

Evaluation of ReminX as a Behavioral Intervention for Mild to Moderate Dementia

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Abstract— Dementia is a growing global challenge that is difficult to treat. Pharmaceutical treatment approaches have had limited success, leading to an increased focus on non-pharmaceutical approaches to the treatment of dementia. A clinical pilot study was performed to evaluate whether ReminX digital therapeutic software, based on reminiscence therapy, has the potential to improve emotional functioning in patients with Alzheimer’s disease and related dementias. ReminX allows the uploading of pictures and narration to create slideshow stories depicting important moments in the patient’s life. Fourteen patients were evaluated in their home, and their emotional health was assessed both before and after using ReminX. Results indicated that patients reported significantly less anxiety, depression, and overall emotional distress after having viewed their story. Furthermore, patient’s caregivers also reported that the patient appeared less emotionally distressed. The effect sizes for the significant results ranged from 0.76 to 0.91. These effect sizes, which were larger than anticipated, suggest that digitally-delivered reminiscence therapy can have an immediate and positive impact on emotional functioning in patients with dementia. In addition, the accessibility, scalability, and ease of use of the software platform suggests that this technology holds great promise as a product for use in both the home and senior care settings.

I. INTRODUCTION

Estimates indicate that there are 5.5 million Americans suffering from Alzheimer’s disease (AD). There are 1.4 million people in nursing homes and another 700,000 in residential care communities, with about 50% of these individuals suffering from some form of dementia. The costs to the United States in caring for patients with AD or other dementias will be approximately \$259 billion in 2017 [1]. The number of individuals with AD is expected to triple by the year 2050, and the cost of patient care will also likely triple to \$708 billion annually. Dementia is a growing problem for the military, and veterans with traumatic brain injury (TBI) in particular have been shown to have an increased risk of developing dementia [2].

The cognitive deficits and behavioral symptoms (e.g., depression, anxiety, and apathy) are difficult to treat in AD and other forms of dementia. The first-line of treatment for AD are pharmaceuticals, but these have met with only limited success, with many high profile AD drugs having disappointing results [3]. For this reason, there has been a renewed focus on non-pharmaceutical approaches, including digital therapeutics, that can target mood and physiological

distress, rather than on pharmaceutical approaches that slow the progression of cognitive deficits.

Reminiscence therapy (RT) is a behavioral intervention that involves the introduction of familiar pictures, music, or other materials to help individuals reminisce about their past experiences. RT has been shown to have a positive impact on mood and cognition in individuals with AD or other dementias, older adults with depression, and older adults with anxiety [4-7]. A recent meta-analysis of 12 randomized controlled studies determined that RT significantly reduced depression and improved cognitive function in dementia patients, and concluded that RT should be considered as routine care for those with dementia [8].

Major limitations of this therapy, however, are that it is typically provided in a formal therapy session, is only provided once a week, and is only provided within a limited time-frame, which greatly limits the consistent use of RT. Furthermore, this therapy often requires an individual to work one-on-one with a patient, which can be very time consuming for the caregiver and is often not practical in most settings.

II. APPROACH



Figure 1. ReminX platform, shown on caregiver’s mobile device and on patient’s tablet. There is no interface for the patient to learn - simply picking up the tablet starts the stories and putting it down stops them. The tablet uses inductive charging, and while on its dock, acts as a photo frame showing all the photos in the system.

Dthera Sciences has developed the ReminX online-based story-sharing platform. This unique approach to RT allows users to record audio over photos as a way to share memories with family members who are suffering from a neurological or psychiatric condition. Similar to RT, ReminX is a potential digital therapeutic that allows patients to reminisce about their past, but does not have the structured time requirement or one-on-one administration that is needed with these formal therapies. Furthermore, ReminX is readily accessible and can easily be used on an ongoing basis by patients.

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The technology is unique in that it allows multiple family members, even if they are separated by time and place, to collaborate on stories in just a few minutes a day. The platform transforms the short audio notes and individual photos into rich documentary-like stories that are then archived in a private and secured database. These stories can then be viewed easily with a tablet whenever the patient chooses and the interface is simple to operate. ReminX has the potential to be a practical and highly implementable adjunct behavioral intervention for a variety of patients, including those with dementia.

Recently, there has been a renewed focus on non-pharmaceutical approaches to dementia treatment, such as exercise, diet, and cognitive training programs, that can target mood and physiological distress, rather than on pharmaceutical approaches that slow the progression of cognitive deficits. Digital approaches have also been developed or are under development, so far with limited acceptance. Digital RT products have included personalized music platforms, virtual reality platforms to transport seniors to relive prior memories, and kiosk and desktop-based solutions for use in senior care facilities. Other related senior care products focus on remote care, family engagement, memory assessment, symptom tracking, caregiver support and coaching, and technology simplification.

Dthera’s patented ReminX solution is unique among digital reminiscence therapy platforms in that personalizes RT for the patient into custom stories, and can optimize content being delivered to the patient. Further, it utilizes and encourages family engagement, providing benefit to the caregiver as well as the patient. In addition, the solution is a truly scalable solution, in that it is a low-cost platform only relying on a custom tablet, family members’ existing mobile devices, and the cloud. Therefore, ReminX can be used at any home or senior care/memory care facility, and in rural and isolated settings where the purchase of large shared kiosks or VR equipment, or specialized staff or caregiver training, may not be practical. Due to its simple user interface, a patient’s openness to new technology is also not a concern, as it is with many other solutions. Patients are given a tablet with no menus or buttons; a patient simply picks up the tablet to begin viewing stories. Overcoming the possible fear of new technology by a patient is almost entirely circumvented.

III. SYSTEM DESIGN

The system (Figure. 2) features three components: (1) an iOS app that can be downloaded onto one or more family members’ phones; (2) a cloud-based server; and (3) a tablet (Google Nexus) that is used by the patient. The purpose of the system is to move stories from the family to the patient. The stories are moved through the cloud-based server, which runs on Amazon Web Services (AWS). The responsibility of the family app and the server together is to request story info via a custom AI chatbot – the AI chatbot is a conversational goal-seeking tool that chats with family members and directs them to upload photos and tell audio stories. Requested photos are based on themes from the senior’s past, and when recording audio, the user has the option to speak freely or use prewritten scripts to help shape the story.

Information sent from the server to the patient is sent via scripts (e.g., at what time each photo should be shown, what music should be in the background, what audio should be layered on top). The software platform automatically creates elegant documentary-like videos, which then allow the patient’s custom tablet to play video stories on demand.

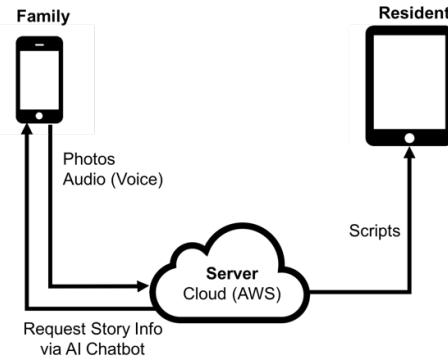


Figure. 2. System schematic, includes family app that is used on a smartphone, a cloud-based server, and a tablet for the patient to display content.

Several additional innovations are under development, including optimization of content being delivered to the patient using machine learning, and proprietary emotional recognition software to track patient feedback and adjust content based on emotional responses from the patient. The purpose of this initial study was to validate the core components of the system prior to the integration of these machine learning and emotional recognition components.

IV. METHODS

A proof of concept study was performed for the in-home use of ReminX in individuals with mild to moderate dementia. The study examined the impact of ReminX digital therapeutic software system on emotional functioning in a group of patients with dementia.

The study included 14 patients with mild to moderate dementia and their caregivers, who uploaded content. Patients were recruited from an outpatient neuropsychological clinic at UC San Diego under an IRB approved study. The inclusion criteria for patients were the following: (1) 60 years or older; (2) Dementia (Major Neurocognitive Disorder) as diagnosed by the DSM-V by Dr. Filoteo; (3) Mild to Moderate cognitive deficits based on an MDRS total score of no less than 110; (4) Adequate hearing and vision to see the tablet; (5) Caregiver who was available and willing to participate; (6) Adequate comprehension and speaking of English (given test materials were currently in English only).

Patients were evaluated in their home, and the initial evaluation consisted of patients responding to questionnaires assessing their levels of depression, anxiety, and overall emotional distress. Patients’ caregivers were also asked to rate the patient’s level of emotional functioning using a caregiver-based questionnaire. After the initial assessment, and on the same day, patients and their caregivers were instructed on how to use the digital therapeutic software. Caregivers uploaded story content onto their mobile devices using the family app, and stories in the form of slideshows

were created and displayed on the patient tablet. Patients then viewed the slideshow and immediately after were re-assessed using the same set of questionnaires as prior to the viewing.

The following measures were used to evaluate patient's mood prior to viewing the slideshow and after: Emotional Thermometer (ET) [9]; State subtest of the State/Trait Anxiety Inventory (STAI) [10]; Hospital Anxiety and Depression Scale (HADS) [11]; Neuro-QOL Depression Scale-Modified (NQOL) [12]; and Caregiver Questionnaire (CQ). Greater scores on each of these measures indicate greater levels of emotional distress. These measures are well validated for their use in older individuals with and without dementia.

V. RESULTS

Results indicated that patients reported significantly less anxiety, depression, and overall emotional distress after having viewed their story. Furthermore, patient's caregivers also reported that the patient appeared less emotionally distressed.

Figures 3-7 display the mean scores for the ET, STAI, HADS, NQOL, and CQ prior to and after the patients viewed their story. The mean pre- and post-viewing scores were compared for each measure using paired sample t-tests. Results indicated that patients' scores were significantly lower post-viewing as compared to pre-viewing on the ET, STAI, HADS, and CQ ($p < .05$), but not the NQOL.

Emotion Thermometer

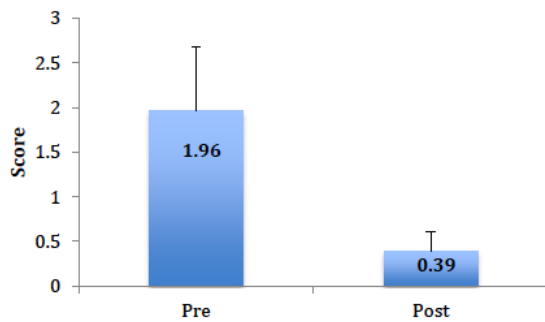


Figure 3. Mean scores on patient the Emotion Thermometer (ET), pre- and post-viewing. The ET pre-viewing score was 1.96 and the post-viewing score was 0.39. Error bars are represented as Standard Error of the Mean (SEM).

State Anxiety Inventory

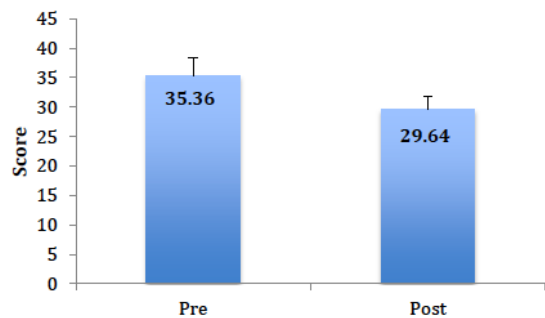


Figure 4. Mean scores on patient the State Anxiety Inventory (STAI), pre- and post-viewing. The STAI pre-viewing score was 35.36 and the

post-viewing score was 29.64.

Hospital Anxiety and Depression Scale

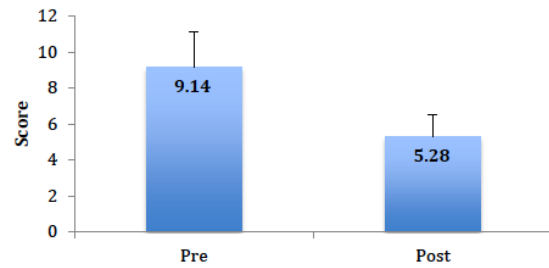


Figure 5. Mean scores on patient the Hospital Anxiety and Depression Scale (HADS), pre- and post-viewing. The HADS pre-viewing score was 9.14 and the post-viewing score was 5.28.

Neuro-QOL

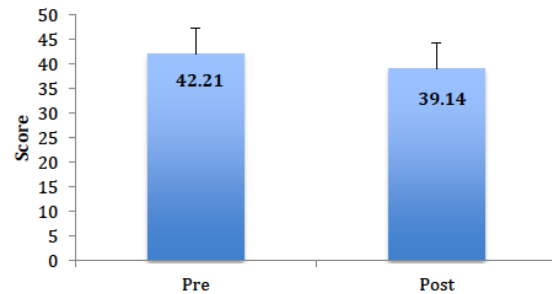


Figure 6. Mean scores on patient the Neuro-Quality of Life (NQOL), pre- and post-viewing. The NQOL pre-viewing score was 42.21 and the post-viewing score was 39.14.

Caregiver Questionnaire

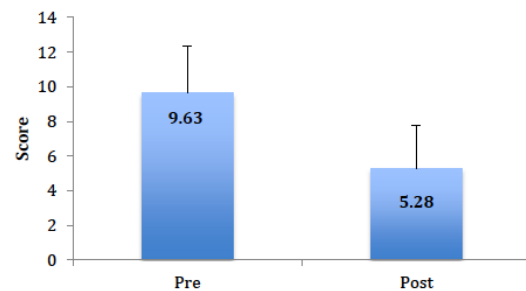


Figure 7. Mean scores on patient the Caregiver Questionnaire (CQ), pre- and post-viewing. The CQ pre-viewing score was 9.63 and the post-viewing score was 5.28.

Effect sizes were computed using Morris and DeShon's method (Equation 8) for effect size estimation in repeated measures [13]. The effect sizes for the significant results were typically large and ranged from 0.76 to 0.91 (Figure 8). Effect sizes are used to quantify the magnitude of a statistical effect, with 0.20 typically being viewed as a "small" effect size, 0.50 being viewed as a "moderate" effect and 0.80 being considered as a "large" effect of an intervention [14]. As can be seen in Figure 7, the impact of the patient viewing their story resulted generally in "large" effect sizes on the ET, STAI, HADS, and CQ, but not the NQOL, which is consistent with the t-test results reported above [14].

These effect sizes, which were larger than anticipated, suggest that the ReminX digital therapeutic software can have an acute and significant impact on the emotional functioning in patients with dementia. In addition, the surveys indicated that the software system was accessible and easy to use, suggesting that this technology holds great promise for bringing important aspects of RT to patients with dementia who are suffering from various mood symptoms.

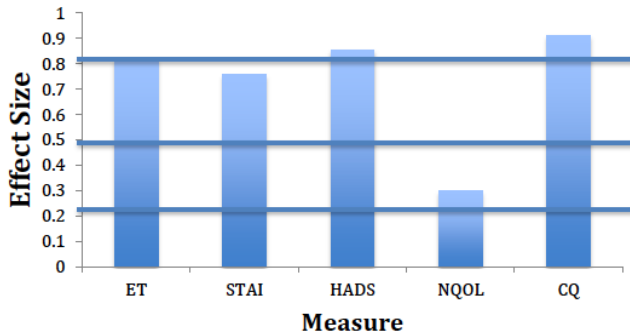


Figure 8. Effect Sizes for the various measures.

VI. DISCUSSION

These results are highly encouraging and indicate the need for future research to determine the neuropsychiatric mechanisms that lead to these emotional improvements (e.g., improved physiological functioning, decreased heart-rate, etc.). Importantly, this study provides the proof-of-concept that elements of an evidence-based therapy can be brought to patients in a much more frequent and consistent manner, with the added benefit of being highly cost-effective.

As noted above, one major limitation of traditional RT is that it is often performed in a one-on-one or group setting, which greatly limits the frequency and consistency in which this therapy can be provided to patients. On the other hand, the ReminX technology enables family members to participate in the implementation of important elements of RT that traditional RT does not enable. This technology enables family members to engage with caregivers from anywhere in the world on their own time, as long as they have an internet connection. This reduces caregiver burden by making it easier for additional family members or friends to become involved in the care of a patient remotely. It also reduces the guilt associated with not being directly involved in care, and at the same time provides a caregiver with satisfaction of being notified of positive emotional feedback from stories shared directly by that caregiver. The impact of this technology on family member's psychological functioning will be an important area of future research.

As with any study, there were limitations, including the lack of a control group, an inability to determine the specific elements of the technology that led to improved mood symptoms, limitations of the prototype technology, and a lack of assessment of the long-term improvement in mood. Future studies will feature a control group in a randomized crossover format, refinements to software and hardware, automated story creation with feedback from both patients and family, and further examination of the impact of ReminX using biological measures. Despite the above limitations, the

results of this study strongly warrant further investigation in how to best implement this important and novel technology, which has great potential for improving mood in patients with dementia. Given recent set-backs in pharmacological trials, behavioral interventions such as those offered by ReminX technology open up a novel approach in the ever-growing area of dementia treatment.

VII. CONCLUSION

The ReminX product is expected to have an immediate and positive impact on emotional functioning in all patients with dementia or major neurocognitive disorder due to other conditions, including individuals with traumatic brain injury (TBI), and potentially in patients with psychiatric conditions, such as posttraumatic stress disorder. The product can have a significant and meaningful impact on quality of life, by reducing anxiety, depression, and overall emotional distress.

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