A Telehealth-based Behavioral Intervention to Mitigate Cancer Related Cognitive Decline in Older Adults: Development and Usability Testing

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Abstract

Background: Cancer-related cognitive decline (CRCD) is a significant problem; interventions are needed to mitigate CRCD for older adults.

Objective: Our objective was to develop Memory and Attention Adaptation Training-Geriatrics (MAAT-G), a CRCD intervention for older adults, and evaluate MAAT-G usability.

Methods: MAAT-G, is a cognitive behavioral therapy-based intervention delivered by a health professional over the course of ten weekly individual workshops via videoconferencing. To develop MAAT-G, the Contextual, Cohort-based, Maturity, Specific Challenge (CCMSC) framework was used for preliminary adaptations. Patient advocate collaborators guided further refinement, reviewing MAAT-G workshop content, participant workbook, and intervention delivery via videoconferencing to optimize relevance and usability for older adults. The usability of MAAT-G and its video-conferencing delivery was subsequently evaluated in 4 older adults with breast cancer using the System Usability Scale (SUS; score range 0-100, >67 above average) and through semi-structured qualitative interviews.

Results: Numerous adaptations were made to address the unique needs of older patients using CCMSC framework and patient advocate feedback. Usability testing included four female patients with breast cancer; mean age 73.3 years (range 67-77). Patients were receiving systemic therapy (two adjuvant, two advanced stage disease). One patient had less than a high school education; three had some college education or more. Two patients identified as low-comfort with technology; one patient required a mobile Wi-Fi hotspot due to limited internet access. All four patients completed study procedures, including 10 MAAT-G workshop sessions (100% intervention adherence). Mean SUS score was 85.6, indicating good usability.

Conclusions: MAAT-G is a behavioral intervention developed to mitigate CRCD. It is designed specifically for older adults and showed above average usability in this population.

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ABSTRACT:

Purpose: Cancer-related cognitive decline (CRCD) is a significant problem; interventions are needed to mitigate CRCD for older adults. Our objective was to develop Memory and Attention Adaptation Training-Geriatrics (MAAT-G), a CRCD intervention for older adults, and evaluate MAAT-G usability.

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Conclusion: MAAT-G is a behavioral intervention developed to mitigate CRCD. It is designed specifically for older adults and showed above average usability in this population.

Keywords: Geriatric Oncology, Older Adults, Tele-Health/Videoconferencing, Cognition, Cancer-related cognitive decline

INTRODUCTION

Cancer-related cognitive dysfunction (CRCD) is a significant problem, particularly for older adults with cancer [1-5]. Up to 75% of patients receiving active cancer treatment experience CRCD, which may manifest as difficulties in attention, processing speed, executive function, and memory [6-8]. Further, half of women aged >65 receiving adjuvant chemotherapy for breast cancer report worsening of cognition, and 25% have measurable declines on neuropsychological testing six months post-chemotherapy [9, 10]. CRCD can also compromise functional independence of older adults, such as ability to remain independent with managing medications or finances (e.g. Activities of Daily Living [ADL]) [11]. While alleviating or preventing CRCD is important to older adult patients and their caregivers, interventions tailored to them do not exist [12].

Memory and Attention Adaptation Training (MAAT) is a cognitive-behavioral therapy (CBT) intervention for CRCD that focuses on an individual's psychological response to injury as compared to the biological events triggering CRCD [13]. MAAT has eight manualized workshops, supplemented by a participant workbook, and is individually delivered by a psychologist via videoconferencing. Together, the workshops and workbook provide instruction and practice with adaptive behavioral coping skills, stress management techniques, and compensation strategies for managing CRCD symptoms [14]. MAAT was pilot-tested in three separate studies of breast cancer survivors and was associated with greater scores on perceived cognition functioning, verbal memory, and processing speed [13-15].

Even though MAAT has shown promising results, and factors such as the online delivery mode and individualized treatment approach hold promise for its application with older cancer survivors, the intervention has been limited to middle-aged adults with a breast cancer diagnosis of curative intent after completion of primary treatment. Considering that older adults are more likely to be diagnosed at later cancer stages [16] and are more vulnerable to CRCD, adapting MAAT to address

their cognitive needs and intervene earlier (e.g., concurrent with cancer therapy) has the potential to improve outcomes in this vulnerable population.

The goals of this study were (1) to adapt MAAT to the unique needs of older adults (e.g. develop MAAT-Geriatrics [MAAT-G]) and (2) to evaluate the feasibility and usability of MAAT-G in a sample of older adults with breast cancer receiving systemic therapy.

METHODS

MAAT-G was developed in two phases: a) Preliminary adaptations based on the Contextual, Cohort-based, Maturity, Specific Challenge (CCMSC) framework [17], and b) Iterative refinement with collaboration of patient research advocates. Then, we conducted an evaluation of the usability of MAAT-G and its telehealth delivery model in a single-arm study of older adults receiving systemic therapy for breast cancer.

MAAT-G adaptation

a. Preliminary adaptation. The Contextual, Cohort-based, Maturity, Specific Challenge (CCMSC) model [17] is informed by research on aging and older adult social contexts and has been previously used to adapt CBT-based interventions [18, 19]. To optimize the relevance and usability of MAAT for older adults, study authors (AM, RF, LD, DM) made initial adaptations based upon CCMSC model principles, as follows:

Contextual: Identification of the unique social and environmental factors that influence the targeted population.

Cohort-based: Analysis of specific factors of the population of interest, like their cognitive abilities, education, word usage, values, normative life paths, and social-historical life experiences.

Maturity: Consideration of factors associated with aging, such as cognitive complexity, emotional complexity, expertise, areas of competence, family experiences, and accumulated interpersonal skills.

Specific Challenge: Examining conditions or situations that may create barriers for engagement, such as chronic illnesses, disabilities, grieving for loved ones, caregiving.

b. Additional refinement. Following the initial adaptations, study authors (AM, GD) presented the protocol to a local older patient and caregiver advisory board (SCOREboard) with experience in the design of clinical trials for older adults with cancer [20-23]. Authors collected high level feedback from the full patient advisory board and made initial modifications as necessary. Next, study authors met with two SCOREboard members (LM, VT) to conduct in depth review of MAAT-G and its delivery method. Four meetings were conducted, each focusing on a separate aspect of MAAT-G, workshop content (across two meetings), participant workbook content and presentation/formatting, and aspects of intervention (e.g., technology interface and development of instructions and support materials). The meetings lasted between 1 and 2 hours, and SCOREboard members reviewed materials prior to and in-between meetings. Modifications were made in real-time in an iterative fashion.

Assessment of usability and delivery mode

***Eligibility*.** Following the adaptations, we tested the feasibility and usability of MAAT-G in an open single-arm study. To be included in the feasibility and usability phase, people had to be 1) ≥ 65 years of age, 2) diagnosed with breast cancer (any stage), 3) receiving systemic therapy with at least two cycles remaining, 4) able to speak and read English, 5) and have decision-making capacity. The feasibility/usability phase of the study was approved by the University of Rochester Institutional Review (NCT 04230941).

Recruitment. Patients were recruited from the Comprehensive Breast Cancer Center at the

Wilmot Cancer Institute (WCI) in Rochester, NY. The study team obtained approval to screen clinic schedules using electronic medical records for prospective patients. Following the identification of a prospective patient, the study team contacted the patient's primary oncologist to inquire about the patient decision-making capacity for informed consent, and to obtain approval for approaching the patient about study participation. The study staff next approached patients and caregivers (if available) at the clinic to present the study, answer study questions, and obtain informed consent.

Instrumentation

Usability. We assessed the usability of MAAT-G quantitatively using the System Usability Scale [24, 25]. Possible scores ranged from 0 to 100, with a score greater than 67 indicating average or good usability [26, 27]. This threshold was used as the benchmark for determining usability in the current study. We also examined the usability qualitatively through semi-structured interviews. The semi-structured interviews consisted of four questions for patients and caregivers focused on their experience over the course of the study regarding the workshop content, the use of the tablet, the participant workbook, and the potential impact of MAAT-G.

Procedures

Baseline. Following informed consent, we provided patients with a bound copy of the patient workbook, a tablet with a HIPAA-compliant video-conferencing application, and a set of instructions on the use of the tablet. The intervention period took place over the course of 10 to 12 weeks and consisted of 10 MAAT-G workshops delivered one-on-one by study staff approximately once per week over videoconferencing.

Follow-Up. After the intervention, patients completed ratings on the usability of the study devices/intervention content using the System Usability Scale (SUS) and participated in a semi-structured interview exploring the usability of MAAT-G, their self-perceived cognition, and their

study experience in general.

Data Analysis

To assess the usability of MAAT-G, we summated responses on the System Usability Scale for each participant and then computed a mean value across patients [24, 25]. Qualitative interviews were audio-recorded, transcribed and imported into MAXQDA software for sorting, coding and analysis. Content analysis was used to code transcripts and extract qualitative themes. Finally, all quantitative analyses were computed using SPSS v. 28.

RESULTS

MAAT-G adaptation

As shown in Table 1, the adaptation characterized by a reduction in the quantity of material covered in each session. This helped decompress the quantity of information provided in each sitting, concordant with CCMSC principles. However, this adaptation subsequently necessitated an extension in the number of workshops from eight to ten. Table 2 displays the content of the adapted intervention, MAAT-G.

Table 1:
Examples of MAAT-G Adaptations

CCMSC component	Specific considerations	Examples of Adaptations implemented through CCMSC model and stakeholder feedback

Contextual Factors	Patient's living situation (e.g. retirement communities, aging services and long-term care facilities) and the influence those factors have on the given population. Patient's social support network. *Unique social contexts were the priority to consider within this domain	**1)** Added section to MAAT-G interventionist manual on social context factors and how they may influence compensatory strategies for older adults **2)** Added screening question to MAAT-G interventionist manual to assess social support to encourage leveraging social support resources for compensatory strategies
Cohort-based	Appreciating that older adults may identify with an aging cohort that may influence their beliefs and attitudes. Language was simplified based on education and experience levels, particularly with the technological aspects. Researchers considered cognitive abilities, education, and other population-specific experiences to alter MAAT-G.	**1)** Developed technology support materials to enhance inclusiveness of those with limited fluency with technology **2)** Added section to interventionist manual on cohort-based factors and their potential influence on coping mechanisms and stress responses **3)** Modified patient workbook by minimizing complex terminology to accommodate potentially lower education levels **4)** Modified examples to increase relevance to older adults (e.g., workplace settings changed to social settings, given the increased likelihood of being retired)
Maturity	Appreciate cognitive strengths of older adults and also the potential for pre-existing conditions (e.g. comorbidities). Family experiences and life experiences may influence perspectives and are unique to each person.	**1)** Added section to interventionist manual on maturity factors and their effect on pace of information receipt, coping mechanisms and stress response **2)** Extended workshop number from 8 to 10 to decrease the amount of material in each workshop **3)** Reduced complexity of examples in patient manual
Specific Challenges	Comorbidities were considered, such as age-related disabilities or common illnesses (e.g. hearing loss, visual impairment).	**1)** Added step to interventionist manual to screen for hearing loss, allowing interventionist to proactively adapt volume and rate of speech while delivering intervention **2)** Highlighted information about volume control in patient technology support manual **3)** Adjusted font type and size in patient workbook to accommodate potential visual impairment

Table legend: CCMSC: Contextual, Cohort-based, Maturity, Specific Challenge. We followed the

CCMSC model as determined by Knight [17] and with involvement of patient advocate collaborators.

Table 2:
Content overview of the adapted intervention, Memory Attention and Adaptation Training- Geriatrics

Session	Title	Overview
1	Introduction	• Presentation of MAAT-G. • Education on the impact of cancer and its therapy on memory and attention. • Importance and strategies to self-monitor memory and attention.
2	Relaxation skills	• Review of session 1 materials and skills. • Education on the impact of stress in the body. • Strategies to manage stress. o Progressive muscle relaxation. o brief relaxation.
3	Self-instructional teaching	• Review of session 2 materials and skills. • Memory and attention adaptation skills. o Self-instructional training. o Verbal and “silent” rehearsal skills. o Rhyming skills.
4	Cognitive flexibility	• Review of session 3 materials and skills. • Education on cognitive flexibility. • Skills to increase cognitive flexibility. o Probability reestimation. o Decatastrophizing.
5	Keeping a schedule and memory routines	• Review of session 4 materials and skills. • External skills to assist with memory and attention problems. o Scheduling. o Memory routines.
6	External cuing and distraction reduction	• Review of session 5 materials and skills. • Education on external cues to assist with memory and attention. • Strategies to help with distraction reduction.
7	Activity scheduling and pacing	• Review of session 6 materials and skills. • Education on the importance of scheduling and pacing. • Strategies to assist with scheduling and pacing. o Active listening. o Summarization. o Clarification.
8	Fatigue management and sleep quality	• Review of session 7 materials and skills. • Education on fatigue and sleep improvement. • Skills for managing fatigue. o Activity pacing.

		○ Relaxation skills. ○ Exercise and diet. • Skills for sleep quality improvement. ○ Sleep hygiene. ○ Exercise and diet.
9	Visualization skills	• Review of session 8 materials and skills. • Education on visualization skills. • Visualization skills.
10	Tying it all together	• Review of materials and skills covered in the workshop. • Tying all MAAT-G skills learned. • Development of strategies to maintain the use of skills learned.

The workshop materials were also revised to accommodate to age-related declines in vision (e.g., using a larger text size and a font without embellishments or serifs). Furthermore, patient advocates (SCOREboard members) played a key role in the development of robust technology support materials to which patients could refer if questions arose during the study. Materials described basic operations like how to log into the tablet, how to charge, and how to log into the Zoom application—including photographs of steps in addition to text instructions. Different versions were developed to accommodate the participants' technological needs (e.g., patients who received a data-enabled vs. Wi-Fi-only tablet).

Assessment of usability and delivery mode

A total of four patients were approached to participate in the feasibility and usability assessment of MAAT-G. All consented to participate, suggesting preliminary feasibility to recruit older adults with breast cancer receiving systemic therapy. All participants also completed the study procedures, including 10 MAAT-G workshop sessions, without delay (100% intervention adherence).

Sample. All participants were women with breast cancer. The mean age was 73.3 years (range: 67 to 77 years) and all identified as white. Two of the patients were married and currently lived with their spouse, while two were widowed and lived alone. Annual household income ranged from less than $20,000 to over $100,000. All patients were enrolled in Medicare. Two patients were presently employed (one part-time, one full-time). All but one participant (who had less than a High School education) had at least some college education. All patients were also receiving active systemic therapy at the time of study participation (two adjuvant chemotherapy-based regimens, and two advanced stage disease regimens with Cyclin Dependent Kinase [CDK] 4/6 inhibitor therapy).

Usability. Quantitatively, we found that the mean total score on the SUS was 85.6 (range; 67.5 – 95), suggesting above average usability [24, 25] and exceeding our *a priori* usability threshold

(> 67). Four themes emerged from the content analyses of the semi-structured qualitative interviews: technology support, comfort with technology, experience with the intervention and utility of its content, and suggested areas of further modification (Table 3).

Table 3:
Qualitative themes and exemplary quotes from interviews on usability

Qualitative Theme	Exemplar Quotes From Participants
Technology Support	• *It worked out really well. The only time I didn't know where to push the volume; I didn't know where that was. I found it to be a great tool. I found the information you gave me on how to set it up, how to get started with Zoom, it was simple to operate it by reading the pamphlet you gave me. I found that – it made the class easy without guessing.* • *I thought having your phone number, the one time we couldn't get in to him for some reason – I'm not sure why – but we had your phone number and we were able to make contact right away. That was really good.*
Comfort with technology	• *The iPad was very easy to use, much easier than the computer.* • *I think she's getting more comfortable with it and better at it for sure. We've used it so much, it's becoming natural.* (Caregiver interview)
MAAT-G Experience	• *Yes, it was useful. I was pretty diligent; I did my homework every week. As a matter of fact, I read a little ahead of time because I liked to be a little familiar. We took notes.* • *I felt very little anxiety looking for something. Usually my anxiety kicks in. I just relaxed myself for a little bit and then I remembered where I put my glasses after a few minutes of doing that.* • *Basically, the whole experience was great, and I was so glad [caregiver] and I could share the experience because we both really enjoyed it.* • *I think it was the right number of sessions.*
Areas for further MAAT-G modification	• *The only thing I did not like about it is the paper, you can't get it – to write on it with pencil, it doesn't show.* • *…putting page numbers on the book.*

Overall, the patients found the technological support manual and staff guidance to be useful for learning how to operate the tablet. Furthermore, it was helpful to reach the study staff by phone for technological support to join the videoconference session or operating the tablet. Over the

course of the study, patients reported increased comfort with the tablet. The participants also described that the material covered during the workshops was useful. One suggestion for the materials included printing on non-glossy paper so that participants could take notes in margins. Also, adding page numbers to the workbook to easily locate different sections.

DISCUSSION

We adapted a CBT intervention to address CRCD symptoms among older adults with cancer undergoing systemic therapy. MAAT-G engages participants in a 1:1 telehealth setting to explore and learn coping skills, stress management techniques, and methods to target the episodes of cognitive failure while undergoing cancer treatment. In developing MAAT-G, we strove to promote universal usability and acceptance using telehealth and early and meaningful involvement of patient advocates throughout the intervention adaptation process.

Although several studies have evaluated behavioral interventions to address CRCD symptoms, their scope is limited [28]. Similar to MAAT-G's parent intervention (MAAT) [13-15], most focused on younger cancer survivors and individuals who have completed treatment months to years prior. For instance, Cherrier et al. [29] studied the effect of a seven-week workshop among middle-aged (mean age: 58.9 years) people with breast, bladder, prostate, colon and uterine cancer, with an average of 4.84 years since receiving treatment. Similarly, ReCog, a group cognitive rehabilitation intervention, improved perceived cognitive functioning in cancer survivors with an average of 3 years since treatment completion [30]. Our findings expand the current literature by providing preliminary evidence on the feasibility of a CRCD intervention for older adults undergoing treatment.

MAAT-G was designed as a telehealth delivery model given that older patients receiving active cancer treatment often have frequent in-person appointments. Thus, having additional in-person study visits may create accessibility barriers for those no longer driving independently. This

design was based upon other studies demonstrating that telehealth provides participants with the flexibility and comfort of completing all study-related tasks from their home [14]. Additionally, a one-on-one intervention delivery model, such as MAAT-G, was preferred due to its flexible scheduling, which allows sessions to be coordinated around existing clinic and therapy appointments.

Previous studies have demonstrated that the inclusion of patient advocates as research collaborators has tremendous benefit in clinical trials [31, 32]. For the current study, we collaborated with the CARing SCOREboard, a patient-advocate advisory board supported by the Cancer and Aging Research Group. CARing SCOREboard members provided critical insight about study design, aspects related to intervention adaptation, and guidance on technology support. The inclusion of the patient perspective throughout the study design and intervention adaptation led to more patient-focused study procedures and design, which contributed to the favorable usability of the resulting intervention, and ultimately protected and prioritized the study participants' needs.

The foundation of the MAAT-G intervention was developed using the CCMSC model [17], which has been previously used in other CBT adaptation studies for older adult populations. For example, Trevino et al. [33] used CCMSC to develop the Managing Anxiety from Cancer (MAC) intervention, which addresses anxiety symptoms among older adults with cancer. Both MAC and MAAT-G adaptations had an emphasis on the cohort component of the CCMSC model, which highlights ideas such as membership and beliefs and attitudes towards the problems. As such, MAC minimized the psychological language and developed examples with situations older cancer participants may experience. Similarly, MAAT-G revised the language of the intervention materials and created examples based on real-life experiences of older adults receiving cancer therapy. Despite this, the two interventions differed in some CCMSC components, particularly the specific challenges and maturity components. For example, MAAT-G accounted for the technological challenges of telehealth intervention delivery by adjusting the font size of the materials, developing an iPad manual, and screening for hearing loss, among others. Regarding the maturity components, MAC

decreased the total number of sessions to minimize the participants' time commitment. In contrast, MAAT-G increased the number of sessions to decompress the quantity of information delivered during each session.

This study had multiple strengths, such as the comprehensive, evidence-based adaptation approach, the intensive patient advocate involvement, and the patient usability and engagement rates. Allowing patients to provide direct input on their experience helped the research team to prioritize intervention components, delivery factors, and overall tailor the intervention to address the needs of the targeted population.

A limitation of this study is the small sample size of the phase 2 of the study. However, our sample size is congruent with other usability studies in the field [34]. Although the use of technology could be considered a limitation, older adults felt more comfortable with the technological components of the intervention over time. Thus, our findings highlight activities that can promote technological engagement among older adults, which have the potential to improve the representation of this population group in future technology-based clinical trials.

In summary, we have developed MAAT-G, a CBT-based intervention to mitigate and address CRCD symptoms of older adults receiving active cancer treatment. A comprehensive, evidence-based, and patient-informed approach was followed, which improved feasibility, usability, and engagement. MAAT-G is currently being evaluated in a pilot randomized clinical trial to further test the feasibility and preliminary efficacy on addressing CRCD in older adults.

Statements & Declarations

Previous presentation: This data was previously presented as an abstract at the International Society of Geriatric Oncology Annual Meeting in 2021.

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Conflict of interest: No authors have any conflicts of interest to disclose.

Data availability: Data will be available from the corresponding author upon reasonable request.

Authors' Contribution: All authors contributed to the study conception and design.

Ethics Approval: The study was approved by the University of Rochester Institutional Review (NCT 04230941).

Consent to Participate: Informed consent was obtained from all individual participants who performed any study procedures.

Consent to Publish: The authors confirmed that human research participants were made aware and provided informed consent for publication of the study findings and exemplar quotes found in Table 2.

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