically significantly lower for patients allocated to the GA intervention group compared to standard care. Systematic reviews without meta-analyses demonstrated a positive impact of GA with management on treatment completion, communication and care planning and patient satisfaction with care.

Conclusion There is evidence demonstrating the predictive value of GAs for older adults with cancer. GAs seems to be beneficial for older adults with cancer across some outcomes, with strong evidence demonstrating the impact of GA with management for treatment toxicity. However, there is mixed or limited evidence demonstrating the effect of GA in other treatment modalities, and on quality of life and economic outcomes.

Keywords Geriatric assessments, Older adults, Cancer, Outcomes, Umbrella review

Background

By 2035, older adults will represent more than half of new cancer diagnoses [1]. There is limited evidence-based data to guide treatment decision-making for older adults with cancer as this population is under-represented in clinical trials [2]. The chronological age of a patient may be used to guide clinicians' treatment recommendations [3]. However, older adults are quite heterogenous and may present with other age-related vulnerabilities [4]. Presence of comorbidities, functional or cognitive impairments can also impact on the patient's tolerance of cancer treatment [4, 5] and/or quality of life [6]. Furthermore, older adults with cancer may be at higher risk of

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treatment complications or toxicity compared to younger adults [7]. This highlights the need for a more holistic and comprehensive assessment to guide treatment decisions and care for older adults with cancer.

A comprehensive geriatric assessment (CGA) provides a holistic understanding of an older adults' health and involves a geriatrician-led multidisciplinary evaluation of an older adult with an aim of developing a care plan and follow-up care [8, 9]. However, in oncology literature, the term CGA has been used non-specifically, such that the subsequent interventions are not mandated following the assessment. Therefore, the term geriatric assessment with management is sometimes used instead. In geriatric oncology, a geriatric assessment (GA) refers to the "multidimensional evaluation of geriatric domains, with or without subsequent interventions" [9], and implemented with or without a geriatrician. Studies have demonstrated the use of GAs in identifying geriatric problems [10, 11], and the predictive value of GAs on important patient outcomes such as treatment complications, particularly treatment toxicity [12, 13]. Multiple systematic reviews [14–16] reporting on the predictive value or effect of GAs for older adults with cancer have been published in the last ten years. Despite this, recent surveys have reported low uptake of GAs as part of routine cancer care [17, 18].

Given the increasing numbers of published systematic reviews, this has not resulted in a change in clinical practice evidenced by studies reporting low adoption of GAs within routine cancer care [17, 18]. It is important to understand the range of outcomes reported and identify where research can be focussed to further examine the effectiveness of GAs in geriatric oncology and thus facilitate implementation efforts. This umbrella review aims to provide an overview on the systematic review evidence for the outcomes reported and used to determine the value and or efficacy of GAs for older adults with cancer.

Methods

Protocol and registration

The results reported here are part of a review registered on PROSPERO (CRD42022338842). Results are reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines [19].

Search strategy

In brief, six electronic databases (PsycINFO, MEDLINE, Embase, CINAHL, Cochrane Library and Web of Science) were searched. Systematic reviews with or without meta-analyses published in English from 2012 were included. The search date was limited from 2012 as Puts et al., (2012)'s systematic review was the first review synthesising results on the use of GAs in oncology [14]. The initial search period was from 2012 to 2022 and updated in September 2024. The following key words and relevant medical subject headings were used: (cancer OR malignant neoplasm OR oncology) AND (geriatric assessment* OR geriatric evalu* OR geriatric consult* or risk assessment OR needs assessment OR frailty) AND (geriatric OR aged OR older OR elderly). See supplementary Table 1 for search strategy.

Reference lists of included articles were also searched to identify any additional reviews.

Study selection process

Based on the aims of the umbrella review, we included: systematic reviews with or without meta-analyses reporting on (i) predictive value of the GA, (ii) impact or outcome of the GA (i.e., GA led to modifications in treatment plan) and (iii) efficacy of the GAs as an intervention (e.g., randomised controlled trials comparing CGA to standard or usual care) for older (age dependent on review definition) adults with cancer (any cancer type). We excluded conference abstracts, reviews that did not include a systematic search of the literature, reviews reporting only screening tools. Study selection process was conducted in Covidence [20], an online platform for managing reviews. The title/ abstracts and full text reviews were independently screened by two reviewers (SH, JS). Disagreements were resolved through discussions with the wider research team.

Data extraction and synthesis

Data extraction was completed by a single reviewer (SH). A subset (12%) was reviewed by the research team. The authors, year of publication, type of review, search strategy (e.g., number of databases searched, search date), review aim(s), participant characteristics (e.g., age, cancer type, cancer stage, treatment type), number of included studies and reported outcomes were extracted.

The data was descriptively synthesised, and evidence tables were created. Outcomes of the GA were categorised based on the Core Outcome Measures in Effectiveness Trials (COMET) taxonomy [21].

Due to heterogeneity of the data, meta-analysis was not conducted to determine effectiveness of review outcomes.

Quality assessment

The A MeaSurement Tool to Assess systematic Reviews (AMSTAR-2) tool [22] was used to assess quality of the included reviews. A subset of the reviews (12%) was assessed by a second reviewer (JS) to confirm quality ratings.

Results

Database searches identified 3,494 articles after duplicates were removed. Title and abstract screening resulted in 128 articles that were full text reviewed and 22 systematic reviews met the inclusion criteria. An updated search conducted in September 2024, yielded an additional review. Hand search yielded an additional three reviews. A total of 26 systematic reviews were included in this umbrella review. PRISMA flowchart is provided as Fig. 1.

Review characteristics

Twenty-six systematic reviews were included. The focus of reviews varied and included: an overview and/or evidence for GAs in cancer populations (n=8) [14, 23–29], predictive value or association of GAs and patient/treatment outcomes (n=8) [16, 30–36] and effect of GAs/GA with management (i.e., GA-based recommendations and or implementation of interventions) in cancer care [15, 37–42] (n=7). Three reviews [43–45] reported on the predictive value of specific domains of the GA on outcomes.

Majority of reviews (n=18) [14–16, 23, 24, 26, 30–33, 35, 37–42, 45] included all cancer types including all solid tumours. Three reviews [27, 28, 34] were haematological specific, two [36, 43] gastrointestinal cancer (including oesophageal), and tumour specific reviews for lung [25], prostate [29] and head and neck cancer [44]. Three reviews [32, 35, 36] examined the use of GAs within surgical settings, and one [26] in the context of radiation oncology.

Age of participants for inclusion varied across reviews. Majority of reviews (n=12) [14, 16, 23, 24, 26, 31, 33, 35–38, 41] defined an older adult as those over 65 or reported a mean/median age of 65. Two reviews [32, 42] defined an older adults as those over 60 years and over, and one [45] used a mean age of 70 years and over. Ten reviews [15, 25, 27–30, 39, 40, 43, 44] did not impose an age limit, with study participants age ranging from 18 to 99 years despite the geriatric oncology review focus. Table 1 Review Details.

Overlap of references

A total of 401 publications (range 6 to 83 publications) were included across 26 reviews. There was a lack of overlap in studies across reviews (33%, (133/401)) of studies were reported across two or more reviews) (Supplementary Table 2). Possible reasons for this include heterogeneity in search strategies reportedly used, diversity of inclusion criteria, and the range in publication dates. However, when limited to randomised controlled trials (RCTs) included across these reviews, more than half of the RCTs (18/22 RCTs, 82%) were referenced two or more times across six reviews [37–42].

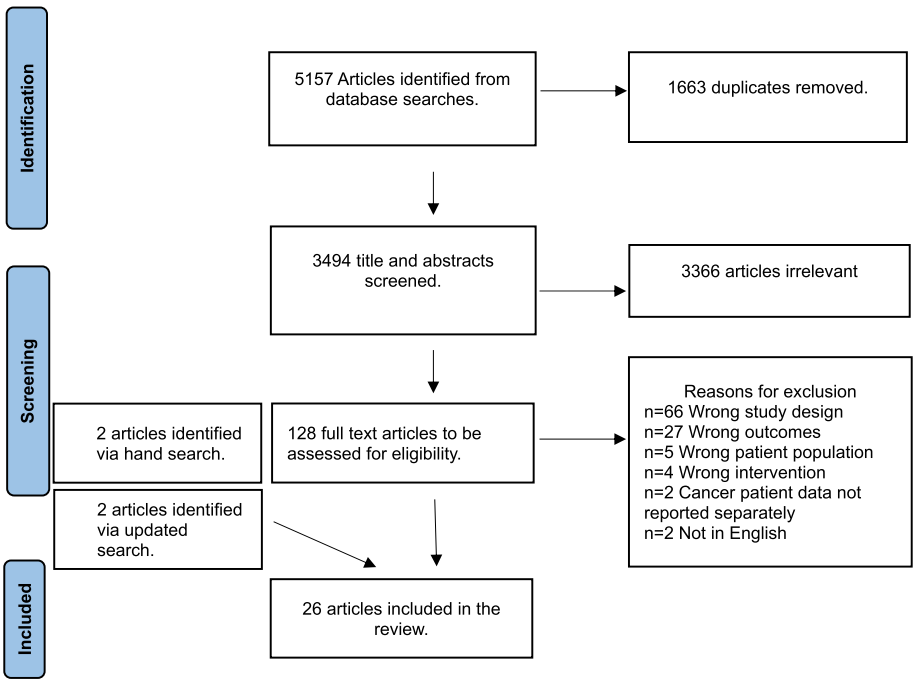

Fig. 1 PRISMA flowchart

Table 1 Review characteristics

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Puts (2012) [14]	N	(i) to provide an overview of all GA tools used in oncology settings, (ii) to examine the feasibility and psychometric properties of the GA tools, and (iii) to systematically evaluate the impact of GA tools in predicting or modifying outcomes	mean or median age of study participants ≥ 65	Patients: 65–99 years	Heterogenous; Heterogenous; Heterogenous	73 (83)	i. overview of GA instruments developed and/or used, ii. feasibility of GA iii. impact of GA on treatment decisions iv. associations/predictive value of GA on treatment complications or toxicity, vi. predictive value of GA on mortality v. association between GA domains and healthcare utilisation	• Common tools used to assess domains within a GA included Katz (ADL), Lawton (IADL), CCI or CIRS-G (comorbidity, MMSE (Cognition), GDS (Depression), MNA or BMI (nutrition), ECOG or Karnofsky (Performance Status), Self-reported falls (Falls risk) • GA generally took 10–45 min. • Short form GA generally had good diagnostic accuracy. • Changes to treatment plans for 40–50% of patients following GA (2/4 studies). • Impairments on at least one GA domain were associated with treatment toxicity or complications (reported in 6/9 studies), mortality (in 8/16 studies), health care use in two studies • Various GA domains associated with treatment toxicity and mortality.
Puts (2014) [23] – Update to Puts 2012	Y	(i) to provide an overview of all GA tools used in oncology settings (ii) to systematically evaluate the impact of GA tools on the treatment decision-making process and their effectiveness in predicting pr modifying outcomes	mean or median age of study participants ≥ 65	Patients: 55–99 years	Heterogenous; Heterogenous; Heterogenous	34 (35)	i. overview of GA instruments developed and/or used, ii. impact of GA on treatment decisions iii. associations/predictive value of GA on treatment complications or toxicity, iv. predictive value of GA on mortality v. association between GA domains and healthcare utilisation	• Common domains assessed within a GA included ADL, IADL, comorbidity, depression, and cognitive function. • Meta-analysis across six studies demonstrated GA modified treatment decisions in 23.2% (weighted percent modification) • Heterogenous results on predictive value of GA on treatment toxicity or complications in seven studies, and mortality in eleven studies. • One study reported association between increasing frailty and increased cost of care

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Hamaker (2012) [30]	N	to summarize all available evidence on the association between GA and oncological outcomes	No limit	Patients: 18–99 years	Heterogenous; Heterogenous; Heterogenous	37 (51)	i. predictive value of GA on all-cause mortality ii. chemotherapy toxicity iii. chemotherapy completion iii. association between GA and perioperative complications v. association between GA and radiotherapy toxicity/completion	• Median of five geriatric domains assessed per study. • Frailty (in 9/10 studies), nutritional status (in all four studies), comorbidity assessed using CIRS-G (in 4/5 studies) predicted mortality. • Frailty (in 2/3 studies) predicted chemotherapy toxicity. • Impairment in cognition (in 2/3 studies), comorbidity (in 2/3 studies), ADL impairment (in 2/3 studies) was associated with chemotherapy completion. • Impairment in IADL (in 3/4 studies) was associated with peri-operative completion. • No studies found reporting on association between GA and radiotherapy toxicity/completion

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Hamaker (2014) [15]	N	to summarise data on the effect of a geriatric evaluation (GE) on oncologic treatment decisions and implementation of non-oncologic interventions for older adults with cancer	No limit	Patients: 70–99 years	Heterogenous; Heterogenous; Heterogenous	10 (10)	i) changes in treatment plan ii) number and type of non-oncologic interventions	• Frequently detected conditions were polypharmacy (median 67%), malnourishment (median 63%), functional impairments (IADL median 45%, ADL median 43%, mobility/falls median 33%), depressive symptoms median 34%, somatic comorbidity and cognitive impairments, followed by social issues (social isolation, caregiver burden; median 21%). • Effect of GE on treatment decisions considered in six studies. Treatment changes for approximately 39% of patients after a GA, with two thirds of these changes made to a less intensive treatment option. • Non-oncologic interventions were recommended to over 70% of patients across seven studies. • Frequently recommended interventions were social interventions (median 38%), modification to medication (median 37%), followed by nutritional interventions (median of 26%). Intervention for psychological, cognitive, impairments, mobility/falls risk or comorbidity were all recommended for a median of 20% of patients.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Hamaker (2018) [39] - Update to Hamaker 2014	N	to summarize all currently available data on the effect of a GE on oncologic treatment decisions, the implementation of non-oncologic interventions and the impact on treatment outcome for older adults with cancer	No limit	Patients: Mean/Median age 74–83 years	Heterogenous; Heterogenous; Heterogenous	35 (36)	i) changes in oncologic treatment plan ii) number and type of non-oncologic interventions iii) effect of GE on treatment outcomes (toxicity, treatment-related complications, completion, quality of life or physical functioning, mortality, and health care utilisation)	• Eleven studies compared treatment decision before and after GE and reported median change to 28% of patients (range 8–54%). Mostly to a less intensive treatment option. • Nineteen studies reported on non-oncologic interventions. Common intervention included addressing social issues (median 39%), nutrition (median 32%) and polypharmacy (median 31%). GA-based interventions were recommended to a median of 70% of patients. • Thirteen studies reported on the effect of GE on treatment outcomes. Positive effect on treatment completion (higher completion in 3/4 studies), and treatment toxicity or complications (positive effect in 5/9 studies), lower rates of mortality (2/7 studies), heterogeneous results for health care use (in 8 studies) • Two of three RCTs found positive effect of GE on quality of life or physical functioning

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Hamaker (2022) [40] – Update to Hamaker 2018	N	to summarize currently available data on the effect of a GA on oncologic treatment decisions, the implementation of non-oncologic interventions, doctor-patient communication, and the impact on treatment outcome. A second aim was to assess differences in impact based on the way the geriatric assessment is implemented.	No limit	Patients: Mean/Median age 68–83 years	Heterogenous; Heterogenous; Heterogenous	61 (65)	i) changes in oncologic treatment plan ii) number and type of non-oncologic interventions iii) effect of GA on patient-doctor communication iv) effect of GA on treatment outcomes (i.e., toxicity, treatment-related complications, completion, mortality, health care utilisation, quality of life or physical functioning)	• Across twenty-one studies, treatment decisions were modified in a median of 31% of patients (range 7–56%), mostly to less intensive treatment option. Modifications were higher when conducted by multidisciplinary team compared to assessment by oncology team or geriatric consultation. • Thirty-three studies reported on GA-based interventions. One or more interventions were recommended to a median of 72% of patients. • Across three RCTs, GA led to more age-related discussions, care planning and improved communication. • Twenty-one studies reported on effect of GA on treatment outcomes. In most studies, GA led to lower treatment toxicity/complications, higher treatment completion (in 6/9 studies) and improved quality of life (in 4/6 studies) or physical functioning (in all three studies)

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Ramjaun (2013) [33]	N	to identify CGA domains that are most predictive of clinical outcomes in patients ≥ 65 years receiving treatment for non-metastatic cancer.	≥ 65 years	Patients: Not reported	Heterogenous; NR; Heterogenous	9 (9)	i) post operative complications ii) chemotherapy-related toxicity iii) mortality	• One study reported association between comorbidity measured by CIRS-G and post-operative complications (OR = 5.62, 95% CI 2.18–14.50) • Treatment-related toxicity examined in three studies. Functional status (OR 1.71 to 2.47) and impaired hearing (OR = 1.67, 95% CI 1.04–2.69) associated with treatment-related toxicity. • At least one or more domains of CGA significantly predicted mortality (7 studies).
Versteeg (2014) [31]	N	to summarise the data on the predictive value of GA on treatment toxicity, mortality and treatment decisions in elderly patients with solid cancer treated with chemotherapy	≥ 65 years	Patients: 65–99 years	Heterogenous; NR; Chemotherapy	13 (13)	i) treatment toxicity ii) mortality iii) influence of GA on treatment decision-making	• Six studies reported on predictive value of GA and treatment toxicity. Inconsistencies across studies in terms of domains that predicted toxicity. 49–64% of older patients experience chemotherapy-related toxicity (at least grade 3) • Malnutrition, impairment in functional status and comorbidities, lower performance status and frailty associated with mortality. Malnutrition is the only factor to predict mortality across all studies. • Across five studies, treatment modifications were made to 21–53% of patients following GA. Impairment in functional status or malnutrition were common reasons for treatment modifications.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Caillet (2014) [24]	N	to review evidence on the usefulness of CGA in assessing health problems, guiding decisions about cancer treatments, predicting outcomes, and developing a coordinated program of tailored geriatric interventions.	≥ 65 years	Patients: 65–99 years	Heterogenous; NR; Heterogenous	35 (35)	i) number of health issues identified following a CGA ii) predictive value of CGA on mortality iii) predictive value of CGA on chemo-toxicity iv) impact of CGA on treatment decision-making v) CGA based care plans	• CGA identified a number of geriatric problems that could affect or interfere with treatment. • 21–49% of treatment decisions were influenced by a CGA. Five studies suggested function and nutritional status have the strongest effect. • Functional impairment, malnutrition and comorbidities were common predictors of mortality and chemotherapy-related toxicity. • Few studies described interventions following CGA results. Only three RCTs reported on effect of GA-based intervention with mixed results.
Feng (2015) [32]	N	to assess which components of the CGA predict clinically relevant outcomes in geriatric surgical oncology	≥ 60 years	Patients: 60+	Solid tumours; NR; Surgery	6 (6)	i) predictive value of GA on 30-day post-surgical mortality, complications within 30-day, and discharge to an institution ii) predictive value of GA on 90-day all-cause mortality	• Impairment in IADL, ADL, fatigue, cognition, depression and frailty predicted overall/major post-operative complications. • No CGA components predicted postoperative mortality (assessed in 4/6 studies) • Impairments in IADL and depression predicted discharge to a non-home institution (assessed 2/6 studies) • Various impairment predicted longer length of stay.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Schulkes (2016) [25]	N	to assemble all available evidence on the relevance of the GA in treatment decisions, outcome prediction, and the prevalence of geriatric conditions in older patients with lung cancer.	No limit	Patients: 73–81 years	Lung cancer; heterogenous; heterogenous	18 (23)	i) prevalence of geriatric conditions ii) predictive value of GA and mortality, iii) association of GA with chemo-toxicity, treatment response iv) predictive value of GA and treatment completion v) effect of GA results on decision-making vi) effect of GA on function or cognitive status during or after treatment, quality of life	• Prevalence of geriatric conditions in older adults with lung cancer was high, median range 29% for cognitive impairment to 70% for impairment on IADL • Objective physical function and nutritional status were commonly associated with mortality (6/10 studies) • Few significant associations found between GA domains and chemotherapy-related toxicity (noted across five studies). • Two studies looked at the correlation between treatment response and GA, however there was no signification association. • Two of four studies found an association between impairment in GA domains and treatment completion. • Treatment modification and implementation of non-oncologic interventions were made based on a GA across four studies.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Molina-Garrido (2017) [29]	N	to assemble all the evidence on the models of CGA, frailty screening tools which have been used in elderly patients with prostate cancer and their feasibility	No limit	Patients: 65–93 years	prostate cancer; NR; NR	8 (8)	i) prevalence of geriatric conditions ii) describe models of CGA iii) feasibility of screening tools	• Geriatric impairments are prevalent in older adults with prostate cancer • No consensus on CGA model to be used for older adults with prostate cancer • One study reported on association between basal information from CGA and early discontinuation, another article reported on association between frailty (based on CGA) and survival, treatment toxicity • Two studies reported that the VES-13 screening tool correctly identified frail patients (72.6–90% accuracy).
van Deudekom (2016) [44]	N	to study the association of functional, cognitive impairment, social environment, and frailty with adverse health outcomes in patients with head and neck cancer.	No limit	Patients: 46.3–78 in 27/31 studies that reported on mean patient age	Head and Neck; Heterogenous; Heterogenous	31 (31)	i) adverse health outcomes defined as mortality, functional or cognitive decline ii) adverse events during or after treatment iii) prolonged length of stay iv) health-related quality of life	• Impairment in functional status, depression symptoms and social isolation are prevalent in head and neck cancer patients. • Most studies reported significant association in impairment in function, cognition, mood or social environment with adverse outcomes • Cognitive function (reported in 2/31 studies), frailty and objectively measured physical function were not assessed for all head and neck cancer patients

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
van Deudekom (2018) [43]	N	to study the association of functional, cognitive impairment, social environment, and frailty prior to any treatment with adverse health outcomes after follow-up) in patients diagnosed with esophageal cancer	No limit	Patients: 55.23–79.5 in the 17/19 studies reporting on mean patient age	esophageal cancer; Heterogenous; Heterogenous	19 (19)	i) adverse health outcomes defined as mortality, functional or cognitive decline ii) adverse events during treatment iii) prolonged length of stay iv) health-related quality of life	• Impairment in function, cognition, frailty were significant associated with adverse health outcomes (19/53 studies) • Functional impairment or social environment significantly associated with adverse health outcomes (4/6 studies) • Objectively measured physical function, cognition (measured in 1/19 studies), and frailty was not measured in all eseophageal cancer patients
Szumacher (2018) [26]	N	(i) to provide an overview of all CGA instruments and geriatric screening tools that are used in the radiation oncology setting; (ii) to examine the feasibility and psychometric properties of CGA and screening tools and (iii) to systematically evaluate the impact of CGA instruments and geriatric screening tools on the radiation therapy treatment decision-making process and their effectiveness in predicting cancer and treatment outcomes	mean or median age of study participants ≥ 65	Patients: 61–95 years	Heterogenous; Heterogenous; Radiotherapy	12 (12)	i) overview of CGA instruments and screening tools used in radiation oncology, ii) feasibility CGA instruments and tools iii) psychometric properties or diagnostic accuracy of instruments iv) impact of CGA and tools on treatment decision-making process v) predictive value of GA for cancer and treatment outcomes	• VES-13 and G8 were the most frequently used screening tools across five studies (standalone in two, and referrals to CGA in three studies) • A CGA was used in seven studies, a geriatrician-led assessment in four of the seven studies, and other studies patient self-administered. • CGA required 80–120 min to complete (reported across three studies) • One study reported treatment modification based on CGA for five of six patients. "• There were a non-significant association between CGA impairment and treatment tolerance (in 6 studies). • Two studies identified relationship between CGA and treatment completion • Two studies reported correlation between mortality and lower G8 score and nutritional risk.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Hamaker (2013) [27]	N	to determine relevance of GA for older patients with haematological malignancy and domains that are predictive of patient and cancer-related outcomes	No limit	Patients: 58–86 years	Haematological; N/A; Heterogenous	15 (18)	i) prevalence of geriatric conditions in haematological setting ii) predictive value of GA for mortality iii) association of GA with other outcomes (e.g., chemo-toxicity, response rates, treatment completion, changes to GA during/after treatment)	• Prevalence of geriatric conditions was high despite good performance status • Predictive value of GA for mortality reported in ten studies. Impairments in IADL (55%), cognition (83%), physical function (100%) and malnutrition (67%) were associated with mortality. Objective physical function and nutritional status retained significance in multivariate analysis. • Varying results for toxicity and response rates. • Poor performance status, palliative treatment intent and renal dysfunction were associated with treatment non-completion in multivariate analysis (reported in a single study). • Improvements on fatigue/depressive symptoms/subjective health measures (based on changes in GA during and after induction chemotherapy) was reported across two studies.
Bruijnen (2019) [16]	N	to determine which domains of a GA predict patient- and treatment-related outcomes and therefore should be included within a GA	≥ 65 years	Patients: 65–99 years	Heterogenous; Heterogenous; Heterogenous	46 (46)	i) predictive value of GA domains patient-related outcomes (defined as mortality, post-operative complications) ii) predictive value of GA domains for treatment-related outcomes (defined as toxicity, dose modification, early withdrawal)	• At least one of the following domains: functional status, nutrition, cognition, mood, physical function, fatigue, social support and falls, predicted mortality, postoperative complications, or treatment-related outcomes. • Physical function as consistent predictive domain of mortality, chemotherapy-related outcomes, and postoperative complication.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Salazar (2019) [34]	Y	to gather, evaluate, and synthesize all available evidence on the effectiveness of GA and frailty scores in predicting mortality and drug toxicity in patients receiving treatment for multiple myeloma.	NR	Patients: mean age 58–74 years	Multiple myeloma; NR; Heterogenous	7 (7)	i) predictive value of GA and frailty scores and treatment-related toxicity ii) predictive value of GA and frailty scores and mortality	• ADL, IADL, CCI, R-MCI, HCT CI and KFI were domains included in the GA across seven studies. • Three studies reported association between GA and treatment-related toxicity. Two studies reported similar risks of grade 3+ haematologic adverse events in intermediate fit and frail patients compared to fit patients. • Predictive value of GA and mortality reported in all studies, common domains predictive of mortality included: comorbidity, functional status and frailty scores. • Meta-analysis of three studies (3/7) reported increased risk of mortality for patients who had an activity of daily living score ≤ 4. Based on frailty scores, increased risk of mortality for frail patients compared to fit patients.

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Scheepers (2020) [28]	N	to give an update of all currently available data on the association between geriatric impairments and hematologic cancer-related outcomes.	No limit	Patients: me(di)an age 58–86 years	Haematological; N/A; Heterogenous	44 (54)	i) prevalence of GA impairments for patients with haematological cancers, ii) association between GA impairment and treatment completion; chemotherapy-related toxicity; healthcare utilization; physical functioning after treatment; quality of life after treatment; mortality	• Polypharmacy, risk of malnutrition, IADL impairments, impaired physical capacity, ADL impairments, symptoms of depression and cognitive impairment were commonly reported geriatric impairments. • Frailty (defined by screening tool or summarising GA) was associated with mortality, treatment-related toxicity and non-completion. • Six of ten studies reported associations between GA and treatment-related toxicity. Four studies reported association between frailty (summarised GA) and toxicity. • Four of five studies reported association between geriatric impairment and treatment completion. Frailty was associated with higher risk of treatment non-completion. • Six of seven studies reported association between geriatric impairment and healthcare use. Impaired physical capacity commonly associated with healthcare utilisation (reported in 4/6 studies). • Quality of life hardly assessed in included studies.
Xue (2018) [36]	Y	to conduct a meta-analysis to identify the effectiveness of CGA for predicting postoperative complications in gastrointestinal cancer patients.	≥ 65 years	Patients: mean age 64 to 81.5 years	gastrointestinal cancer; NR; surgery	6 (6)	i) predictive value of CGA on postoperative complications (defined as 30-day postoperative complications, 30-day major postoperative complications, 90-day major postoperative complications)	• Meta-analysis (6 studies) identified predictive value of comorbidity, polypharmacy and impairments ADL with 30-day postoperative major complications in gastrointestinal cancer patients. • Polypharmacy, pain, weight loss were related to 90-day postoperative major outcomes (reported in 1/6 studies)

Table 1 (continued)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Szabat (2021) [35]	N	to summarize results of studies investigating individual domains of GAs and the GA among older patients undergoing laparoscopic surgery.	≥ 65 years	Patients: *N* = 3 ≥ 65 *N* = 4 ≥ 70 *N* = 3 ≥ 75	Heterogeneous (Colorectal cancer in 6 articles, various solid abdominal cancer in 3 articles); NR; surgery	10 (10)	i) predictive value of GA domains and GA as a whole on postoperative complications	• Inconsistencies across individual domains that predicted postoperative complications. • Impairment in functional status was a reliable predictor for risk of postoperative complications. • Authors confirmed effectiveness of cumulative GA in predicting postoperative complications following laparoscopic surgery.
Couderc (2019) [45]	N	to review the data available on most frequently used tools to assess ADL and IADL in a geriatric oncology setting and their predictive values on overall survival, toxicity, treatment feasibility or decisions, and postoperative complications	mean age over 70 years	Patient: NR	Heterogenous; Heterogenous; Heterogenous	40 (40)	i) tools used to assess ADL, IADL ii) predictive value of tools on overall survival, toxicity, treatment feasibility or decision and postoperative complication	• The most used tool to assess ADL was the Katz, and for IADL, the Lawton scale. The loss of ability to perform at least one activity on the Katz was used as the cut-off (i.e., categorise patient as dependent or independent), the same cut-off was used for the Lawton scale. • Functional status predicted mortality in eleven of twenty-two studies, treatment feasibility in 2/5 studies, changes in treatment decisions for 2/3 studies and postoperative complications in 4/6 studies. Following a regression analysis, functional status was significantly associated with chemotoxicity in 2/7 studies.

Table 1 (continued)ed)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Chuang (2022) [37]	Y	to evaluate whether implementation of a CGA could reduce treatment-related toxicity in older patients undergoing non-surgical cancer treatments	≥ 65 years	Patients: *N* = 5 ≥ 70 *N* = 1 ≥ 65	Heterogenous; Heterogenous; Heterogenous	6 (6)	i) impact of CGA-based intervention on incidence of Grade 3 + adverse events measured by the Common Terminology Criteria for Adverse Events (i.e., treatment-related toxicity) Secondary outcomes: i) association with early discontinuation of treatment ii) impact on treatment modification iii) treatment delay and hospitalisation iv) progress-free and overall survival	• Meta-analysis demonstrated association with CGA-based interventions and reduced incidence of Grade 3 + toxicity, and a lower rate of reducing treatment dosage during treatment compared to usual care. • No significant difference for early treatment discontinuation, treatment modification (i.e., reduction in treatment intensity), treatment delay or hospitalisation or mortality between CGA-based interventions and control groups.
Anwar (2023) [41]	Y	to synthesize information on the effectiveness and cost-effectiveness of comprehensive geriatric assessment (with or without implementation of recommendations) compared with usual care	≥ 65 years	Patients: mean age 72–80 years	Heterogenous; Heterogeneous; Heterogenous (chemotherapy *n* = 4, surgery *n* = 3, radiotherapy *n* = 1, combination of treatments *n* = 9)	17 (19)	i) mortality ii) hospitalization, readmission iii) treatment toxicity iv) change in treatment v) quality of life and functional status vi) cost-effectiveness (any type of economic evaluation and outcomes and cost-effectiveness measures)	• Meta-analysis of 17 RCTs found that treatment toxicity was significantly lower in intervention group compared to usual care, however no differences reported for mortality risk, treatment reduction, early treatment discontinuation and hospitalisation • No significant differences in functional outcomes between intervention and control group reported across 8 RCTs • Only 6 RCTs evaluated quality of life, with mixed results reported. • No studies reporting on cost-effectiveness

Table 1 (continued)ed)

First Author (Year)	Meta-analysis (Y/N)	Review aim(s)	Age of eligible patients	Age of included participants	Cancer type; stage; treatment	Number of included studies (articles)	Outcomes or objectives	Key Findings
Disalvo (2023) [38]	N	To summarise the data on the effect of a comprehensive geriatric assessment or geriatric assessment with intervention on cancer care, treatment completion, adverse effects, GA domains and survival	mean or median age of study participants ≥ 65	NR	Heterogenous; Stage NR; Systemic therapy	10 (10)	i) Effect on cancer care received ii) Treatment completion iii) Adverse treatment effects iv) Survival v) Health-related quality of life	• CGA prompted less intensive treatment and improved health related quality of life scores in 4/5 studies • CGA increased treatment completion in 3/9 studies • CGA lower rate of grade 3 + chemotherapy toxicity in 2/6 studies • CGA lead to increased supportive care interventions
Ng (2024) [42]	Y	To evaluate if CGA-guided care improves health related quality of life for older adults with cancer compared to standard care	≥ 60 years	Patients: mean age range 71–78 years	Heterogeneous; NR; NR	8 (9)	i) Health-related quality of life	• Variable effects, however positive trend towards improvement at 3 months, • RCTs with larger sample size and CGA conducted prior to treatment demonstrate statistically significant improvement in health-related quality of life for CGA intervention group

GA geriatric assessment, *CGA* comprehensive geriatric assessment, *ADL* activities of daily living, *IADL* independent activities of daily living, *RCT* randomised controlled trials, *CIRS-G* cumulative illness rating scale – geriatrics, *CCI* Charlson comorbidity index, *MNA* mini nutritional assessment, *BMI* body mass index, *R-MCI* revised myeloma comorbidity index, *HCT CI* Hematopoietic stem-cell transplantation comorbidity index, *KFI* Kaplan-Feinstein Index, *GDS* geriatric depression scale, *HR* hazard risk, *CI* confidence interval, *OR* odds risk, *NR* not reported, *RCT* randomised controlled trials, *VES-13* vulnerable elders survey

Quality assessment

None of the 26 reviews met all 16 AMSTAR-2 criteria as most reviews did not establish prior protocol or report sources of funding for included studies. Majority of reviews ($n=20$) did not include a meta-analysis due to heterogeneity of data. Despite this, over 80% of the AMSTAR-2 criteria were met in 23 reviews, with most ($n=24$) reviews reporting or assessing risk of bias. Reviews were not excluded from the umbrella review based on the quality assessment. See Supplementary Table 3.

GA outcomes

Outcomes used to assess the value or efficacy of the GA were categorised using the COMET taxonomy [21]. The main outcomes reported across the reviews included mortality/survival (23/26 reviews), adverse events, such as treatment-related complications (reported in all reviews), specifically treatment toxicity (18/26 reviews) and peri-operative complications (9/26 reviews), delivery of care reported as treatment completion/early withdrawal (14/65 reviews) and treatment modification (11/26 reviews) and resource-related outcomes such as hospitalisations, length of stay (11/26 reviews), and the number and or type of interventions recommended (7/26 reviews).

Prevalence of issues identified by GAs

Nine reviews [15, 24, 25, 27–29, 31, 43, 44] reported on the prevalence of geriatric issues identified by GAs. Common issues identified across majority of these reviews included functional impairment, polypharmacy, malnutrition, symptoms of depression and cognitive impairment. Proportion of patients with these issues ranged within and across reviews. For example, in Scheepers et al., (2020)'s review [28], prevalence of polypharmacy was detected in a median of 51% of patients (range 17–80%), while in Hamaker et al., (2014)'s review [15] this was detected in a median of 67% of patients (range 48–74%).

Predictive value of GAs/components of the GA on outcomes

The value of the GA/individual GA domains in predicting outcomes was reported in nineteen reviews [14, 16, 23–36, 43–45] (See Table 2). Commonly reported outcomes to determine the predictive value or association of GAs included mortality ($n=16$), treatment-related complications or outcomes ($n=5$), including treatment-related toxicity ($n=10$) and or perioperative complications ($n=9$), treatment completion ($n=9$) and resource-related outcomes ($n=4$).

Mortality/overall survival

Majority of studies across the sixteen reviews [14, 16, 23–28, 30–34, 43–45] reported an association between GAs (or an impairment on at least one GA domain) and mortality/overall survival. In Salazar et al. (2019)'s review [34] of older adults with myeloma, three out of seven studies included in the meta-analyses reported significant increased mortality risk for patients with an activity of living dependency score of ≤ 4 (pool hazard risk (HR) = 1.576; 95% confidence interval (CI), 1.051–2.102; $\chi^2=0.87$; $p=.647$; $I^2=0$) and a modest increase of mortality risk for patients classified as frail compared to fit patients (HR = 2.169; 95% CI, 1.002–2.336; $\chi^2=3.02$; $p=.221$; $I^2=33.7\%$). In Feng et al., (2015)'s review [32], none of the GA components were predictors of post-operative mortality. Studies across two reviews [27, 30] that used a summary score of the GA to define patients as "frail", reported the predictive value of "frailty" for mortality. Overall, the GA domains predictive of mortality and or survival differed across reviews, however, physical function and nutritional status were common domains that predicted mortality across nine [14, 16, 24, 25, 27, 30, 31, 33, 45] of the fourteen reviews.

Treatment-related complications or outcomes

Two reviews [14, 23] reported on treatment-related complications which included both treatment-related toxicity and post-operative complications. Both reviews reported that impairments in activities of daily living (ADL) and depression were consistently associated with treatment toxicity. In Puts et al., (2014)'s updated review [23], comorbidity was inconsistently associated with poor outcomes. A single study in Couderc et al., (2019) [45]'s review reported that decrease in ADL score predicted changes to initial treatment plan. A single study in Molina-Garrido et al., (2017)'s review [29] reported that frail patients with prostate cancer, classified by the GA, treated with chemotherapy drug type called taxanes, had severe toxicities (grade ≥ 3) but better overall survival and clinical benefit compared to patients that did not receive taxane treatment.

Treatment-related toxicity Ten reviews [16, 24, 25, 27, 28, 30, 31, 33, 34, 45] reported on the predictive value of GAs (or individual domains within a GA) on treatment-related toxicity. Majority of reviews reported an association between geriatric impairments identified by a GA and treatment-related toxicity, with most reviews [16, 24, 25, 27, 30, 33] specifying chemotherapy-related toxicity as the main treatment outcome. Geriatric domains associated with higher risk of treatment toxicity differed within and across reviews. For example, in Ramjaun et al., (2013)'s review [33], functional status (odds

Table 2 Summary of systematic reviews reporting on the predictive value or association of GAs/GA domains

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
Puts (2012) [14]	73 – cohort, cross-sectional or chart reviews	Not explicitly defined	- Impairments on GA domains associated with mortality varied across 8/16 studies			- Age, poorer mental health associated with greater use of social resources in single study -Cognitive impairment predicted visits to emergency department in single study	- Impairments on GA domains associated with treatment complications varied across 6/9 studies	
Puts (2014) [23]	34 - longitudinal observation, cross-sectional, retrospective studies, phase II/III trials	Not explicitly defined	- Impairments on varied GA domains associated with increased mortality risk across 11 studies			- Increased frailty associated with increased hospital costs, discharge to care facility and re-admission rates in single study	- Impairments on varied GA domains predicted treatment toxicity/complications across 7 studies	
Hamaker (2012) [30]	37 – prospective, retrospective studies	Assessment using validated assessment tools composed of ≥ 2 domains.	- Frailty (3/4 studies), nutritional status (in all 4 studies), and comorbidity assessed by the Cumulative Illness Rating Scale for Geriatrics (in 4/5 studies) predicted all-cause mortality	-Cognitive function (in 2/3 studies) and ADL impairment (2/3 studies) associated with lower completion or dose reduction -Comorbidity predicted lower completion rates in 3/4 studies			- Summary score based on GA associated with chemotherapy-related toxicity in 2/3 studies	- IADL impairment predicted peri-operative complications in 3/4 studies

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
Ramjaun (2013) [33]	9 – prospective cohort studies	Conducted before treatment which included functional status or autonomy, nutritional status, cognitive function, polypharmacy and the presence of geriatric syndromes	- Nutrition (HR 1.84 to 2.54), function (HR 1.04 to 1.22) and geriatric syndromes seemed to be most important predictors across 7 studies				- Functional status and the presence of geriatric syndromes, such as impaired hearing most frequently associated with chemotherapy-related toxicity across 3 studies	- Severe comorbidity highly associated with severe complications and functional status significantly associated with experiencing any complication in single study
Hamaker (2013) [27]	15 – cohort studies	Assessment using validated assessment tools composed of ≥ 2 domains.	- Impairments in IADL (55%), cognition (83%), physical function (100%) and malnutrition (67%) were associated with mortality across 10 studies	- Univariate analysis showed poor performance status, falls, IADL dependency associated with treatment non-completion in single study	- Two studies reporting changes in GA domains. -Improvement in depressive symptoms or emotional functioning and subjective measure of health across two studies - Improvement in fatigue post induction chemotherapy in single study		- Comorbidity as risk factor for grade 3–4 chemotherapy-related non-haematological toxicity (OR = 6.13, 95% CI 1.65–22) in single study	
Versteeg (2014) [31]	13 - cohort studies, non-randomized trials	Not explicitly defined	- Nutritional status consistent predictor of mortality across 3/5 studies.				- No consistent factors that predicted toxicity across 6 studies	

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
Caillet (2014) [24]	35 - prospective, cross-sectional, randomised trials	Assessment of at least five CGA domains	- IADL dependency or ECOG-PS, mobility impairment, cognition, depressive mood, malnutrition, comorbidities independent predictors or mortality across nine studies.				- IADL dependency or ECOG-PS, mobility impairment, cognition, malnutrition, social difficulties, polypharmacy independent significant associated with chemotoxicity across four studies.	
Feng (2015) [32]	6 – prospective studies	Any combination of CGA components were included.	- No CGA domains predicted postoperative mortality across 4 studies			- Frailty, IADL, depression predicted discharge to nonhome institution across 2 studies - ADLs ($n=1$), nutrition ($n=2$), inability to feed or shop for oneself ($n=1$) and polypharmacy ($n=1$) associated with longer length of stay – 1/2 studies reported worse frailty scores predicted postoperative readmission		- IADL ($n=1$), fatigue ($n=1$), frailty ($n=2$) predicted overall complications - Cognition ($n=1$), frailty ($n=2$), ADL ($n=1$), IADL ($n=1$), depression ($n=2$) predicted major complications.
Schulkes (2016) [25]	18 – cohort studies	Assessment using validated tools, composing ≥ 2 domains	- Univariate and multivariate analysis of 6 studies demonstrated association between objective physical capacity, nutritional status, and mortality	– 2/4 studies reported associations between GA and treatment completion -IADL as factors across both studies			– 2/5 studies reported associations between GA and chemotherapy-related toxicity	

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	Number /Types of included studies	GA as defined by review criteria	Death	Life impact		Resource use	Adverse events	
			Mortality	Treatment completion and other treatment-related outcomes	Other outcomes	Healthcare use	Treatment-related toxicity or complications	Peri-operative complications
Molina-Garrido (2017) [29]	8 – cohort studies	Not explicitly defined.	- Frailty was associated with overall survival (frail taxane treated patients had better overall survival, $p=.025$ compared to no taxane-treated patients with prostate cancer) in single study	- statistically significant relationship between basal information and presence of early chemotherapy discontinuation ($p=.037$) reported in single study				
van Deudekom (2016) [44][b]	31 – longitudinal studies	Not reported - only specified functional, cognitive impairment, social environment and frailty.	- Function (9/12 studies) associated with overall survival - Marital status (in 6/8 studies) and living situation (in 1 study) associated with overall survival - Depression was a predictor of overall survival in 1/3 studies		- Depressive symptoms (in 4 studies) associated with lower quality of life. -Patients with no partner (in 2 studies) had lower quality of life than those who had a partner.	- Moderate-severe depressive symptoms predicted longer length of stay in a single study - Significant association between IADL dependence and prolonged length of stay in single study (RR 1.97, 95% CI 1.07–3.61)		- Cognitive impairment (aHR = 3.83, (95% CI 1.70–8.63)) ($n=1$) and living alone ($n=1$) significantly more frequent post-operative delirium

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
van Deudekom (2018) [43][b]	19 – longitudinal studies	Not reported - only specified functional, cognitive impairment, social environment and frailty.	- Karnosfky performance score associated with survival in a single study			- Decreased function status associated with increased length of stay in single study	- No statistically significant association between functional status and risk of grade 3 toxicity in a single study	- Statistically significant association between physical functioning and postoperative complications in single study (OR = 28.3 95% CI = 3.5–227.7) - Cognitive impairment associated with postoperative delirium reported in single study - Depression associated with postoperative delirium reported in single study
Szumacher (2018) [26]	12 - retrospective, cross-sectional, prospective trials	Not explicitly defined.	- Lower G8 scores correlated with increased frequency of mortality in two studies	-Trend towards lower treatment completion rates for vulnerable patients based on G8 or VES-13 across 2 studies - Non statistically significant association between CGA and treatment tolerance across 6 studies	-Cancer specific CGA predicted fatigue (beta 1.75, standard error 0.49) in single study			

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
Xue (2018) [36]	6 – cohort studies	CGA – not explicitly defined.						• Meta-analysis (6 studies) identified predictive value of comorbidity (measured by CCI), polypharmacy (≥ 5 drugs/day) and impairments ADL with 30-day postoperative major complications • Polypharmacy, pain scale score > 0 and ≥ 10% weight loss were related to 90-day postoperative major outcomes in single study
Bruijnen (2019) [16]	46 – prospective, retrospective studies	Excluded comorbidity as GA domain as considered routine oncological workup.	- Physical function (5/8 studies) and nutrition (13/23 studies) were most associated with mortality				- Physical function (in all 4 studies) and nutrition (in 5/6 studies) were most associated with chemotherapy-related outcomes[a]	- Physical function (in 3/4 studies) commonly associated with post-operative complications
Couderc (2019) [45]	40 – observational studies, randomised clinical trials, non-randomised intervention studies	Not defined.	- Significant association between functional status and overall survival in 11/22 studies	- ADL predicted changes in treatment decisions in 2/3 studies - IADL predicted treatment feasibility in 2/5 studies			- IADL significantly associated with chemotoxicity 2/7 studies	- Functional status predicted postoperative complications in 4/6 studies

Table 2 (continued)

Review Characteristics			Reported outcomes as mapped to core areas of COMET taxonomy					
Author (Year)	**Number /Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**		**Resource use**	**Adverse events**	
			Mortality	**Treatment completion and other treatment-related outcomes**	**Other outcomes**	**Healthcare use**	**Treatment-related toxicity or complications**	**Peri-operative complications**
Salazar (2019) [34]	7 – cohort studies	Must include ≥ 2 of the following domains: nutrition, cognition, functional status, polypharmacy, social support, and/or comorbidities	- Meta-analysis of 3/7 studies demonstrated significant increased hazard ratio for death in patients with ADL ≤ 4 (HR = 1.576; 95% CI, 1.051–2.102; *P* = .647)				-Significant increased risk of nonhematologic adverse events in frail patients compared to fit patients across 3 studies (HR = 2.169; 95% CI, 1.002–2.336; *P* = .221)	
Scheepers (2020) [28]	44 – Not reported	Assessment composed of ≥ 2 domains.	- Univariate analysis (27/29 studies) showed significant association between at least one geriatric impairment and mortality	- Frailty (based on screening tool or summarised GA) associated with higher risk of non-completion across 4 studies		– 6/7 studies reported association between geriatric impairments and healthcare use - Impaired physical capacity associated with increased used in 4 studies	– 6/10 studies reported association for treatment toxicity -Frailty (based on summarised GA) associated with treatment-toxicity in 4 studies	
Szabat (2021) [35]	10 – retrospective controlled clinical trial, cohort studies,	Not defined.						- Functional impairment as reliable risk factor for postoperative complications in most studies - Function impairment predicted postoperative delirium in single study - Cognition (*n* = 1), comorbidity (*n* = 1), polypharmacy (*n* = 1), depression (*n* = 2) associated with increased risk of post-operative complications

ADL activies of daily living, *IADL* independent activies of daily living, *CCI* Charlson Comorbidity Index, *CIRS-G* Cumulative Illness Rating Scale for Geriatrics, *ECOG-PS* Eastern Cooperative Oncology Group Performance Status *CI* confidence interval, *OR* odds ratio, *HR* hazard ratio, *aHR* adjusted for age hazard ratio

[a] Chemotherapy-related outcomes included toxicity, early withdrawal, functional decline after chemotherapy. [b] Outcomes reported in these reviews were generally grouped or reported together as "adverse outcome". This was defined as mortality, functional or cognitive decline, adverse events during treatment, prolonged length of hospitalization and health related quality of life

ratio (OR) ranged from 1.71 to 2.47) and presence of geriatric syndromes (OR = 1.67, 95% CI 1.04–2.69) had the most predictive value for treatment-related toxicity. Two reviews [28, 30] examined the association of the GA and treatment toxicity based on GA score. Both reviews reported an association between frail patients, based on a summarised GA score and higher risk of toxicity. In an additional review, Szumacher et al., (2018) [26] reported a non-significant association between vulnerable patients identified by the GA, and poor treatment tolerance within the radiation oncology setting.

Overall, this umbrella review noted a trend demonstrating geriatric impairments such as functional or nutritional status, or frailty based on a summarised GA score, being associated with higher risk of treatment-related toxicity.

Peri-operative complications Nine reviews [16, 30, 32, 33, 35, 36, 43–45] reported on the predictive value and or association between GA and/or individual geriatric domains on peri-operative complications. Functional impairment as defined by loss of independence on ADLs, seemed to be the only consistent predictor and associated with peri-operative complications across majority of reviews [30, 32, 33, 35, 36, 45]. A meta-analysis of six studies in Xue et al. (2018)'s review [36] reported the predictive value of impairments in ADL (OR = 1.69, 95% CI [1.20, 2.38], $p = .003$), comorbidity (using the Charles Comorbidity Index, OR = 1.31, 95% CI [1.06, 1.63], $p = .01$), and polypharmacy (≥ 5 drugs/day; OR = 1.30, 95% CI [1.04, 1.61], $p = .02$) and postoperative complications. Cognitive impairment, determined by the Mini-mental state examination, was the common domain associated with post-operative delirium reported across four [35, 36, 43, 44] of five reviews. Impairments in other geriatric domains predictive of post-operative complications varied within and across reviews.

Treatment completion

The association between treatment completion and/or early discontinuation was considered in nine reviews [16, 25–30, 34, 45]. Majority of reviews reported an association between impairment on GA domains and treatment completions, although the type of domain associated with this outcome varied within and across reviews. For example, both Scheepers et al., (2020) [28] and Salazar et al., (2019)'s [34] reviews reported a positive association between risk of treatment non-completion/early discontinuation in frail patient (based on a screening tool or summarised GA score). While in Hamaker et al., (2012)'s review [30], impairment in cognitive status and activities of daily living were common domains that predicted treatment completion.

Resource-related outcomes

Six reviews [14, 23, 28, 32, 43, 44] reported on the association between GA domains and healthcare use including length of stay, readmission and discharge to care facilities. Most found an association between geriatric impairments and increased healthcare use. Only three studies reported within Puts et al., (2012) [14] and Feng et al., (2015)'s review [32] examined the predictive value of GA domains on healthcare use. There was a trend across reviews demonstrating impairments in GA domains predicting increased healthcare use. However, the type of domains that predicted this varied and depended on the definition of healthcare use (e.g., discharge to care facility or length of stay).

Overall, despite limited reviews reporting on healthcare use and heterogeneity of results, this umbrella review noted an association between geriatric impairments and healthcare use (such as increased length of stay or discharge to care facilities).

Other outcomes

Studies across two reviews [43, 44] reported impairments in geriatric domains were associated with lower quality of life. Two studies in Hamaker et al., (2013)'s review [27] examined changes in the GA during and after chemotherapy. Both studies reported improvement in depressive or emotional functioning and subjective measures of health. Fatigue was another outcome, in which a single study in Hamaker et al., (2013)'s review [27] reported improvements in fatigue when examining changes in the GA pre-post chemotherapy, while a single study in Szumacher et al., (2018)'s review [26] reported on the predictive value of the GA on fatigue for older adults with breast cancer.

The impact of GAs

Interventions recommended or implemented following the GA were reported across eight reviews [14, 15, 24, 25, 31, 38–40]. Of the eight, seven reviews [15, 24, 25, 31, 38–40] reported on the number and or type of interventions recommended or implemented to patients. Across these reviews, the proportion of patients that received at least one recommendation ranged from 10% (a single study in Schulkes et al., (2016)'s review [25]) to over 70% (reported in studies across six reviews [15, 24, 25, 38–40]). Recommended interventions were reported across six reviews [15, 24, 25, 38–40], with nutritional care, social support and polypharmacy or medication changes as the more commonly recommended interventions (See Table 3) .

Table 3 Summary of findings from systematic reviews reporting on the impact of GA

Author (Year)	Number/Types of included studies	GA as defined by review criteria	Reported outcomes as mapped to core areas of COMET taxonomy	
			Life impact[a]	**Resource Use**
			Delivery of Care: Impact on treatment decisions	**Need for further intervention: Recommendations following GA**
Puts (2012) [14]	73 – cohort, cross-sectional or chart reviews	Not explicitly defined	GA led to changes in treatment plan for 40–50% patients in 2/4 studies	GA led to interventions prior to treatment initiation reported in 3 studies.
Puts (2014) [23]	34 - longitudinal observation, cross-sectional, retrospective studies, phase II/III trials	Not explicitly defined	Estimated weighted modifications to treatment plan following GA was 23.2% across 6 studies	Not available
Caillet (2014) [24]	35 - prospective, cross-sectional, randomised trials	Assessment of at least five CGA domains	CGA influenced treatment decision in 21–49% of patients across 5 studies. -Impairment in function or malnutrition reported as strongest effect for changes across 5 studies	GA led to interventions for patients reported in 2 studies. Interventions ranged from 19–70% for one study, while another studies reported 25% of patients received interventions.
Versteeg (2014) [31]	13 - cohort studies, non-randomized trials	Not explicitly defined	GA led to treatment changes for 21–53% of patients across 5 studies, mostly to less intensive treatment option. -Impairment in function or malnutrition commonly reported across 3 studies as reasons for treatment changes	GA led to interventions for 25.7% of patients in single study.
Hamaker (2014) [15]	10 – cohort studies	GA involved geriatric consult, or assessment by oncology team or HCP, involving ≥3 domain	GA led to modification in median of 32% of patients across 6 studies.	GA based interventions recommended in median 83% of patients across 8 studies
Schulkes (2016) [25]	18 – cohort studies	Assessment using validated tools, composing ≥ 2 domains	GA led to changes in 45% of oncologic treatment decisions reported in single study.	GA based interventions recommended for 10–75% of patients across two studies.
Szumacher (2018) [26]	12 - retrospective, cross-sectional, prospective trials	Not explicitly defined.	Treatment modifications reported in 1/2 studies following CGA	Not available
Hamaker (2018) [39]	35 - RCTs, cohort studies, conference abstracts	GA involved geriatric consult, or assessment by oncology team or ≥ 2 medical HCP, involving ≥3 domain	GA led to modification in median of 28% of patients across 11 studies, mostly to less intensive treatment option.	GA based interventions recommended for median of 72% of patients across 19 studies.
Hamaker (2022) [40]	61 - cohort studies, RCTs, conference abstracts	GA involved geriatric consult, or assessment by oncology team or ≥ 2 medical HCP, involving ≥3 domain	GA led to treatment modification in median 31% of patients across 21 studies, mostly to less intensive treatment option	GA based interventions recommended for over 70% of patients across 33 studies.
Disalvo (2023) [38]	10 - RCTs, phase 2 pilot RCTs prospective cohort study	CGA/GA with intervention (GA evaluate <3 domains were excluded)	CGA impacted treatment plans (e.g., dose reduction, lower intensity, treatment modifications) in 4/6 studies.	GA based interventions implemented for across six trials. Common interventions differed across trials, with medication being the most common across 3/5 trials.

[a] The outcome domain included in this Core area include delivery of care such as treatment adherence and tolerability. *RCT* randomised controlled trials, *HCP* healthcare professional

Ten reviews [14, 15, 23–26, 31, 38–40] reported on the impact of the GA on treatment decisions. Across eight reviews [14, 15, 23–25, 31, 39, 40], the GA results led to treatment modifications for 6–56% of patients, with most reviews reporting a reduction in treatment intensity or patients allocated to the intervention arm receiving less aggressive treatment (See Table 3). In Puts et al. (2014)'s review [23], a meta-analysis of six studies was conducted to determine the effect of GA on treatment decisions. Across the six studies (which included three of four studies from their previous review Puts et al., (2012) [14]), less than half of patients received modifications to their treatment plan following a GA (estimated weighted percent 23.2%, 95% CI 20.3% −26.1%). However, in an additional two meta-analyses [37, 41] of RCTs, there was no significant difference between intervention arm and standard care in incidences of initial dose reduction (See supplementary Table 4).

Outcomes reported when examining the effect of GA with management/CGA for older adults with cancer

The effectiveness of GA with management/CGA compared to standard care was examined across three meta-analyses [37, 41, 42] of RCTs. Across the three meta-analyses [37, 41, 42], six different outcomes were considered (mortality/survival; progression free survival; treatment toxicity; changes in treatment which included early treatment discontinuation, initial reduction in treatment intensity, treatment delay, dose reduction; hospitalisation and health-related quality of life) (See Supplementary Table 4). Risk of treatment-related toxicity was the only outcome that was significantly lower for patients allocated in the GA with management group compared to usual/standard care reported across two meta-analyses [37, 41]. In Chuang et al., (2022)'s meta-analysis [37] of six RCTs, there was moderate certainty of evidence that patients randomised to the GA with management group had lower incidence of treatment-related toxicity compared to standard care (risk ratio (RR) = 0.81, 95% CI: 0.7–0.94). Similarly, the more recent meta-analysis of 17 RCTs by Anwar et al., (2023) [41] demonstrated high certainty of evidence for lower incidence of treatment-related toxicity in the GA with management group compared to standard care (RR = 0.78, 95% CI = 0.70–0.86). While Chuang et al., (2022)'s meta-analysis [37] also demonstrated lower incidence of dose reduction during treatment for those in intervention group compared to standard care (RR = 0.73, 95% CI = 0.63–0.83, moderate strength); this finding was not replicated in Anwar et al., (2023)'s systematic review [41] (RR = 0.87, 95% CI = 0.70–1.09, moderate strength). In Ng et al., (2024)'s meta-analyses [42] of two RCTs demonstrated CGA-guided care favoured improved health-related quality of life at three months post randomisation (Cohen's d = 0.27; 95% CI = − 0.03–0.58; moderate strength).

The effect of GAs for older adults with cancer was explored across a further three reviews [38–40] (See Table 4). A total of thirteen outcomes (mortality or survival; treatment-related complications including toxicity or postoperative complications; treatment modifications including dose intensity, delays or reduction; treatment completion; number and or type of recommended interventions; healthcare utilisation; quality of life; physical function and or mobility; social functioning; depression; nutrition; patient satisfaction; communication and care planning) were considered across these reviews. The effect of GA on outcomes varied within and across reviews.

Effectiveness of GA on overall survival and healthcare utilisation

The reviews [38–40] generally reported similar results for mortality, with many studies reporting no significant differences in survival outcomes between patients that received a GA with management compared to usual care. A similar finding was reported when examining the effect of the GA on healthcare utilisation. There was a general trend across reviews [38–40] demonstrating no significant differences or mixed results between groups on health care utilisations, which included hospitalisation, length of stay or readmissions.

Effectiveness of GA on treatment-related outcomes

There was a positive effect of GA on treatment-related complications (including treatment toxicity and or post-operative complications) across majority of studies reported across both two reviews [39, 40]. Similarly in Disalvo et al., (2023)'s review [38], reported a reduction in grade 3 + chemotherapy toxicity in two of five studies. However, three trials reported in Anwar et al., (2023)'s review [41], reported no statistically significant differences between study arms on the rates of post-operative complications. Three reviews [38–40] also reported increased treatment completion rate in the intervention group compared to standard care.

Effect of GA on function, depression, and nutrition

The effect of the GA on functional status varied across reviews, with Hamaker et al., (2022)'s review [40] reporting a positive effect across three studies, whilst Disalvo et al., (2023) [38] reported varied results across three RCTs. The effect on depression varied across reviews with two trials in Disalvo et al., (2023)'s review [38] reporting no significant differences, while one trial in Hamaker et al., (2018)'s review [39] reporting on a significant decrease in emotional limitations for patients

Table 4 Summary of findings from systematic reviews reporting on the effect of CGA/GA with management

Review characteristics			Reported outcomes as mapped to core areas of COMET taxonomy									
Author (Year)	**Number/ Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**						**Resource Use**		**Adverse events**
			Mortality/ Survival	**Changes to treatment**	**Treatment completion**	**Quality of life**	**Function**	**Depression**	**Nutrition**	**Other outcomes**	**Healthcare utilisation**	**Implementation of interventions**	**Treatment toxicity or complications**
Hamaker (2018) [39]	35 - RCTs, cohort studies	GA involved geriatric consult, or assessment by oncology team or ≥ 2 medical HCP, involving ≥3 domain	-Mostly no differences across 5 studies. Only 2 reported lower rates of mortality in intervention arm.	-Modification in median 28% across 11 studies, mostly to less intensive treatment option	-Trend towards higher treatment completion in 3/4 studies[a]	- Non-sig positive effect of QOL at 3 months but at 6 months in single study	-No effect on physical function in single study			- Sig decrease in pain, emotional limitations and social dysfunction in single study	- Mixed results for healthcare use across 8 studies	- Interventions recommender for median of 72% of patients across 19 studies	- Trend towards positive effect on treatment toxicity/complications in 5/9 studies[a]
Hamaker (2022) [40]	61 - RCTs, cohort studies, conference abstracts	GA involved geriatric consult, or assessment by oncology team or ≥ 2 medical HCP, involving ≥3 domain	-No differences across 14 studies	-Modifications following GA in median 31% across 21 studies, mostly to less intensive treatment option	- Increased rates of treatment completion in 6/9 studies[a]	-Improved quality of life in 4/6 studies[a]	-Improved functioning in 3 studies[a]			- Increased discussions and care planning across 3 trials[a]	-No differences in healthcare use across 15 studies	- Over 70% of patients received recommendations across 33 studies	- Lower toxicity/complication rates across 60% of 21 studies[a]
Chuang (2022) [37]	6 - RCTs	CGA-guided care	-No sig difference across 5 trials	- No sig difference in initial reduction of treatment intensity across 5 trials, RR = 0.99,95%CI:0.77–1.28 - No sig difference in treatment delays across 3 trials, RR = 0.86,95%CI:0.6–1.22	- No sig difference in early treatment discontinuation across 5, RR = 0.88,95%CI:0.62–1.25						- No sig difference in hospitalisation across 4 trials, RR = 0.86,95%CI:0.6–1.22		- Significantly lower incidence of grade 3 + chemotherapy toxicity CGA arm across 6 trials, RR = 0.81,95%CI:0.7–0.94[a]
Disalvo (2023) [38]	10 - RCTs, prospective cohort study	CGA/GA with intervention (GA evaluate <3 domains were excluded)	-No sig difference on survival outcomes across 6 trials	Impacted treatment plans (e.g., dose reduction, lower intensity, treatment modifications) in 4/6 studies.[a]	-Increased treatment completion in 3/9 studies	- Improved quality of life in 4/5 studies[a]	-Mixed results for impact of functional across 3 trials	-No sig difference across 2 trials	-No sig difference in single trial	- Deterioration of social functioning significantly lower in intervention arm reported in single trial -Lower proportion of falls in intervention arm reported in single trial	-Mixed results for unplanned hospital admission across 5 trials - Mixed results for emergency department presentations across 2 trials	-Increased interventions for GA arm reported in single trial -Interventions recommender across 6 trials	- Significantly lower rate of grade 3 + chemotherapy toxicity in GA/CGA arm across 2/6 studies[a]

Table 4 (continued)

Review characteristics			Reported outcomes as mapped to core areas of COMET taxonomy										
Author (Year)	**Number/ Types of included studies**	**GA as defined by review criteria**	**Death**	**Life impact**							**Resource Use**		**Adverse events**
			Mortality/ Survival	**Changes to treatment**	**Treatment completion**	**Quality of life**	**Function**	**Depression**	**Nutrition**	**Other outcomes**	**Healthcare utilisation**	**Implementation of interventions**	**Treatment toxicity or complications**
Anwar (2023) [41]	17 - RCTs	CGA - no limits on number or types of domains for CGA inclusion	-No sig difference across 7 trials. RR = 1.08; 95% CI:0.91–1.29	- No sig difference in initial/subsequent dose reduction across 5 trials	- No significant difference in early treatment discontinuation across 5 trials, RR = 0.89, 95% CI:0.67 to 1.9	-Mixed results across 6 trials	-No statistically sig difference across 8 trials			- Mixed results for patient satisfaction across 3 trials	- No sig difference across 4 trials, RR = 0.92, 95% CI: 0.77 to 1.10		- Grade 3–5 treatment toxicity significantly lower in intervention group compared reported across 6 trials, RR = 0.78, 95% CI: 0.70 to 0.86[a] - Mixed results on effect of GA on postoperative complications (across 3 trials)
Ng (2024) [42]	8 - RCTs	CGA guided care				-Variable effect - Potential improvement at 3 months, (Cohen's d 0.27, 95% CI:−0.03–0.58)							

[a] Demonstrate statistically significant or trend towards positive effect of GA on specified outcome. *CGA* comprehensive geriatric assessment, *GA* geriatric assessment, *HCP* healthcare professional, *RCT* randomised controlled trials, *RR* risk ratio, *CI* confidence interval

allocated to the GA intervention arm compared to standard care. In a single RCT included in two reviews [38, 40], there was no statistically significant difference in nutrition between groups.

Effect of GA on other outcomes

Other outcomes also considered across the reviews reporting on the effectiveness of the GA, included quality of life, doctor-patient communication and patient satisfaction with care. Mixed results were reported for quality of life within and across reviews [38–41]. In a recent meta-analysis by Ng et al., (2024)'s the authors reported variable effects on health-related quality of life, however the results seemed to favour potentially improved health related quality of life at 3 months [42]. Similar mixed results were reported for patient satisfaction with care, in three RCTs reported in Anwar et al., (2023)'s review [41]. When reporting on doctor-patient communication, RCTs in Hamaker et al., (2022)'s review [40] generally reported increased age-related or end-of-life goal discussions in the intervention group compared to usual care in response to GA results. A single trial reported in Disalvo et al., (2023)'s review [38] reported the number of interventions recommended and implemented in the intervention group compared to usual care, with a higher proportion of these interventions implemented in GA intervention arm compared to usual care (76.8% vs. 12.5%).

Overall, 5/13 of outcomes included reported that GA with management/CGA had a positive effect for patients compared to usual care. There was a significant reduction in treatment-related toxicity (mostly chemotherapy-related toxicity) for patients allocated to the GA intervention group compared to standard care. A non-significant positive trend was reported for treatment completion in majority of studies reported across reviews. In Hamaker et al., (2022)'s review [40], three RCTs reported increased communication and care planning for patients in the GA intervention group compared to the standard care group. Across two RCTs (in Disalvo et al., (2023) [38] and Hamaker et al., (2018) [39] review), social functioning (based on the Quality of Life Questionnaire Core-30 and Medical Outcomes Study short form-36, respectively) was significantly lower for patients allocated to the GA group compared to standard care.

Discussion

This umbrella review identified 26 systematic reviews that described the value or efficacy of GAs for older adults with cancer. Most ($n = 20$) did not include a meta-analyses of study outcomes due to heterogeneity of study designs or populations. Outcomes used to determine the predictive value or association of the GA and outcomes for older adults with cancer included mortality or overall survival, treatment-related outcomes (treatment modification, completion, treatment-related complications including toxicity and peri-operative complications), resource-related outcomes (healthcare utilisation such as length of stay or readmission, number and or types of recommended interventions following a GA) and patient-level outcomes (quality of life, changes in GA domains). Majority of these domains were also considered when examining the effectiveness of CGA/GA with management.

Similar to a previous umbrella review on frailty [46], our review demonstrated variations in clinical outcomes and quality of the evidence reported across individual systematic reviews. In a previous umbrella review focussed on the CGA definition, elements and outcomes [47], mortality, disability and institutionalisation were key outcomes. In our review, we also reported mortality as a common outcome, however given our focus on older adults with cancer, treatment-related complications and toxicity was another key outcome as opposed to disability, reported across reviews.

Treatment complications are an important factor that impacts on treatment decisions for an older adult with cancer [48]. Despite inconsistencies across and within reviews, there was an association between impairments or "frail" patients as categorised by the GA and treatment toxicity, highlighting the benefit of GA in guiding appropriate treatment decisions. Furthermore, results from two meta-analyses [37, 41] of RCTs also demonstrated moderate to high certainty of evidence that GA with management/intervention arm significantly reduced the risk of treatment toxicity compared to usual care. Similar results were reported in terms of post-operative complications, with functional impairment as defined by loss of independence based on ADLs as a common a predictor of post-operative complications for older adults with cancer across six of nine reviews. However, there were limited RCTs across reviews reporting on effectiveness of CGA/GA with management in reducing post-operative complications and radiation-related toxicities. As radiotherapy and surgery are also important treatment modalities for an older adult with cancer [49, 50], future trials should also examine the role and effect of GA with management/CGA in surgical and radiation oncology settings. In terms of mortality/overall survival, the association between impairment in individual GA domains and mortality varied from no association to associations across multiple geriatric domains. In the five reviews [37–41] reporting on the effect of GA with management/CGA, there was no significant difference in

survival between the intervention group and usual care group.

As international guidelines such as American Society of Clinical Oncology (ASCO) [51] recommend pre-treatment GA to guide decision-making, ten reviews [14, 15, 23–26, 31, 38–40] reported on the impact of GA on treatment decisions including adjustments to treatments. Where adjustments were noted, most pertained to a reduction in treatment intensity for older adults with cancer. This is important given that there is limited evidence-based data for treatment guidelines for older adults with cancer leading to possible under- or over-treatment [2]. Furthermore, studies across three reviews [38–40] also reported higher treatment completion rates for patients in the GA intervention group compared to standard care. This highlights the value of a comprehensive, holistic assessment of the older adult in guiding cancer treatment decisions and adherence.

The predictive value or effect of GA on quality of life, or on other GA domains such as social functioning or functional status was not commonly assessed within reviews. Whilst limited studies reported this, most studies demonstrated a positive effect of GA for older adults with cancer. Ng et al., (2024)'s meta-analyse [42] demonstrated variable effects, and highlighted a positive effect in RCTs with larger sample sizes and when the GA was conducted prior to initiating treatment [42]. Studies have demonstrated that quality of life is an important factor and sometimes prioritised over survival for older adults with cancer [52]. This highlights the potential value of GAs in assisting with decision-making related to commencement or continuation of treatment and/or improving quality of life for older adults with cancer.

The cost of GAs/GAs with management was not commonly reported across reviews. Given that implementation of GAs is low within cancer services [53], there is a need to move beyond recording initial GA details to increased focus on the consequences of a GA with regard to treatment decisions, uptake of treatment regimens and implementation of this process across service workflows. In a recent narrative review by Zuccarino et al., (2022) [54] reporting on cost-effectiveness of CGA, the authors report on the lack of studies in this area, with majority of studies reporting on benefits of CGA as a measure of cost-effectiveness (e.g., reduction in length of stay), highlighting the need for more economic evaluation of the CGA.

Limitations

This umbrella review is not without limitations. The quality of evidence varied across the included reviews, impacting on the strength of reported outcomes. Umbrella reviews synthesise evidence from existing systematic reviews. As such the validity of umbrella reviews will depend on the quality of the individual systematic reviews or meta-analyses. Furthermore, existing systematic reviews may use different eligibility criteria and have aims that poorly align with the umbrella review, limiting applicability. The included reviews were heterogeneous in terms of study population, age criteria for a GA, cancer type and treatment modality as well as the domains considered within the GA and corresponding tools used. When examining reviews reporting on the effectiveness of the GA with management, trials within and across reviews had varying personnel that conducted the GA, variations in timing of the GA (e.g., prior to decision making, or during treatment) and the interventions and or management recommendations following the GA. In addition, definition of outcomes differed within and across reviews potentially impacting on strength of these findings. For example, in Anwar et al., (2023)'s review [41], some studies defined hospitalisations as any unplanned admissions within 6–12 months after the intervention, while another study defined hospitalisation during the span of chemotherapy treatment. Heterogeneity of review data, further demonstrated by the limited number of meta-analyses, meant that definitive outcomes could not be concluded. Variability of review data can impact on GA recommendations for older adults with cancer and subsequent uptake of GAs as part of routine care. Clear, standardised definition on GA domains and research outcomes is important to support further evidence and implementation efforts.

Clinical implications

The findings support use of GAs for older adults with cancer in clinical practice and will help inform clinical guidelines. Impairments across geriatric domains predicted clinically relevant outcomes (e.g., mortality, treatment-related complications, healthcare use), demonstrating the predictive value of GAs in guiding appropriate treatment and addressing potential under or over-treatment. Two meta-analyses [37, 41] included in our umbrella review reported moderate to high certainty evidence for the effect of GA with management in reducing the risk of treatment-related toxicity. This highlights the importance of GAs with management/CGA in providing appropriate care and thus optimising outcomes. Furthermore, GAs with management/CGA have demonstrated positive impacts on communication and care planning. Age-related concerns are not commonly discussed in these consultations [55]. The results from a GA can facilitate these discussions.

Conclusion

In conclusion, a total of thirteen associations and or outcomes were reported when examining the predictive value or effectiveness of GAs for older adults with cancer. GA domains predictive of outcomes varied within and across reviews. Treatment-related toxicity (mostly chemotherapy-related toxicity) was significantly lower in the GA with management/CGA groups compared to usual care. The CGA also demonstrated a positive impact on four further outcomes (treatment completion, communication and care planning, social functioning, patient satisfaction with care) compared to standard care, although the differences were non-significant. It is promising that there has been an increasing number of RCTs in recent years to provide clinical evidence of GA with management/CGA for older adults with cancer. However, there is need for further research examining the effect of GA/GA-based interventions within oncology settings, and to determine the cost-effectiveness of GA to facilitate implementation of GAs as part of routine care. Overall, the findings demonstrate the predictive value of GAs for older adults with cancer.

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Authors' contributions

Concept and design: All authors.Data collection: SH carried out initial database searches. Analysis: SH and JS screened initial results and articles that met inclusion criteria. Any disagreements were resolved with other authors (HS and MA).Interpretation of data: All authors contributed to quality review of a subset of included reviews.Manuscript writing: SH wrote first draft of manuscript. JS, HS and MA made contributions to subsequent drafts. Approval of final article: All authors.

Data availability

This manuscript is an umbrella review. Articles selected for this review were referenced in the manuscript. All data extracted from the reviews were summarised in the manuscript and its supplementary information files.

Declarations

Ethics approval and consent to participate

Not applicable as this is an umbrella review.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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