Implementation of geriatric assessment in oncology settings: a systematic realist review

Gordon A G McKenzie[1]

Alex Bullock[1]

Sarah Greenley[1]

Michael Lind[1]

Miriam Johnson[1]

Mark Pearson[1]

[1]Wolfson Palliative Care Research Centre, Hull York Medical School, Allam Medical Building, University of Hull, Hull, HU6 7RX

Correspondence to:

Dr Gordon McKenzie

3rd Floor, Hull York Medical School,

Allam Medical Building,

University of Hull,

Hull,

HU6 7RX

Tel.: +44 (0)1482 465111

gordon.mckenzie@hyms.ac.uk

Abstract

Older adults with cancer are more likely to have worse clinical outcomes than their younger counterparts, and shared decision-making can be difficult, due to both complexity from adverse ageing and under-representation in clinical trials. Geriatric assessment (GA) has been increasingly recognised as a predictive and prehabilitative tool for older adults with cancer. However, GA has been notoriously difficult to implement in oncological settings due to workforce, economic, logistical, and practical barriers. We aimed to review the heterogenous literature on implementation of GA in oncology settings to understand the different implementation context configurations of GA and the mechanisms they trigger to enable successful implementation. A systematic realist review was undertaken in two stages: i) systematic searches with structured data extraction combined with iterative key stakeholder consultations to develop programme theories for implementing GA in oncology settings; ii) synthesis to refine programme theories. Medline, Embase, PsycInfo, Cochrane Library, CINAHL, Web of Science, Scopus, ASSIA, Epistemonikos, JBI Database of Systematic Reviews and Implementation Reports, DARE and Health Technology Assessment were searched. Four programme theories were developed from 53 included articles and 20 key stakeholder consultations addressing the major barriers of GA implementation in oncology practice: time (leveraging non-specialists), funding (creating favourable health economics), practicalities (establishing the use of GA in cancer care), and managing limited resources. We demonstrate that a whole system approach is required to improve the implementation of GA in cancer settings. This review will help inform policy decisions regarding implementation of GA and provide a basis for further implementation research.

Keywords: geriatric assessment, neoplasms, implementation science

Introduction

Older adults with cancer generally experience worse outcomes compared to younger adults, including increased post-operative complications, length of hospital stay, chemotherapy toxicity, and discharge to dependent care settings (1-3). Age-related cognitive issues and the accrual of co-morbidities, medications and functional deficits, creates complexity (4-6). This makes shared decision-making between the patient and cancer multi-disciplinary team (MDT) more difficult, compounded by underrepresentation of older adults in clinical trials (7). Undertreatment (e.g. inappropriate best supportive care) or overtreatment (e.g. avoidable post-treatment morbidity and mortality) is possible, although older adults can tolerate and benefit from cancer treatments when appropriately selected (8). The clinician's recommendation is a significant factor in treatment acceptance (9) and the use of chronological age as a proxy for health status is associated with worse patient outcomes (10-12).

To enhance decision-making, international guidelines from authoritative bodies, including the American Society of Clinical Oncologists (ASCO) and International Society of Geriatric Oncology, recommend pre-treatment geriatric assessment (GA) for older adults (13, 14). GA has evolved in oncology from comprehensive principles employed by inpatient geriatric medicine (15), to a more focussed cancer-specific GA (CSGA) and/or the use of short screening tools (e.g. G8) (16, 17). Traditional comprehensive GA (CGA) is a complex intervention most commonly defined as "*a multidimensional, multidisciplinary process which identifies medical, social and functional needs, and the development of an integrated/co-ordinated care plan to meet those needs*" (15). Systematic reviews have demonstrated that CGA improves mortality and function for older medical patients and orthopaedic patients admitted with hip fracture (18, 19). Evidence that CSGA models improve outcomes are lacking. One randomised controlled trial (RCT) demonstrated feasibility (20). Another RCT was negative for improved morbidity or mortality (21), although other protocols have been published (22). The current view of GA in oncology therefore focuses on its role in prognostication, rather than its therapeutic effectiveness as a complex intervention (13, 14). Even so, first principles suggest that identifying and acting on unknown vulnerabilities identified through CSGA will improve outcomes. Moreover, implementation issues within RCTs may limit their effectiveness (21).

GA is notoriously difficult to implement in oncology with numerous barriers frequently cited, including workforce limitations (23), time, health economics, logistics, training, and practical concerns (24). International guidelines inadequately cover implementation details, which tend to focus on reducing time required to undertake GA by using brief instruments. Insufficient detail is provided on practical, technological, and logistical enablers and a more detailed analysis of implementation science in this setting is required (13, 14). We aimed to review the heterogenous literature on implementation of GA in oncology settings to understand the different implementation context configurations of GA and the mechanisms they trigger to enable successful implementation. A review of the implementation of GA in oncology settings is presented, focussing on the strategies that can be employed to overcome the major implementation barriers.

Methods

Realist review is a theory-driven approach designed to understand the contextual basis of success for complex interventions and their mechanisms (25-27). Given the heterogeneity of implementation literature regarding GA in oncology, realist review was selected to explore the contexts, mechanisms and outcomes of GA implementation in this setting. The study protocol for this review was registered with PROSPERO (CRD42019156058) (28). The review meets the Realist And Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES) quality standards for realist review (29) (as documented in **Supplementary Table 1)** and is reported consistent with the RAMESES reporting guidelines (see **Supplementary Table 2**). A two-stage approach was employed as we sought to focus on undertaking a robust systematic review, rather than an initial scoping review (29).

Stage 1 – identifying the evidence relevant to GA and testing and refining the programme theories

The primary ideas used to develop an intervention are termed the programme theories (25), which herein explain how to implement GA and achieve predictive and

prehabilitative outcomes. The systematic review search strategy is outlined in **Figure 1** and inclusion and exclusion criteria are outlined in **Figure 2**. We undertook a single comprehensive search strategy, as opposed to an iterative search strategy, to ensure we fully understood the heterogenous research base and capture its diversity (30). Backward citation searching involved screening reference lists of relevant papers. Forward citation searching utilised Web of Science from the included studies after full text screening.

Title and abstract screening were initially undertaken, followed by full text retrieval and review by GM. 'If then' statements were developed to document the various proposed situations towards successful GA implementation, which was supported by evidence drawn from the literature and our research group discussions (31). These statements generated programme theories linked to their respective proposed context, mechanism and outcomes for presentation and critique of plausibility and relevance by our research and steering groups. The quality of the evidence was determined by its ability to build or test the relevance of a programme theory, based on established methodology for realist reviews (29, 32-34). Data extraction followed for articles meeting this test of relevance and were primarily extracted by one team member (GM), with a random 25% independently checked by a second team member (AB). The data extraction process was form-based and included the programme theory that the article intended to support, the explicit or implicit conclusions made relevant to that theory and how the relevant evidence was organised (25). Data extraction included the study type, research methodologies and evidence to enable testing of programme theories. Following data extraction, relationships between context (e.g. organisational conditions), mechanisms (e.g. processes) and outcomes (e.g. all consequences and overall impact) were synthesised. Extracted information was organised into evidence tables with respect to different bodies of literature (e.g. implementation strategy, barriers and facilitators). Patterns related to context-mechanism-outcome configurations were themed across the evidence table. Finally, patterns were linked to form hypotheses.

Key stakeholders were identified by peer recommendations from the professional network of the steering group, and then informal consultations were conducted to test and refine programme theories. Experts consulted from oncology MDTs included

medical and clinical oncologists, surgeons, nurses, allied health professionals, MDT coordinators and a cancer business manager. Meetings with geriatricians, information technology (IT) staff and a clinical coding manager responsible for oncology services were also arranged. We presented stakeholders with proposed solutions to successfully implement GA and invited them to express how the contextual elements of GA may impact on the behaviours of those involved in its implementation. These consultations were documented by GM and used in combination with literature synthesis to support or refute programme theories. Data synthesis was further supported from a combination of individual reflection and group discussion in order to challenge the integrity of each theory, judge competing theories and compare the stated theory with actual practice. Data from the studies or stakeholder consultations were used to confirm, refute or refine the candidate theories. Alternative theories were sought where theories could not explain the data.

Patient and public involvement

Early findings were discussed with five patients in the context of their lived experience of cancer. Three of these patients were consulted on the configuration of a new GA service for oncology patients developed and operated by the lead author (GM).

Ethical approval

This realist review was part of a larger study which gained ethical approval by the Yorkshire and Humber – South Yorkshire Research Ethics Committee (19/YH/0382). Consultations with key stakeholders were not deemed to be research. Hull York Medical School ethical approval was gained prior to the start of the study.

Stage 2 – analysing and synthesising evidence to test the proposed programme theories

Following the completion of preliminary mapping of evidence into tables, the steering group was consulted. This group consisted of trans-disciplinary experts including oncologists, palliative care physicians, mixed-methodology researchers, statisticians, sociologists and systems thinking academics. The findings were discussed, and the resultant hypotheses were confirmed or rejected. Confirmed hypotheses were used as synthesised statements of context, mechanism, outcome narratives along with their

supporting evidence. The process of analysis, synthesis and discussion was iterative in order to reach sufficient refinement of programme theories towards developing a new system for optimisation and predictive assessment of older adults with cancer.

Results

After deduplication of articles, 5,458 describing GA were screened and 214 were included in the review (**Figure 3**). Backward citation searching identified a further two articles and forward citation searching three articles. Twenty key stakeholder consultations were undertaken. Fifty-three articles were selected that provided sufficient detail on implementation of GA. Twenty-seven programme theories were initially developed from the 53 articles, which were consequently expressed as four programme theories addressing the major barriers in GA implementation in oncology practice: i) workload (*leveraging non-specialists*); ii) funding (creating favourable health economics); iii) practicalities (establishing the use of geriatric assessment in cancer care); and iv) resources (managing limited resources). **Supplementary Table 3** summarises the 53 included studies, their study designs and major findings. **Table 1** summarises the four programme theories linked to relevant studies and includes citations to the studies that helped generate them, in order to make the following text more readable, which also integrates insights from key stakeholder consultations and reflection. **Figure 4** presents a conceptual framework for implementing GA in oncology.

Programme theory 1: leveraging non-specialists

Protocolised organisational structure

GA is a complex intervention with indications, benefits, and alternatives, although it is frequently viewed as an assessment undertaken solely by geriatricians. Protocols for the use of GA within the cancer MDT can be constructed, which can help GA to be viewed as a complex intervention that can benefit oncological care. This view can help cancer specialists better appreciate the holistic value of GA, so that they can focus on cancer diagnosis and treatment, knowing that geriatric issues will be covered at some point, and vulnerabilities identified.

Role of the geriatrician

The role of the geriatrician is frequently identified by two extremes: i) reliance on geriatrician-led oncology services or Geriatric Oncology Programmes (GOPs); or ii) patient-led, CSGA with referrals to other services, including geriatric medicine. A GA can be undertaken by non-geriatricians, with careful protocolisation and systematisation within the host organisation. Geriatricians should be considered a scarce resource, as national workforce shortages to meet current and emerging healthcare demands are evident (35, 36). Implementation configurations which consider this real barrier therefore seem favourable and progressive. GA results can drive protocolised referrals to other healthcare professionals including allied health professionals (e.g. dieticians), geriatric medicine, and external services (e.g. social services). This implementation strategy reduces the number of consultations geriatricians have to undertake within cancer services, whilst enabling them to focus on the most complex patients.

Patient self-report

Patient self-report of GA either remotely or otherwise independently from the clinician has demonstrated feasibility. Not all patients will be capable of self-reporting, therefore systems must be in place to fall back to clinician-led reporting. This also requires psychometrically validated instruments, which are suitable for patient self-report wherever possible. Remote self-reporting can occur through paper-based methods (e.g. post) or digitally (e.g. mobile devices). An outpatient area can also be used, with the advantage of assistance being available if necessary. This can reduce the clinical time required to administer the assessment. Digital methods also offer more efficient capture of information and the potential to automate the processing of data. Digitalised remote completion may involve modern communication channels, including email, short message service, and push notifications, which save paper and offer environmental advantages. The process of self-reporting is widely acceptable to older patients and assistance is not required in the majority; therefore, it removes an additional time burden from all clinical staff.

Workforce

Time is a scarce resource and a frequently cited barrier for cancer specialists. A substantive GA has healthcare provider components, including cognitive screening, co-morbidities assessment, medication review, and physical examination. However, this can be protocolised, systematised, and rationalised for outsourcing to trained staff other than physicians. Clinicians are often competing against overbooked clinics, frenetic MDT meetings, inpatient reviews, operating lists, and other service-critical activities. Leveraging an alternative workforce therefore reduces implementation time and subsequently cost. Opportunities exist to capitalise on emerging roles (e.g. physician associates) to undertake GA. Identifying the training opportunities, continuing professional development and support structures to create, develop, and sustain these positions is key.

Assessment-guided care processes

GA can guide subsequent care processes by identifying opportunities to refer to other healthcare professionals (e.g. dietetics), according to local service configurations and availability. Where referrals cannot be fulfilled (e.g. they are unavailable or have no capacity), there is an opportunity to collect important data on unmet needs. This can be used to drive business cases for service improvement, so could be viewed as a facilitator. Establishing assessment-guided care processes may create favourable networks, which can sustain conditions for implementation of GA. The concept of networks and their feedback loops is derived from complex adapting systems (CAS) theory, which has been applied to implementation science (37). CAS theory considers individual agents (e.g. cancer MDT, GA service, general practitioner) as a collection of dynamic, self-similar entities which are adaptive (37). Over time a degree of mutual dependency upon referrals can be anticipated, leading to the emergence of normalised co-operation between services and the individuals operating them.

Autonomisation

Recommendations made to cancer specialists from a GA team are not always implemented. There may be legitimate reasons, although some cases may be from

lack of insight into their benefits. Where GA-guided referrals are made by clinical staff other than the cancer specialist, protocolisation can be established to autonomise the professional(s) undertaking a GA. The same professional(s) making the recommendations can take personal responsibility for their implementation and follow-up, which may improve adherence to GA-guided recommendations. This autonomisation also reassures the cancer MDT that these referrals will be handled and helps to leverage the expertise of non-specialists.

Programme theory 2: creating favourable health economics

Geriatric oncology programmes

The ideal model of GA in cancer care is frequently cited as a formal Geriatric Oncology Programme (GOP). A GOP is geriatrician-led and generally well-integrated into cancer pathways with mature referral criteria and strategy. Other members of the geriatric medicine team (e.g. clinical nurse specialists and allied health professionals) have key positions and may co-lead aspects of the service. However, this model exhibits significant workforce and economic resources making implementation challenging. If organisations can operate a GOP, maximisation of sustainability should take precedence to fully embed the GOP within cancer care. This includes developing local/regional networks to enable full clinical governance of the GOP within cancer services, creating training opportunities (e.g. fellowships), leveraging inter-disciplinary skills and developing research studies. Generating high quality health economic data to demonstrate favourable outcomes helps build the case necessary to secure long-term funding. Cancer clinicians would likely become dependent upon GOP services, leading to ongoing demand and therefore sustainability.

Insurers and payers

Insurers generally do not cover GA within oncology and often institutions underwrite this themselves. There are no national financial incentives within the UK to undertake GA as part of cancer care. Dialogue is therefore required with insurers and payers to convince them of the wider value of multidimensional predictive assessment and prognostication. This includes health economic impacts (e.g. reducing chemotherapy

toxicity admissions), the pricing of insurance premiums (e.g. risk mitigation), hospital tariffs (e.g. improved clinical coding) and population health planning. New top-down opportunities can be recognised by key stakeholders to encourage the use of GA at a national level.

Data and quality improvement

The use of data can support the understanding of the positive effects that implementing GA can have on cancer services. For example, reduced chemotherapy toxicity rates following GA service introduction. Data-driven continuous quality improvement can be undertaken and used for health economic analyses, particularly cost consequence analysis. Service-level improvements can further improve clinical- and cost-effectiveness and generate the data needed to support sustainability. IT systems can be established to build real-time, searchable databases of structured local/regional data, with high granularity relevant to geriatric oncology. This also drives advanced predictive analytics, institutional case series and provides further data towards clinical treatment, research, and service evaluation.

Information technology

GA-guided interventions can also be delivered using IT. Smartphone and web applications and Internet of Things devices have demonstrated feasibility for the delivery and monitoring of GA-guided interventions at home. This can save the travel burden, costs, and environmental impacts of visits to local services and encourages patient independence. Clinicians can gain reassurance from community monitoring of vulnerable patients and acquire new insight into the biopsychosocial effects of cancer and its treatment.

Programme theory 3: establishing the use of geriatric assessment in cancer care

Cancer-specific geriatric assessment

There is a lack of evidence regarding which tools to use within a CSGA. Whilst attempts have been made to reach international consensus, heterogeneous instruments are often recommended. This largely depends on the rationalisation for

their selection (e.g. short time taken to complete) versus their underlying psychometric properties. Cancer-specific geriatric assessment was popularised by Hurria *et al*. (16) in 2005. Building on this principle and taking advantage of the numerous systematic reviews of psychometric instruments that have been published since, CSGA can be developed further. The outputs of the GA can be aligned to the prediction of outcomes or optimisation before cancer intervention. A synthesis of the best available psychometrically validated instruments appropriate to the patient population, the method of administration and the potential unmet needs (e.g. pain) of patients with cancer can be designed at national levels. Homogeneity of the CSGA process at the national level may facilitate meta-analysis of CSGA outcomes, something which has not yet been undertaken. Positive findings at this level may help convince some clinicians who are doubtful of the evidence behind GA in cancer care.

Cancer multi-disciplinary team policy

Cancer MDTs may have initial uncertainty about how best to use GA in their care pathways. There are two main strategies: reactive (i.e. the index clinician makes a referral to a GA service) and proactive (i.e. the GA service proactively screens cancer pathway outpatient lists). Even within a single cancer site MDT, two different strategies may be employed and the conversion rate to cancer from outpatient lists should be explored. This insight can be used to strategise selection of patients who will most likely benefit from the predictive and optimisation capabilities of GA.

Screening

Some cancer centres have such limited resources to undertake GA that a screening strategy should be considered. Screening can either help select which patients would benefit most from a GA or can be used as an independent decision-support tool. Where screening is undertaken, population-relevant screening tools with high diagnostic accuracy (e.g. G8) can be utilised.

Clinician accessibility

The integration of a geriatrician within a cancer MDT is often favoured, although current workforce limitations make this an unscalable solution. The strategy of dual cancer-site and geriatric oncology MDTs has demonstrated feasibility in some studies but was thought to be logistically too difficult in our stakeholder consultations. In NHS cancer services, MDTs frequently run over lunchtime hours and back on to outpatient clinics. There is little scope within specialist's timetables to attend another MDT and this also depends on geriatrician–leadership and a formal GOP being established. These dependencies make this proposition unscalable in many healthcare systems. However, GA findings can be summarised in ways that are suitable for non-geriatricians, either using proformas or well-designed software. Summarised GA findings using accessible terminology can be integrated into MDT processes to facilitate utilisation of results in clinical decision-making, in the absence of a geriatrician.

Local champion

There is lack of consensus between medical and surgical research groups regarding the use of GA in cancer care. A cohesive view of the cancer pathway and where GA fits is distinctly missing. At the local level, this consensus is vitally important so that GA can be used centrally by the MDT and made available to all patients who will likely benefit. The championing of GA by a local opinion leader can help to establish this consensus.

Clinical staff education

Rather than trying to train cancer specialists (e.g. surgeons and oncologists) in geriatric principles, brief educational interventions appear better suited. Alternatives include a geriatric rotation in higher specialist oncology training. These should encourage GA to be considered as both a shared-decision support tool (e.g. predictive assessment) and a complex intervention (e.g. through generating referrals). This is in keeping with national work in the NHS such as the UKs national Perioperative Quality Improvement Programme (38). The aim should be for members of the cancer MDT to

better understand the role of GA in cancer care and promote embedding into routine practice at the level of the MDT. Furthermore, ancillary motivators can be conveyed to front-line clinicians, which include: i) reduction of potential medico-legal action; ii) continuous professional development; and iii) research opportunities, particularly in collaboration with geriatric specialists to promote inter-departmental cross-fertilisation. This can help establish new bottom-up incentives that can drive local adoption of GA in cancer MDTs.

Patient education

Patients may be unwilling to complete a GA when they have not been adequately briefed about its indications and benefits. There may be a role for brief educational interventions for patients (e.g. scripted face-to-face summarisation or audio-visual introduction). This may help to fully engage patients in the process and help them to become active participants, by realising the value in GA at the point in their care.

Whole system approach

The issues of GA in oncology practice are a whole system implementation problem and a higher-level approach is required (37). This may include quasi-autonomous non-governmental organisation guidance (e.g. National Institute of Health and Care Excellence) and governmental lobbying by specialist interest groups (e.g. British Geriatrics Society, Geriatric Oncology Special Interest Group) and charitable organisations (e.g. Macmillan Cancer Support). This could help refocus the national care agenda for older adults with cancer and establish powerful facilitators to encourage national implementation.

Programme theory 4: managing limited resources

Timing of assessment

Undertaken too late in the cancer pathway and the results of a GA are unlikely to be used in shared decision-making and opportunities for optimisation and prehabilitation are missed. Undertaken too early and there is a chance that older adults who have a symptomatic benign condition or a false positive on screening undergo a GA, which is not ultimately required for decision-making. The latter situation may be preferred as it

affords the opportunity to identify general health vulnerabilities that can be addressed. In a reactive model, the ideal time to undertake GA is immediately after the index specialist review when cancer is suspected, and investigation continues. In a proactive model, screening of 2 Week Wait lists is possible, including inviting patients for GA before the index specialist review. However, this generates a risk of overloading the GA service and not targeting those most in need, who may enter the cancer pathway through other routes.

Primary care integration

A significant number of new patients enter a cancer pathway through referrals from primary care. This opens the possibility of undertaking GA at the point of referral. A deterioration in health of an older adult is an opportunity to undertake GA, even if cancer is eventually excluded. However, increasing the workload of general practitioners or straining primary care services is discouraged. To avoid unnecessary duplication of data collection or intervention during GA, there is scope for improved health data utilisation from primary care. Primary care electronic health records are rich in data and mining this information using new technologies is possible. For example, natural language processing can extract and summarise health care data in structured (e.g. height and weight) or unstructured (e.g. freetext) forms. Cancer specialists are unlikely to have sufficient resources to provide robust aftercare agreements for frail older adults returning to the community. Primary care plays a role here, but robust longitudinal care coordination will be required to manage complex patients, ideally with a community geriatrician. Evolving services such as Integrated Care Centres may be important in this space.

Policy

Locally or nationally set cancer pathway targets were identified as a significant competing barrier. However, these could be relaxed, or an exception agreed for older adults to undergo GA before decision-making. If the pressure to meet targets in the context of complexity can be relieved, this could create time in the pathway for GA and prehabilitation.

Information technology

There is still an opportunity cost for IT infrastructure and mechanisms to accommodate patients who cannot use technology must be implemented. For a digital patent reported CSGA, the remainder of the clinical components could be integrated into routine oncology appointments, without the need for a formal GA service. There is some evidence that even a Timed Up and Go test can be predicted using a three-question decision tree, although this remains to be prospectively validated (39). This movement appears to have driven the reductionism of CSGA and emphasis on using short instruments easily used in outpatient settings by non-specialist staff (13).

Outpatient space

Physical space and logistics have also been cited as an implementation barrier. If outpatient space is limited for inter-professional teams, technology can also offer solutions. Professionals undertaking CSGA can consider the use of telephone, video, instant messaging and automated conversational agent consultations. These are particularly suited towards advice-based interventions undertaken by allied health professionals (e.g. pharmacists, dieticians, and social workers). The decreased reliance on face-to-face consultations, where appropriate, can also reduce perceived or actual travel burden for patients, healthcare costs and consequent environmental effects.

Existing resources

Where referrals to geriatrician-led services are required based on GA results, these can be integrated into existing structures (e.g. geriatric day clinic). This can reduce the initial barriers of establishing a dedicated GOP and promotes inter-speciality cross-fertilisation. Exploration of the individual capacity of specialties and services is important. Geriatricians may be able to accommodate referrals from cancer services within a few weeks. If early GA through a proactive model and/or the relaxation of cancer pathway targets for older adults can be negotiated, then existing geriatric services can be utilised.

Discussion

We have systematically reviewed and synthesised evidence from 53 research articles and 20 key stakeholder consultations using realist methodology regarding the implementation of GA in oncology settings. We have developed four major programme theories based on the most commonly cited implementation barriers, namely limited workload capacity, absence of funding, uncertain practicalities and limited resources. For each of these programme theories we have attempted to outline enablers around themes that map to these barriers. Enablers include protocolisation of GA towards the generation of GA-guided interventions formulated as referrals to other services by clinically autonomous non-specialists. A GOP requires robust clinical governance and the development of training, research and health economic data to promote sustainability. Where geriatricians are unavailable to operate a GOP, referring to existing geriatrician-led services can promote favourable network formation Technology can be utilised to address workload, health economic and resource barriers. These enablers are the product of realist review using the available evidence, key stakeholder expertise and the authors' reflections.

Strengths of this review include the novelty of using realist synthesis in the systematic review of GA in oncology settings and, to the best of our knowledge, this is the first of its kind. The vast majority of systematic reviews concerning GA within oncological settings have focussed on effectiveness (64, 65). Because respected international organisations already endorse and use GA in oncology settings, we chose to focus on implementation. We made the assumption that GA is an evidence-based practice. Realist review was chosen to facilitate the combination of heterogeneous literature exhibiting a range of study types with real-life experience and reflection. The lead author (GM) has designed and operates a new GA-based service for cancer patients. This first-hand experience helps to contextualise literature findings, thereby making programme theories more generalisable towards clinical practice and the wider implementation science community. The iterative approach of the steering committee also improved sense-making of the limited implementation literature, noting the absence of ideal study types such as hybrid implementation-effectiveness trials (40). A robust systematic search strategy was undertake utilising a novel implementation filter designed by an information specialist (SG) to help identify relevant papers from

a large literature base (>10,000 results). We avoided the need to exclude key MeSH terms (e.g. 'geriatric assessment') to reduce the abstract screening workload (41). Limitations include those common to systematic reviews, including the search strategy employed and the heterogeneity of studies. The search strategy was not designed to encompass all diagnostic accuracy studies of screening tools used before GA, which have been subject to several systematic reviews (42). We also excluded studies solely focussing on healthcare education, as our search strategy was not developed to capture all healthcare education literature. Some studies may not have been analysed in our review, although, the large number of abstracts screened and our rigorous forward and backward citation searching strategy means that major implementation studies were unlikely to be missed.

Zubair *et al*. (41) undertook a realist review of CGA in UK care homes and found that the effectiveness of CGA in this context requires three components: i) structured/standardised assessment; ii) MDT review; and iii) care delivery coordination. Similarly, we found that a protocolised assessment undertaken by non-specialist staff with carefully summarised results integrated into a tumour-site specific MDT appears effective. Oncological care delivery co-ordination comes either from the integration of geriatrics into oncology (e.g. establishing a GOP) or from autonomising a CSGA service to make and follow-up geriatric-specific referrals.

Conclusion

We have demonstrated that a whole system approach is required to improve the implementation of GA in cancer settings using four programme theories. At the service-level, utilisation of IT, leverage of non-specialist staff skills and the consensus of individual MDTs helps to view GA as a predictive optimisation tool. At the organisation level, recognition of the cost consequences of GA, such as medicolegal mitigation, research opportunities and data generation for service improvement provide top-down incentives for GA. Finally, insurers, payers, and regulators should make a clear declaration, either way, about the value of GA within cancer care. This review should help guide policy decisions regarding implementation of GA and provide a basis for further implementation research.

Figure Captions

Figure 1 – Systematic review search strategy

Search strategy for systematic review. *Abbreviations: GA = geriatric assessment*.

Figure 2 – Inclusion and exclusion criteria for systematic review

Inclusion and exclusion criteria for studies retrieved using systematic review strategy. Abbreviations: *GA = geriatric assessment*.

Figure 3 – Literature search Preferred Reporting Items for Systematic review and Meta-Analyses

Literature search Preferred Reporting Items for Systematic review and Meta-Analyses diagram for the systematic review of eligible studies.

Figure 4 – Conceptual framework for implementing geriatric assessment in oncology practice.

Summary of the key concepts for implementation of geriatric assessment in oncology practuce. *Abbreviations: GA = geriatric assessment; G8 = geriatric 8; MDT = multi-disciplinary team.*

Tables

Theme	Context-mechanism-outcome	References
Programme theory 1 – leveraging non-specialists time		
Time is frequently cited as a major barrier to implementing GA in oncology care, although certain implementation configurations can help to leverage non-specialists time. These include: -		
Protocolised organisational structure	The process of undertaking GA can be delegated away from cancer specialists within a protocolised organisational structure. This can help to establish the *indications*, *benefits,* and *alternatives* of GA within the cancer multi-disciplinary team.	(43-61)
Role of the geriatrician	Processes and structures can be instituted (e.g. IT systems, protocolisation, and pathways) to enable non-geriatricians to undertake GA. This can help to generate efficient referrals to geriatricians to maximise their input as a scarce resource	(23, 45, 47, 48, 50, 53-69)
Patient self-report	If patients can self-report (where able) as much of a GA as possible, either remotely or otherwise independently from the clinician, by using the best available psychometrically validated instruments for this method of administration, then the clinician time to complete the GA process can be reduced. *However*, where IT is utilised to offer patient-led geriatric assessments within a digital-first strategy (e.g. using mobile or tablet devices), processes must be instituted to fall back to clinician-led or paper-based alternatives to enable data capture from groups unable or unwilling to self-administer the assessment digitally	(47, 61, 63, 70-83)
Workforce	The protocolisation and systemisation of the healthcare provider components of a GA can be outsourced to trained staff other than physicians where time is a scarce resource. This can reduce the implementation time and cost, whilst also creating new roles and opportunities for an evolving workforce (e.g. physician associates, advanced nurse practitioners, and allied healthcare professionals)	(53, 54, 56, 58-61, 63, 64, 67, 69, 81, 84)

Assessment-guided care processes	Geriatric assessment-guided processes can be developed according to local service configurations and availability. This means that many of the recommendations of GA can be fulfilled by referring to allied health professionals and other specialist services creating a network effect and emergence of a complex adapting system	(58, 60, 67, 85-87)
Autonomisation	Processes (e.g. agreements, protocolisation, and pathways) can be established to autonomise the professional(s) undertaking a GA before cancer treatment. This means that the same professional(s) making the recommendations can take responsibility for their implementation and follow-up.	(45, 46, 53-55, 60, 62, 64, 74, 86)
Programme theory 2 – creating favourable health economics		
Cost is another frequently cited barrier to implementing GA in oncology care, although certain implementation configurations and system-wide factors may help to create favourable health economics to sustain implementation, including: -		
Geriatric oncology programmes	There may be cases where organisations have sufficient resources (e.g. time, funding, and workforce) to establish a formal Geriatric Oncology Programme. In these cases, attempts should be made to embed local/regional networks to enable the programme to have full clinical governance, create training opportunities (e.g. fellowships), leverage inter-disciplinary skills, and recruit into research studies. This can ensure long-term incentives are created to maintain long-term funding.	(58, 60, 61, 68, 69, 81, 83, 84, 88)
Insurers and payers	If insurers and payers can be convinced of the wider value of multidimensional predictive assessment and prognostication from the perspective of economics, including pricing of insurance premiums, hospital tariffs, and population health planning, then new top-down opportunities can be recognised for key stakeholders to encourage the use of GA.	(54, 58, 60, 61)
Business intelligence	GA-based services can be subjected to data-driven continuous quality improvement and health economic analysis. Service-level improvements can be made to improve clinical- and cost-effectiveness and build business cases for longer term, mainstream funding and therefore sustained implementation. IT systems can be established to build real-time,	(51, 58, 60, 85, 89, 90)

	searchable databases of structured local/regional data with high granularity relevant to geriatric oncology. This data can drive predictive analytics, institutional case series and business intelligence towards clinical treatment, research, and quality improvement.	
Information technology	If GA-guided interventions can be delivered using IT (e.g. mobile/web applications, Internet of Things devices), then some interventions can be delivered and monitored at home, saving the travel burden, costs, and environmental impacts of visits to local services and encouraging independence	(81, 87)
Programme theory 3 – establishing the use of geriatric assessment in cancer care		
Geriatric assessment can take different configurations in cancer care and can be driven by both internal and external factors, including: -		
Cancer-specific geriatric assessment	Lack of evidence and/or an international consensus often precludes the homogeneity of GA in oncology settings. *However*, CSGA can be undertaken utilising a synthesis of the best available psychometrically validated instruments appropriate to the patient population, the method of administration, and the potential unmet needs (e.g. pain and fatigue) of patients with cancer. The outputs of GA can therefore be aligned to prediction of outcomes or optimisation before cancer intervention.	(47, 58, 64, 70, 71, 73-76, 79, 91)
Cancer multi-disciplinary team policy	If models of reactive (e.g. by referral) and proactive selection (e.g. screening of suspected cancer outpatient lists) for GA can be agreed within individual cancer multi-disciplinary teams, then GA can be used for patients most likely to benefit from its predictive and optimisation capabilities.	(54, 56, 64, 81, 82, 89, 92)
Screening	If cancer centres have limited resources to undertake GAs, then population-relevant screening tools with high diagnostic accuracy (e.g. G8) can be utilised either to identify patients potentially more in need of GA or as an independent decision-support tool.	(23, 47, 49, 50, 53, 54, 58, 62, 64, 67, 69, 77, 81, 88, 89, 92, 93)

Clinician accessibility	Geriatricians cannot often be integrated within cancer multi-disciplinary team meetings to convey results of GA. However, summarised GA findings which are suitable for non-geriatricians can be integrated into MDT processes to facilitate utilisation of results in clinical decision-making.	(46, 48, 50, 52-54, 58-62, 64-66, 69, 84, 89, 92)
Local champion	If medical and surgical oncologists can be aligned by consensus and championed by a local opinion leader towards utilising GA at the level of the MDT, then the benefits of GA can be made available to all cancer patients.	(23, 49-54, 60, 61, 81, 94)
Clinical staff education	Brief educational interventions can encourage GA to be considered as both a shared-decision support tool (e.g. predictive assessment) and a complex intervention (e.g. through generating referrals). This can enable members of the cancer MDT to better understand its role in cancer care and promote embedding of GA into routine practice. Furthermore, ancillary motivators can be conveyed to front-line clinicians including reduction of potential medico-legal burden, continuous professional development, and research opportunities. This can help establish new bottom-up incentives that can drive local adoption of GA in cancer multi-disciplinary teams.	(46, 49, 50, 52, 54, 58-61, 81, 83, 88)
Patient education	Patients can undergo brief educational interventions (e.g. scripted face-to-face summarisation or audio-visual introduction) concerning the indications and benefits of GA in oncology settings. They may therefore be more likely to engage fully in the process and become active participants.	(49, 58, 63, 72)
Whole system approach	A whole system approach can be considered, including local implementation champions, regional policies, quasi-autonomous non-governmental organisation guidance (e.g. National Institute of Health and Care Excellence) and governmental lobbying by specialist interest groups/medical organisations. This could help refocus the care agenda for older adult with cancer and powerful facilitators could be established to encourage national implementation	(54, 58, 60, 61, 81, 88)
Programme theory 4 – managing limited resources		

Resources can be limited to undertake geriatric assessment in cancer care, although there are ways of managing this scarcity including: -		
Timing of assessment	GA can occur early in the cancer pathway, immediately after the index clinical review. This enables the results of GA to be available to the cancer MDT for shared decision-making and more time will become available within existing cancer pathway targets to enable prehabilitation	(23, 51, 52, 54, 57, 94)
Primary care integration	Integration with primary care and community services can be improved, in terms of GA timing, health data utilisation, aftercare agreements and referral guidelines. The process of GA can therefore be streamlined and the challenges of the longitudinal care for the most frail and older adults can be improved	(69, 81)
Policy	Locally or nationally set cancer pathway targets can be relaxed or an exception agreed for older adults to be allowed time to undergo GA before decision-making. This eliminates one-size-fits-all pathway configurations, which can be more accommodating for older adults with cancer, and the pressure to meet targets in the context of complexity can be relieved	(58, 64, 95)
Information technology	If systems can be developed (e.g. cybernetics, automation, and algorithms) so that implementation cost (e.g. time, training, human resources, procurement) can be minimised, then GA can be embedded into routine oncology practice without the need for a separate geriatric oncology team.	(23, 47, 50, 53-55, 57-61, 63-65, 67, 69, 72, 79, 81, 83, 84, 86-88, 93)
Outpatient space	If outpatient space is limited for inter-professional teams, then increased use of phone, video, instant messaging and automated conversational agent consultations can be considered (e.g. pharmacy, nutrition, and social work interventions), which can also reduce travel burden, costs and environmental effects	(81)

Existing resources	If referrals to geriatrician-led services are required based on GA results and these are integrated into existing structures (e.g. internal liaison, geriatric day clinic), then this reduces the initial barriers of establishing a dedicated geriatric oncology service and promotes inter-speciality cross-fertilisation	(54, 58, 60, 61, 65, 66, 68, 69, 81, 84)

Table 1 – Programme theories tested in the review

The four programme theories with their sub-theories are presented. Abbreviations: GA = geriatric assessment; MDT = multi-disciplinary team; IT = information technology

Figure 1

Timescale

Electronic databases were searched using their relevant control language from inception to July 2019

Databases

MEDLINE®, Embase, and PsycInfo via OVID; The Cochrane Database of Systematic Reviews and Cochrane Central Register of Controlled Trials within the Cochrane Library; CINAHL via EBSCOhost, Web of Science Core Collection, Scopus, Applied Social Sciences Index and Abstracts (ASSIA) via ProQuest, Epistemonikos, JBI Database of Systematic Reviews and Implementation Reports, Database of Abstracts of Reviews of Effects, and Health Technology Assessment

Search terms

For cancer: “cancer*”, “neoplas*”, “tumor*”, “tumour*”, “malignan*”, “carcinoma*”, “metasta*”, “oncolog*”, “leukemi*”, “leukaemi*”, “lymphoma*”, “myeloma*”, and “sarcoma*”. The Medical Subject Heading (MeSH) term “Neoplasms” was also used where possible, depending on the database.

For geriatric assessment: MeSH terms “Geriatric Assessment” and “Health Services for the Aged”. The MeSH terms “Needs Assessment”, “Risk Assessment”, “Diagnostic Services”, "Health Services Needs and Demand", “Health Services”, "Delivery of Health Care", "Outcome and Process Assessment (Health Care)" were also combined with “geriatrics”. MeSH terms were ‘exploded’ (using the Ovid® interface where appropriate). See **Supplementary Data File 1** for full search strategies.

Limits

Limits were applied for adult humans in MEDLINE® and to remove conference abstracts from Embase. Where >2,000 results were returned from a database using the above search strategy, attempt was made to filter the results using an implementation research filtering strategy devised by an Information Specialist (SG) based on similar systematic reviews. This was applied to the combined results from the MEDLINE®, Embase, and PsycInfo via OVID and Scopus. This included the MeSH terms “Implementation Science”, “Organizational Innovation”, “Quality Improvement” and “Diffusion of Innovation”, combined with the keywords “barrier*”, “constraint*”, “facilitator*”, “enabler*”, “sustainability”, “feasibility”, “maintenance”, “acceptab*”, “appropriat*”, “uptake”, “embed*”, “adher*”, “usage”, “engagement”, “fidelity”, “Institutionalis*”, “institutionaliz*”, “implement*”, “dissemin*”, “adopt*”, “practice*”, “organi?ational change*”, “diffus*”, “quality improvement*”, “transform*”, “translat*”, “transfer*”, “sustainab*”, and “capacity”. Searches across all fields were also made for the terms (system* ADJ2 change*) in combination with MeSH terms and other keywords. Where databases returned <2,000 results using the GA and cancer terms, implementation filters were not used.

Software

EndNote X9 (Clarivate, USA) was used for search results management and abstract screening.

Figure 2

Inclusion criteria for research studies

- Reported data from participants aged 65 and over
- Participants had a diagnosis of cancer
- Article focused on the implementation or use of GA

Exclusion criteria for research studies

- Reported data on implementation or use of GA in community, care of the elderly, orthogeriatric, and acute settings
- Absent detail of the implementation strategies employed, barriers of implementation, facilitators of implementation, amount of infrastructure and human resources required or the satisfaction of patients undergoing the assessment process
- Studies reporting the diagnostic accuracy of screening tools, unless screening was part of a relevant implementation strategy
- Studies focussing solely on healthcare education
- Review articles, case report, editorial, opinion piece or commentary

Figure 3

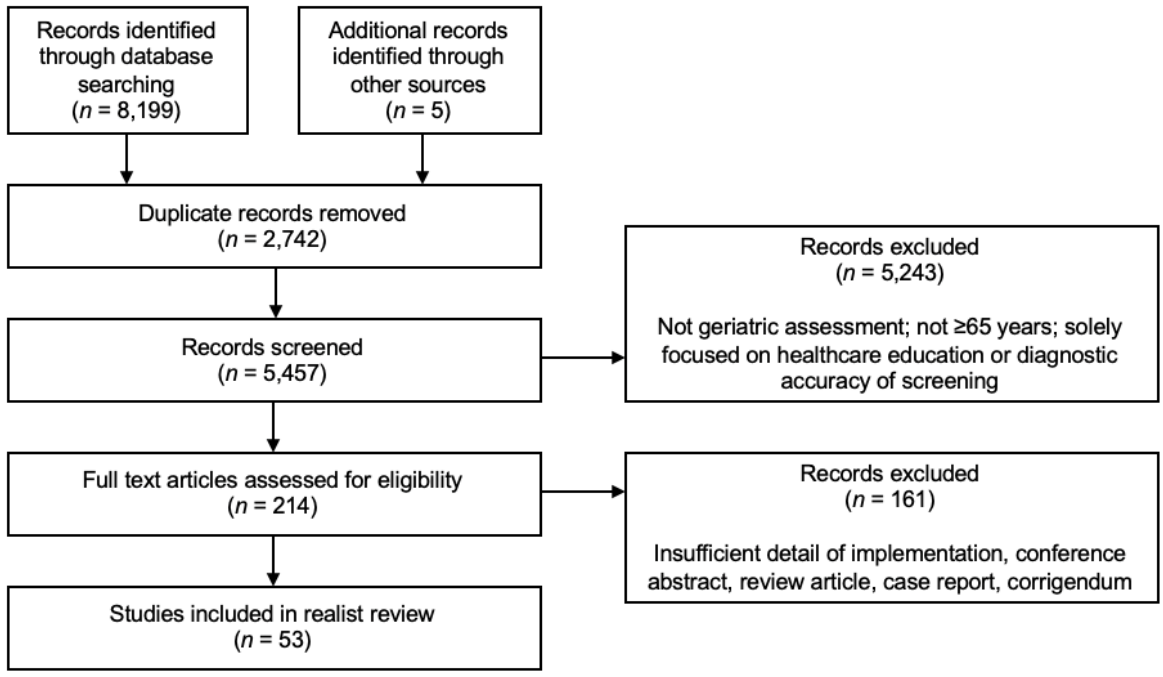
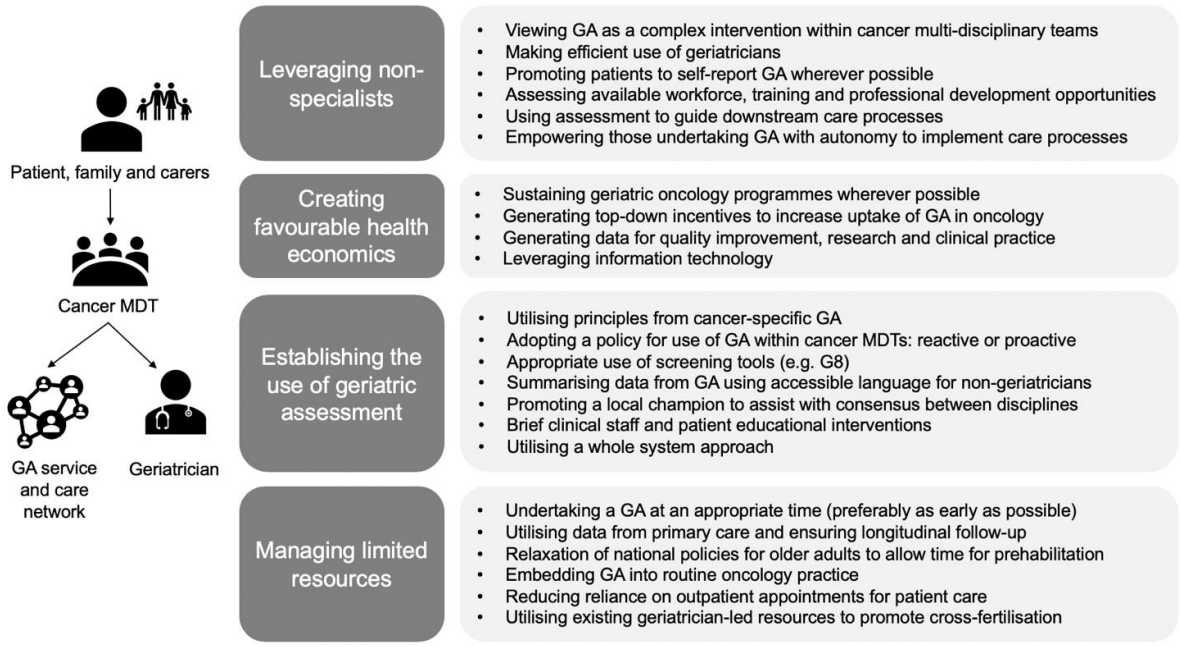


Figure 4



Conflicts of interest: none

Author contribution

Conception and Design: GM, SG, ML, MJ, MP**; Data Collection:** GM; **Analysis and Interpretation of Data:** GM, AB, MP**; Manuscript Writing:** GM**. All authors have approved the final article.**

References

1. Lidsky ME, Thacker JK, Lagoo-Deenadayalan SA, Scarborough JE. Advanced age is an independent predictor for increased morbidity and mortality after emergent surgery for diverticulitis. Surgery. 2012;152(3):465-72.
2. Turrentine FE, Wang H, Simpson VB, Jones RS. Surgical risk factors, morbidity, and mortality in elderly patients. J Am Coll Surg. 2006;203(6):865-77.
3. Hurria A, Mohile S, Gajra A, Klepin H, Muss H, Chapman A, et al. Validation of a Prediction Tool for Chemotherapy Toxicity in Older Adults With Cancer. J Clin Oncol. 2016;34(20):2366-71.
4. Abdulaziz K, Perry JJ, Taljaard M, Emond M, Lee JS, Wilding L, et al. National Survey of Geriatricians to Define Functional Decline in Elderly People with Minor Trauma. Can Geriatr J. 2016;19(1):2-8.
5. Yarnall AJ, Sayer AA, Clegg A, Rockwood K, Parker S, Hindle JV. New horizons in multimorbidity in older adults. Age Ageing. 2017;46(6):882-8.
6. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr. 2017;17(1):230.
7. Hurria A, Dale W, Mooney M, Rowland JH, Ballman KV, Cohen HJ, et al. Designing therapeutic clinical trials for older and frail adults with cancer: U13 conference recommendations. J Clin Oncol. 2014;32(24):2587-94.
8. Kemeny MM. Surgery in older patients. Semin Oncol. 2004;31(2):175-84.
9. Puts MT, Tapscott B, Fitch M, Howell D, Monette J, Wan-Chow-Wah D, et al. A systematic review of factors influencing older adults' decision to accept or decline cancer treatment. Cancer Treat Rev. 2015;41(2):197-215.
10. Tranvag EJ, Norheim OF, Ottersen T. Clinical decision making in cancer care: a review of current and future roles of patient age. BMC Cancer. 2018;18(1):546.
11. Care DoHaS. The Impact of Patient Age on Clinical Decision Making in Oncology. 2012.
12. Peake MD, Thompson S, Lowe D, Pearson MG. Ageism in the management of lung cancer. Age Ageing. 2003;32(2):171-7.
13. Mohile SG, Dale W, Somerfield MR, Schonberg MA, Boyd CM, Burhenn PS, et al. Practical Assessment and Management of Vulnerabilities in Older Patients Receiving Chemotherapy: ASCO Guideline for Geriatric Oncology. J Clin Oncol. 2018;36(22):2326-47.
14. Mohanty S, Rosenthal RA, Russell MM, Neuman MD, Ko CY, Esnaola NF. Optimal Perioperative Management of the Geriatric Patient: A Best Practices Guideline from the American College of Surgeons NSQIP and the American Geriatrics Society. J Am Coll Surg. 2016;222(5):930-47.
15. Parker SG, McCue P, Phelps K, McCleod A, Arora S, Nockels K, et al. What is Comprehensive Geriatric Assessment (CGA)? An umbrella review. Age Ageing. 2018;47(1):149-55.
16. Hurria A, Gupta S, Zauderer M, Zuckerman EL, Cohen HJ, Muss H, et al. Developing a cancer-specific geriatric assessment: a feasibility study. Cancer. 2005;104(9):1998-2005.
17. Szumacher E, Sattar S, Neve M, Do K, Ayala AP, Gray M, et al. Use of Comprehensive Geriatric Assessment and Geriatric Screening for Older Adults in the Radiation Oncology Setting: A Systematic Review. Clin Oncol (R Coll Radiol). 2018;30(9):578-88.

18. Stuck AE, Siu AL, Wieland GD, Adams J, Rubenstein LZ. Comprehensive geriatric assessment: a meta-analysis of controlled trials. Lancet. 1993;342(8878):1032-6.
19. Eamer G, Taheri A, Chen SS, Daviduck Q, Chambers T, Shi X, et al. Comprehensive geriatric assessment for older people admitted to a surgical service. Cochrane Database Syst Rev. 2018;1:Cd012485.
20. Puts MTE, Sattar S, Kulik M, MacDonald ME, McWatters K, Lee K, et al. A Randomized Phase II Trial of Geriatric Assessment and Management for Older Cancer Patients. Supportive care in cancer : official journal of the Multinational Association of Supportive Care in Cancer. 2018;26(1).
21. Ommundsen N, Wyller TB, Nesbakken A, Bakka AO, Jordhoy MS, Skovlund E, et al. Preoperative geriatric assessment and tailored interventions in frail older patients with colorectal cancer: a randomized controlled trial. Colorectal Dis. 2018;20(1):16-25.
22. Puts MTE, Hsu T, Mariano C, Monette J, Brennenstuhl S, Pitters E, et al. Clinical and Cost-effectiveness of a Comprehensive Geriatric Assessment and Management for Canadian Elders With Cancer-the 5C Study: A Study Protocol for a Randomised Controlled Phase III Trial. BMJ open. 2019;9(5).
23. Conroy SP, Bardsley M, Smith P, Neuburger J, Keeble E, Arora S, et al. Comprehensive geriatric assessment for frail older people in acute hospitals: the HoW-CGA mixed-methods study2019 2019.
24. Gladman JR, Conroy SP, Ranhoff AH, Gordon AL. New horizons in the implementation and research of comprehensive geriatric assessment: knowing, doing and the 'know-do' gap. Age Ageing. 2016;45(2):194-200.
25. Pawson R, Greenhalgh T, Harvey G, Walshe K. Realist review--a new method of systematic review designed for complex policy interventions. J Health Serv Res Policy. 2005;10 Suppl 1:21-34.
26. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. Bmj. 2008;337:a1655.
27. Shepperd S, Lewin S, Straus S, Clarke M, Eccles MP, Fitzpatrick R, et al. Can we systematically review studies that evaluate complex interventions? PLoS Med. 2009;6(8):e1000086.
28. McKenzie GAG, Pearson M, Greenley S, Johnson M, Lind M. Using comprehensive geriatric assessment for assessment in older adults following cancer diagnosis: a realist review. PROSPERO 2019. CRD42019156058 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42019156058
29. Wong G, Greenhalgh T, Westhorp G, Buckingham J, Pawson R. RAMESES publication standards: realist syntheses. BMC Med. 2013;11:21.
30. A B, S B, JM W. The "Realist Search": A Systematic Scoping Review of Current Practice and Reporting. Research synthesis methods. 2020;11(1).
31. Pearson M, Brand SL, Quinn C, Shaw J, Maguire M, Michie S, et al. Using realist review to inform intervention development: methodological illustration and conceptual platform for collaborative care in offender mental health. Implementation Science. 2015;10(1):1-12.
32. Rycroft-Malone J, McCormack B, Hutchinson AM, DeCorby K, Bucknall TK, Kent B, et al. Realist synthesis: illustrating the method for implementation research. Implement Sci. 2012;7:33.
33. Pawson R. Evidence-Based Policy. London: Sage; 2006 2020-02-05.

34. Papoutsi C, Mattick K, Pearson M, Brennan N, Briscoe S, Wong G. Social and Professional Influences on Antimicrobial Prescribing for Doctors-In-Training: A Realist Review. The Journal of antimicrobial chemotherapy. 2017;72(9).
35. Kocman D, Regen E, Phelps K, Martin G, Parker S, Gilbert T, et al. Can comprehensive geriatric assessment be delivered without the need for geriatricians? A formative evaluation in two perioperative surgical settings. Age Ageing. 2019.
36. Dhesi J, Moonesinghe SR, Partridge J. Comprehensive Geriatric Assessment in the perioperative setting; where next? Age Ageing. 2019.
37. Braithwaite J, Churruca K, Long JC, Ellis LA, Herkes J. When Complexity Science Meets Implementation Science: A Theoretical and Empirical Analysis of Systems Change. BMC medicine. 2018;16(1).
38. D G, SR M. The Perioperative Quality Improvement Programme: Improving Outcomesd. British journal of hospital medicine (London, England : 2005). 2018;79(2).
39. Sasani K, Catanese HN, Ghods A, Rokni SA, Ghasemzadeh H, Downey RJ, et al. Gait speed and survival of older surgical patient with cancer: Prediction after machine learning. J Geriatr Oncol. 2019;10(1):120-5.
40. Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. Med Care. 2012;50(3):217-26.
41. Chadborn NH, Goodman C, Zubair M, Sousa L, Gladman JRF, Dening T, et al. Role of comprehensive geriatric assessment in healthcare of older people in UK care homes: realist review. BMJ Open. 2019;9(4):e026921.
42. Huisman MG, Kok M, de Bock GH, van Leeuwen BL. Delivering tailored surgery to older cancer patients: Preoperative geriatric assessment domains and screening tools - A systematic review of systematic reviews. Eur J Surg Oncol. 2017;43(1):1-14.
43. Bagayogo FF, Lepage A, Denis JL, Lamothe L, Lapointe L, Vedel I. Factors influencing cancer specialists' decision to collaborate with geriatricians in treating older cancer patients. Age and Ageing. 2016;45(5):721-4.
44. Bagayogo FF, Lepage A, Jean-Louis D, Lamothe L, Lapointe L, Vedel I. Grassroots inter-professional networks: the case of organizing care for older cancer patients. Journal of Health Organization and Management. 2016;30(6):971-84.
45. Baitar A, Kenis C, Moor R, Decoster L, Luce S, Bron D, et al. Implementation of geriatric assessment-based recommendations in older patients with cancer: A multicentre prospective study. Journal of Geriatric Oncology. 2015;6(5):401-10.
46. Decoster L, Vanacker L, Kenis C, Prenen H, Van Cutsem E, Van Der Auwera J, et al. Relevance of Geriatric Assessment in Older Patients With Colorectal Cancer. Clinical Colorectal Cancer. 2017;16(3):e221-e9.
47. Driessen EJM, van Loon JGM, Maas HA, Dingemans AMC, Janssen-Heijnen MLG. Geriatric Assessment for Older Patients with Non-small Cell Lung Cancer: Daily Practice of Centers Participating in the NVALT25-ELDAPT Trial. Lung. 2018;196(4):463-8.
48. Festen S, Kok M, Hopstaken JS, van der Wal-Huisman H, van der Leest A, Reyners AKL, et al. How to incorporate geriatric assessment in clinical decision-making for older patients with cancer. An implementation study. Journal of Geriatric Oncology. 2019.
49. Gulasingam P, Haq R, Mascarenhas Johnson A, Togo E, Moore J, Straus SE, et al. Using Implementation Science to Promote the Use of the G8 Screening Tool in Geriatric Oncology. Journal of the American Geriatrics Society. 2019;67(5):898-904.

50. Hamaker ME, Jonker JM, Maas HA, Schiphorst AH, Portielje JEA, Smorenburg CH. The geriatricians' perspectives on geriatric oncology in the Netherlands - results of a national survey. European Geriatric Medicine. 2014;5(4):265-9.
51. Harari D, Hopper A, Dhesi J, Babic-Illman G, Lockwood L, Martin F. Proactive care of older people undergoing surgery ('POPS'): Designing, embedding, evaluating and funding a comprehensive geriatric assessment service for older elective surgical patients. Age and Ageing. 2007;36(2):190-6.
52. Horgan AM, Leighl NB, Coate L, Liu G, Palepu P, Knox JJ, et al. Impact and feasibility of a comprehensive geriatric assessment in the oncology setting: A pilot study. American Journal of Clinical Oncology: Cancer Clinical Trials. 2012;35(4):322-8.
53. Kenis C, Bron D, Libert Y, Decoster L, Van puyvelde K, Scalliet P, et al. Relevance of a systematic geriatric screening and assessment in older patients with cancer: Results of a prospective multicentric study. Annals of Oncology. 2013;24(5):1306-12.
54. Kenis C, Heeren P, Decoster L, van Puyvelde K, Conings G, Cornelis F, et al. A Belgian survey on geriatric assessment in oncology focusing on large-scale implementation and related barriers and facilitators. Journal of Nutrition, Health and Aging. 2015.
55. Magnuson A, Lemelman T, Pandya C, Goodman M, Noel M, Tejani M, et al. Geriatric assessment with management intervention in older adults with cancer: a randomized pilot study. Supportive Care in Cancer. 2018;26(2):605-13.
56. Schulkes KJG, Hamaker ME, Lammers JWJ, Van Elden LJR. Geriatric evaluation in lung cancer care: A survey of daily practice. European Journal of Oncology. 2017;22(3-4):150-6.
57. Shahrokni A, Tin A, Downey RJ, Strong V, Mahmoudzadeh S, Boparai MK, et al. Electronic Rapid Fitness Assessment: A Novel Tool for Preoperative Evaluation of the Geriatric Oncology Patient. Journal of the National Comprehensive Cancer Network : JNCCN. 2017;15(2):172-9.
58. To THM, Soo WK, Lane H, Khattak A, Steer C, Devitt B, et al. Utilisation of geriatric assessment in oncology - a survey of Australian medical oncologists. Journal of Geriatric Oncology. 2019;10(2):216-21.
59. Zereshkian A, Cao X, Puts M, Dawdy K, Di Prospero L, Alibhai S, et al. Do Canadian Radiation Oncologists Consider Geriatric Assessment in the Decision-Making Process for Treatment of Patients 80 years and Older with Non-Metastatic Prostate Cancer? – National Survey. Journal of Geriatric Oncology. 2019;10(4):659-65.
60. Wildiers H, Heeren P, Puts M, Topinkova E, Janssen-Heijnen MLG, Extermann M, et al. International society of geriatric oncology consensus on geriatric assessment in older patients with cancer. Journal of Clinical Oncology. 2014;32(24):2595-603.
61. Girones R, Morilla I, Guillen-Ponce C, Torregrosa MD, Paredero I, Bustamante E, et al. Geriatric oncology in Spain: survey results and analysis of the current situation. Clinical & translational oncology : official publication of the Federation of Spanish Oncology Societies and of the National Cancer Institute of Mexico. 2018;20(8):1087-92.
62. Droz JP, Boyle H, Albrand G, Mottet N, Puts M. Role of Geriatric Oncologists in Optimizing Care of Urological Oncology Patients. European Urology Focus. 2017;3(4-5):385-94.

63. Hurria A, Cirrincione CT, Muss HB, Kornblith AB, Barry W, Artz AS, et al. Implementing a geriatric assessment in cooperative group clinical cancer trials: CALGB 360401. Journal of Clinical Oncology. 2011;29(10):1290-6.
64. Kenis C, Heeren P, Bron D, Decoster L, Moor R, Pepersack T, et al. Multicenter implementation of geriatric assessment in Belgian patients with cancer: a survey on treating physicians' general experiences and expectations. Journal of geriatric oncology. 2014;5(4):431-8.
65. Sifer-Riviere L, Girre V, Gisselbrecht M, Saint-Jean O. Physicians' perceptions of cancer care for elderly patients: a qualitative sociological study based on a pilot geriatric oncology program. Critical reviews in oncology/hematology. 2010;75(1):58-69.
66. Sifer-Riviere L, Saint-Jean O, Gisselbrecht M, Cudennec T, Girre V, Programme d'OncoGeriatrie de l'Ouest P. What the specific tools of geriatrics and oncology can tell us about the role and status of geriatricians in a pilot geriatric oncology program. Annals of oncology : official journal of the European Society for Medical Oncology. 2011;22(10):2325-9.
67. Zullig LL, Kimmick G, Smith V, Little K, Bosworth HB, Gonzales S, et al. Using a geriatric oncology assessment to link with services (GOAL). Journal of Geriatric Oncology. 2019;10(1):164-8.
68. Puts MTE, Girre V, Monette J, Wolfson C, Monette M, Batist G, et al. Clinical experience of cancer specialists and geriatricians involved in cancer care of older patients: A qualitative study. Critical reviews in oncology/hematology. 2010;74(2):87-96.
69. O'Donovan A, Mohile SG, Leech M. Expert consensus panel guidelines on geriatric assessment in oncology. European journal of cancer care. 2015;24(4):574-89.
70. Clough-Gorr KM, Noti L, Brauchli P, Cathomas R, Fried MR, Roberts G, et al. The SAKK cancer-specific geriatric assessment (C-SGA): a pilot study of a brief tool for clinical decision-making in older cancer patients. BMC medical informatics and decision making. 2013;13:93.
71. Handforth C, Burkinshaw R, Freeman J, Brown JE, Snowden JA, Coleman RE, et al. Comprehensive geriatric assessment and decision-making in older men with incurable but manageable (chronic) cancer. Supportive Care in Cancer. 2019;27(5):1755-63.
72. Hurria A, Akiba C, Kim J, Mitani D, Loscalzo M, Katheria V, et al. Reliability, validity, and feasibility of a computer-based geriatric assessment for older adults with cancer. Journal of Oncology Practice. 2016;12(12):e1025-e34.
73. Hurria A, Gupta S, Zauderer M, Zuckerman EL, Cohen HJ, Muss H, et al. Developing a cancer-specific geriatric assessment - A feasibility study. Cancer. 2005;104(9):1998-2005.
74. Hurria A, Lichtman SM, Gardes J, Li D, Limaye S, Patil S, et al. Identifying vulnerable older adults with cancer: integrating geriatric assessment into oncology practice. Journal of the American Geriatrics Society. 2007;55(10):1604-8.
75. Ingram SS, Seo PH, Martell RE, Clipp EC, Doyle ME, Montana GS, et al. Comprehensive assessment of the elderly cancer patient: the feasibility of self-report methodology. Journal of Clinical Oncology. 2002;20(3):770-5.
76. McCleary NJ, Wigler D, Berry D, Sato K, Abrams T, Chan J, et al. Feasibility of computer-based self-administered Cancer-Specific Geriatric Assessment in older patients with gastrointestinal malignancy. Oncologist. 2013;18(1):64-72.

77. Whittle AK, Kalsi T, Babic-Illman G, Wang Y, Fields P, Ross PJ, et al. A comprehensive geriatric assessment screening questionnaire (CGA-GOLD) for older people undergoing treatment for cancer. European journal of cancer care. 2017;26(5).
78. Williams GR, Deal AM, Jolly TA, Alston SM, Gordon B-BE, Dixon SA, et al. Feasibility of geriatric assessment in community oncology clinics. Journal of geriatric oncology. 2014;5(3):245-51.
79. Williams GR, Kenzik KM, Parman M, Al-Obaidi M, Francisco L, Rocque GB, et al. Integrating geriatric assessment into routine gastrointestinal (GI) consultation: The Cancer and Aging Resilience Evaluation (CARE). Journal of Geriatric Oncology. 2019.
80. To THM, Okera M, Prouse J, Prowse RJ, Singhal N. Infancy of an Australian geriatric oncology program—characteristics of the first 200 patients. Journal of Geriatric Oncology. 2010;1(2):81-6.
81. Korc-Grodzicki B, Tew W, Hurria A, Yulico H, Lichtman S, Hamlin P, et al. Development of a Geriatric Service in a Cancer Center: Lessons Learned. J Oncol Pract. 2017;13(2):107-12.
82. Lin RJ, Dahi PB, Shahrokni A, Sarraf S, Korc-Grodzicki B, Devlin SM, et al. Feasibility of a patient-reported, electronic geriatric assessment tool in hematopoietic cell transplantation - a single institution pilot study. Leuk Lymphoma. 2019;60(13):3308-11.
83. Rittberg R, Sutherland J, Huynh E, Green S, Wiens A, Stirling M, et al. Assessing the learning needs of the multidisciplinary team on geriatric oncology and frailty. J Geriatr Oncol. 2019;10(5):829-31.
84. Monfardini S, Aapro MS, Bennett JM, Mori M, Regenstreif D, Rodin M, et al. Organization of the clinical activity of geriatric oncology: Report of a SIOG (International Society of Geriatric Oncology) task force. Critical Reviews in Oncology Hematology. 2007;62(1):62-73.
85. Mohile SG, Velarde C, Hurria A, Magnuson A, Lowenstein L, Pandya C, et al. Geriatric Assessment-Guided Care Processes for Older Adults: A Delphi Consensus of Geriatric Oncology Experts. Journal of the National Comprehensive Cancer Network : JNCCN. 2015;13(9):1120-30.
86. O'Hea EL, Cutillo A, Dietzen L, Harralson T, Grissom G, Person S, et al. Randomized controlled trial to test a computerized psychosocial cancer assessment and referral program: methods and research design. Contemporary clinical trials. 2013;35(1):15-24.
87. Loh KP, Ramsdale E, Culakova E, Mendler JH, Liesveld JL, O'Dwyer KM, et al. Novel mHealth App to Deliver Geriatric Assessment-Driven Interventions for Older Adults With Cancer: Pilot Feasibility and Usability Study. Jmir Cancer. 2018;4(2).
88. Extermann M, Aapro M, Audisio R, Balducci L, Droz JP, Steer C, et al. Main priorities for the development of geriatric oncology: A worldwide expert perspective. Journal of Geriatric Oncology. 2011;2(4):270-3.
89. Dougoud-Chauvin V, Lee JJ, Santos E, Williams VL, Battisti NML, Ghia K, et al. Using Big Data in oncology to prospectively impact clinical patient care: A proof of concept study. Journal of Geriatric Oncology. 2018;9(6):665-72.
90. Kenis C, Decoster L, Flamaing J, Debruyne PR, De Groof I, Focan C, et al. Adherence to geriatric assessment-based recommendations in older patients with cancer: a multicenter prospective cohort study in Belgium. Annals of Oncology. 2018;29(9):1987-94.
91. Molina-Garrido MJ, Guillen-Ponce C. Development of a cancer-specific Comprehensive Geriatric Assessment in a University Hospital in Spain. Critical Reviews in Oncology/Hematology. 2011;77(2):148-61.

92. Blanco R, Capo M, Libran AM, Alfaro J, Dotor E, Fernandez L, et al. Multidisciplinary treatment planning in elderly patients with cancer: A prospective observational study. Journal of Community and Supportive Oncology. 2016;14(10):466-72.
93. Banerjee J, Satapathy J, Upadhyay AD, Dwivedi SN, Chatterjee P, Kumar L, et al. A short geriatric assessment tool for the older person with cancer in India-Development and psychometric validation. Journal of Geriatric Oncology. 2019;10(2):222-8.
94. Ghignone F, van Leeuwen BL, Montroni I, Huisman MG, Somasundar P, Cheung KL, et al. The assessment and management of older cancer patients: A SIOG surgical task force survey on surgeons' attitudes. European journal of surgical oncology : the journal of the European Society of Surgical Oncology and the British Association of Surgical Oncology. 2016;42(2):297-302.
95. Jonker JM, Smorenburg CH, Schiphorst AH, van Rixtel B, Portielje JEA, Hamaker ME. Geriatric oncology in the Netherlands: a survey of medical oncology specialists and oncology nursing specialists. European journal of cancer care. 2014;23(6):803-10.