

Evaluation of a multifunctional technology system in a memory care unit: Opportunities for innovation in dementia care

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ABSTRACT

Introduction: Stimulating recreational and leisure activities (RLAs) are essential to physical and mental well-being; however, people living in memory care units (MCUs) may lack access to them. Technology has the potential to facilitate and enrich activity engagement in this context. *Objectives:* In this 6-month study, we evaluated a commercially available system designed to encourage the engagement of people with dementia in activities and social interactions, using a mixed-methods approach in a MCU. *Methods:* Quantitative measures included those to evaluate cognition, depression, quality of life, and resource utilization. We qualitatively evaluated the system using semi-structured interviews with family members and staff. Five residents with dementia, four family members, and seven staff were included in the 6-month study. *Results:* Staff and family members reported benefits for residents such as enjoyment, interactions and connections with others, and mental stimulation. Findings also highlight challenges such as technical and ethical concerns. Factors that influence system use and integration are also discussed. *Conclusion:* It was feasible to introduce a system designed for recreation and engagement in a MCU, and staff, family members, and residents experienced benefits. However, barriers existed in the introduction and use of the system.

KEYWORDS

Dementia; games; ICT; memory care unit; quality of life technology

Background

According to the World Health Organization, 35.6 million people live with dementia worldwide, with 7.7 million new cases arising every year (1). While much research focuses on pharmacological interventions, there is also significant interest in psychosocial interventions to address the social and recreational needs of people with dementia.

Though they may be overlooked due to precedence given to physical needs, structured recreational and leisure activities (RLAs) are extremely important for people with dementia. Types of RLAs include psychosocial interventions (e.g., reminiscence therapy, speaking to family and friends), sensory interventions (e.g., listening to music or soothing sounds), cognitive interventions (e.g., playing games or puzzles), and movement interventions (e.g., dance, Tai Chi). People with dementia appear to experience short-term benefits during RLAs such as greater well-being, positive affect (2,3), and reduced agitation (4). Furthermore, there have been documented long-term effects of RLAs such as delayed progression of cognitive impairments (5). When RLAs are offered throughout the day, research suggests that further benefit can be seen, such as decreased use of psychotropic medications (6). Another benefit of activities is that they can serve as non-pharmacological interventions to address behavioral and psychological symptoms of dementia (BPSDs) (7). The benefits of participation in activities has been recognized by The Centers for Medicare and Medicaid Services (CMS), which require long-term care facilities receiving

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reimbursement to provide “an on-going program of activities designed to meet . . . the interests and the physical, mental, and psychosocial well-being of each resident.” (8)

Currently, 30–40% of older persons with dementia reside in memory care units (MCUs), nursing or assisted living facilities (9). Even though RLAs are documented to be beneficial to people with dementia, those who live in MCUs may not have the opportunities for sustained social interactions and stimulating activities (10–12). RLAs may be underutilized because they are time-intensive to deliver and can be difficult to tailor to the personalities and interests of individual residents. There is presently an unmet need for innovative ways to provide stimulating activities that do not place an additional financial burden on the healthcare system or time burden on staff.

One potential method for delivering activity interventions is through the use of information and communication technology (ICT). ICT has the potential to reduce costs and staff time, as well as provide additional benefits. Marshall described the following nine uses of technology for people with dementia: reminders, safety, surveillance, control, service coordination, assistance to relatives, compensation, stimulation, and relaxation (13). In a review of technology for people with dementia and their caregivers, Topo adds communication to that list (14). Of these, communication, stimulation, relaxation, and even compensation for limitations are all related to the use of ICT to facilitate recreational activities for people with dementia.

Many interventions have explored the use of ICT for single applications for people with dementia, including playing music and exercise games and conducting reminiscence therapy (15–17). While these have shown promise, they serve a single purpose and therefore require people to purchase, learn how to use, and set up each one. This is both time consuming and costly and can be a major barrier to their integration into care. One potential solution to overcome these limitations would be the use of a multifunctional technology system. Using current understanding experiences with individual components or smaller systems tested in specific settings can provide knowledge that will help us improve the design of future multipurpose systems. These systems have been examined in several studies with people with dementia or mild cognitive impairments. Four systems—AMUPADH (18), COGKNOW (19), the Companion (20), and tablet computers (21)—have applications that fall under psychosocial and sensory activities. The mobileWAY system (22) and another tablet study (23) have applications in the cognitive and sensory categories, and ISISEMD (24), a cognitive training program (25), and SOCIABLE systems (26) have applications in the cognitive and psychosocial domains. While these projects are novel and hold promise, limitations of their ability to be used more broadly include that many of the systems are not commercially available, were designed for people only in the early stages of dementia, and are quite limited in terms of the number of applications they support (usually just two or three). Additionally, none of the projects mentioned satisfied cognitive, psychosocial, and sensory categories, let alone other activity categories such as exercise. The need for comprehensive systems with a wide range of applications targeting people across all stages of dementia motivated this study, which involves a field test of a multipurpose technology system in a MCU.

Purpose

The goal of this study was to assess whether and how a multipurpose technology system designed for dementia care could benefit people with dementia in an MCU and the people in their care network, such as family members and staff. A secondary goal was to assess the feasibility and acceptance of such a system.

This work was informed by activity theory, which posits that people should continue doing as many of the activities they enjoy as possible as they age and modify or replace activities that they can no longer do (27). Thus, using a system that is flexible to people’s abilities and interests may assist older people with dementia continue to engage in activities of interest despite increasing impairments.

Methods and procedures

Study design

The study design was a mixed-methods longitudinal evaluative study of a technology intervention. As this was a feasibility study, no controls or randomization were used.

System used for study

We used a commercially available computer system designed for older adults in community settings (iN2L Mobile FLEX Lite Package, It's Never 2 Late, Centennial, CO; Figure 1). The system included: (1) a commercially available standard interface designed for use with older adults, as well as (2) a prototype interface designed specifically for use with people with memory impairment/dementia. The system included access to freely available web resources such as search engines as well as programs developed specifically for the system. The system is intended to provide access to and opportunities for various recreational leisure activities, such as social involvement (e.g., video calling, email-access, and Facebook), entertainment (e.g., through games, puzzles, exercise videos, movies, and music), motor involvement (e.g., exercise videos), and cognitive training (e.g., memory games). Applications within the dementia care interface are organized into categories such as “reminiscence,” “entertain,” and “stay connected.” The system also allows the user to create custom grouping of applications and place them under icons for a specific resident or staff member.

Features of the unit include a touch-screen monitor which can be plugged into an external monitor. In addition, the unit can be wheeled from room to room and has a webcam, microphone, and speakers. It also comes with additional peripherals such as a video camera, hand/foot pedal for exercise and therapy, joystick, and headset. The height of the unit can be adjusted to allow the unit to be used by people seated or standing.

The system was placed in the activity/dining room of the MCU and was used there by staff. It was wheeled into a side room or resident's rooms by the researchers for individual sessions.

Study setting

We made the system available for use in a 26-apartment MCU for people with mild-to-severe dementia.



Figure 1. *Left:* The technology system used in the study. *Right:* The system home screen.

Participants and inclusion and exclusion criteria

Stakeholders from multiple groups were involved as the perceptions of the various people involved in the lives of the person with dementia are important to understand the use of the system. Participants ($N = 16$) came from three groups: (1) older adults residing in the MCU (R; $n = 5$); (2) family members of older adults living in the MCU (FM; $n = 4$); and (3) staff members in the MCU (S; $n = 7$). As this was a feasibility study, the small sample size in the groups is appropriate (28). Older adults in the R group had to be residents of the participating community, 50 years of age or older, and able to understand spoken English. Individuals were excluded if they were legally blind. Cognitive status of residents was not used as inclusion or exclusion criteria. People with any stage of dementia who resided in the MCU could participate in the study; however, weekly sessions were only held with individuals who appeared able to sit and focus for an hour. Family members had to be related to the resident, be aged 18 or older, have visited their relative residing in the MCU at least monthly in the year preceding the study, be willing to meet at the MCU for interviews, and be able to read and speak in English. Staff had to be aged 18 or older and interact directly with the individuals in the MCU. Family members and staff were excluded if legally blind or had significant auditory impairments that affected conversations as assessed by the research team. All procedures were approved by the University of Washington Institutional Review Board.

Recruitment

Due to the residents' cognitive status, those in the R group were not able to provide informed consent for themselves to participate in the research study. Therefore, letters were sent to the legally authorized representative (LAR) inviting study participation. Once LARs consented for their relatives to take part in the study, persons residing in the MCU were approached to discuss study procedures and obtain verbal assent. LARs and residents were also informed that they could choose not to participate or withdraw at any time without affecting care. LARs were asked if they were interested in being a part of the study (family member group). Staff were recruited through on-site information sessions.

Study procedures

Procedures: MCU participants (R)

Participants in the MCU were enrolled for 6 months. Residents were given the opportunity to use the unit in weekly hour-long sessions with the first author (AL). The best time for sessions was determined by speaking to family and staff members and took into account times of day residents were most alert while avoiding times favorite activities were scheduled. Sessions took place either in resident apartments or in common areas, depending on resident preference. Researchers took notes during sessions on residents' reactions to components of the system. Residents were not interviewed given the severity of dementia; it would have been difficult for them to remember details about the system to yield meaningful findings and it could have potentially increased participant fatigue.

Instruments included the Mini-Mental State Examination (MMSE) (29), the Quality of Life in Alzheimer's Disease (QOL-AD) (30), the Cornell Scale for Depression in Dementia (CSDD) (31), and the Resource Utilization in Dementia – Formal Care (RUD-FOCA, reports the total number of minutes spent caring for a resident with dementia per month) (32), The MMSE, an 11-item test that scores people as having mild, moderate, severe, or no appearance of dementia, and the QOL-AD, a 13-item questionnaire that allows people to score elements of their life from poor to excellent, were administered directly to people with dementia by the researchers. Staff and/or researchers filled out the CSDD, a 19-item scale that evaluates people for no depression, depression, or major depression. Staff filled out the RUD-FOCA, which assesses the amount of time formal and informal care assist the resident in four areas of care. These instruments were administered at baseline, 3 months, and 6 months.

Procedures: Family members (FM)

Family members took part in audio-recorded interviews at baseline and 6 months with an optional interview at 3 months. During the baseline visit, we administered a demographics form including a section on comfort with technology. During the baseline interview, we also administered the five single-item indicators from the positive affect instrument (PAI) for the family member to fill out regarding their relationship with their cognitively impaired relative (33). The PAI is used to assess the relationship between parents and children. Bengtson et al. found that the instrument has a test-retest reliability of 0.89 and construct and discriminant validity, and designed it to measure affect regardless of age (33). During the baseline interview, we asked questions about applications they thought their family member would enjoy using to help us plan sessions, whether they thought the system as described was appropriate for people with cognitive impairments, whether they had any concerns about the system such as privacy, and their expectations of how their family member would perceive the system. The subsequent interviews focused on use of the system, interactions with their family member using the system, and impact of reminiscence or other activities on interactions.

Procedures: Staff members (S)

We audio-recorded interviews and administer instruments to staff monthly for a total of seven sessions. During the baseline interview, a demographics form was administered and questions were asked regarding what kind of activities were currently offered in the MCU, what activities would be offered in an “ideal world,” and whether they had comments on features of the system. During monthly and exit interviews with staff, staff were asked to provide information about their use of the system and issues they had.

Analysis

Descriptive statistics were performed on questionnaire data. All audio-recordings of interviews were transcribed and verified. Thematic coding was performed both inductively and deductively. Interviews were deductively coded for the larger themes of benefits and challenges, and subthemes emerged through coding of the data. The theme of influencers on the use of the technology emerged inductively through open coding of the data using a content analysis approach (34). A subset of the transcripts was coded by a second member of the research team for validation. Data management was facilitated using NVivo Version 10.

Findings**Demographics**

The average age of MCU residents was 87.8 years (SD 4.6). Four residents were female. The mean age of the staff was 31.7 years (SD 8.1). Five staff members were female. Four were Asian/Pacific Islander, two White/Caucasian, and one identified as other. Four said they were very comfortable using computers, two somewhat comfortable, and one not very comfortable. The average family member age was 64.3 years (SD 15.7). Three family members were children of residents, and one was a spouse. Three family members were female. Three were White/Caucasian and one was multiracial. All said they were very comfortable using computers. One resident did not have any relatives in the area that visited at least once monthly and was enrolled without a corresponding family member.

Descriptive statistics

Descriptive statistics for MCU participants can be found in Table 1. These measurements are not intended to provide any evidence about the effectiveness of the intervention, but rather to provide a full picture of each of the residents. Five MCU residents were enrolled initially, with four residents

Table 1. MCU Resident (R) scores on instruments.

| | | Mental status (MMSE) | Quality of life (QOL-AD) | Depressive symptoms (CSDD) | Resource utilization (RUD-FOCA) (min/ month) |
|----|----------|-------------------------|--------------------------------|-------------------------------|---|
| R1 | Baseline | 16 | 48 | 0 | 976 |
| | 3 months | 21 | 47 | 0 | 380 |
| | 6 months | 21 | 49 | 1 | 220 |
| R2 | Baseline | 2 | 25 | 8 | 10920 |
| R3 | Baseline | 20 | 37 | 1 | 700 |
| | 3 months | 21 | 36 | 0 | Missing |
| R4 | Baseline | 21 | 39 | 4 | 1036 |
| | 3 months | 19 | 46 | 1 | 1960 |
| R5 | Baseline | 17 | 41 | 3 | 420 |
| | 3 months | 20 | Missing | 2 | 1540 |

still enrolled at 3 months. One participant with an MMSE of 2 was unable to understand researcher instructions and was deemed unable to take part in weekly sessions. He was transferred to another facility shortly after, leading to his and his corresponding family member's withdrawal. A second participant was also transferred to another facility and she and her corresponding family member were withdrawn from study participation. Two additional residents were admitted to the facility during the course of the study and completed procedures out to 3 months before the study ended. R1 participated in 26 sessions, R2 in 0, R3 in 9, R4 in 13, and R5 in 5.

At baseline, family members scored an average of 22.3 (SD 4.8) on the five single indicator items (rated from 1, "don't agree with closeness items," to 6, "agree with closeness items") on the PAI.

Themes

Themes were organized into the following categories: benefits, challenges, and influencers on use of the evaluated system (see Table 2).

Benefits

Benefits were identified from transcripts for all parties involved: residents, family members, and staff.

Residents, family members, and staff all benefited from the way the system facilitated interactions. One application that especially promoted interaction was a library of links to YouTube videos. S2 noted:

Table 2. Themes from interviews.

| Benefits | Challenges | Influencers |
|--|---|--|
| <ul style="list-style-type: none"> ● Facilitated interactions (R, FM, S) ● Learned more about residents (FM, S) ● Enjoyment (R, S) ● Mental stimulation (R) ● Recover physical mobility (R) ● Reminiscence (R) ● Accommodate individuals along the dementia spectrum (R) ● Aided attention and served as a visual memory aid (R) ● Self-esteem (R) ● Something to look forward to (R) ● Convenience/availability of information/media (S) ● Relieving pressure (S) ● Replaced or augmented activities (S) | <ul style="list-style-type: none"> ● Technical issues and user-friendliness ● Lack of resources ● Cognitive impairments ● Disease-related disabilities ● Ethical concerns ● Boring ● Physical nature of the system | <ul style="list-style-type: none"> ● Facilitator ● One-on-one or in a group ● Attitudes toward or experience with computers ● Frequency of use ● Effect of time |

“The baby videos got them talking about their own kids and how many kids they had and stuff like that. ‘My baby used to do this,’ ‘my baby did that.’ And they started talking to each other, almost like a new mom parenting group.”

In addition to residents conversing spontaneously with each other in response to an application, staff engaged and elicited responses from residents by utilizing materials on the system. Staff benefitted from these interactions as well. S5 noted that playing music that residents and staff liked “bridges the age gap and the generation difference,” leading to a sense of connection. Family members also benefited from interactions facilitated by the system: family members who used the system with their relatives noted positive experiences. While enjoyable, these new interactions were not reported to affect the relationship in a larger sense: FM3 said, “it’s given us something to do together, but I don’t think it’s really changed the relationship.”

Staff and family members benefited from learning more about residents. S5 noted, in reaction to seeing a resident playing blackjack on the unit and learning that she was a “card shark,” that learning things about residents “is good because especially here in the memory care, you can hear things from them but you don’t necessarily know if it is true.” Another reason that getting to know residents better was seen as beneficial was because it informed staff of residents’ likes and dislikes, which they used to plan and tailor activities. Family members also valued learning more about their relatives through use of the system; FM1 learned that her relative enjoyed karaoke by observing one of our sessions and then scheduled her to be engaged in more singing activities.

Both residents and staff benefited through *enjoyment* using the system. For example, when asked how the system had led to changes in R1’s quality of life, FM1 said that R1 was “always happy when she thinks about it . . . And it brings a big brightness to her life.” FM3 less enthusiastically noted that R3 was “relatively engaged in enjoying it.” Staff reported that residents in the MCU (not only those enrolled in the study) enjoyed specific applications. Staff noted that they enjoyed the novelty of the content. Discussing using a music application during lunch, S5 said “it’s not the same thing all the time, which is good . . . because [before] you’re like ‘oh it’s that CD again’ whereas now it’s like something different all the time. You can change it up.” Residents benefited from the system prompting *mental stimulation*. Both staff and family members perceived applications as being beneficial for exercising residents’ cognitive functions. S6 mentioned that observing the first author using the system with residents convinced her that “it’s exercising their mind.” Another benefit was related to physical stimulation: FM2 saw the system as useful for helping her mother *recover physical mobility* after a stroke she had during the study.

Reminiscence was another benefit residents experienced from using the system. The system’s applications reached participants through the variety of applications (so one was bound to be relatable to residents) as well as through the wealth of materials from past eras. Each of the residents that participated in weekly sessions chose to return over and over to applications relevant to activities that they had done in the past (e.g., casino/card games and slideshows with images of horses). These applications brought back individual memories for the residents, and FM1 explained that R1 “absolutely loves the casino one, and that’s because she used to . . . meet her favorite sister in Las Vegas. So it’s brought back memories.” Staff spoke frequently about playing older movies and TV shows for residents. S5 explained that she used the movie application often because:

“they shouldn’t really be watching the news, it will stress them out and confuse them. Right now . . . they’re just playing Christmas movies and I don’t know if it’s really relevant to them because they’re newer. So I feel like I should put on something that they may know at least it’s from their generation . . . and [they] might remember it.”

Though staff appreciated the older movies, shows, and music, it is important to note that content did not have to be older for residents to relate to them. In some cases, older content was frustrating to residents. S2 commented on a trivia slideshow on the system, saying that:

“They do love trivia, but it’s a double-edged sword, when they start not being able to remember things, but they know they know it, then it frustrates them. And so . . . they’re like ‘Well I lived in the forties, why don’t I know this?’ ‘Who came up with these questions?’ Then it gets indignant.”

Residents were frustrated knowing they should recognize materials from a certain era but not being able to do so.

Another way the system benefited residents was by *accommodating individuals along the dementia spectrum*. Music was particularly meaningful to people with different levels of dementia: S3 said: “Music’s always probably the top thing, because no matter what level someone is at mentally, it’s very soothing and it usually brings people together.”

Another benefit to residents of the MCU was that the system *aided attention and served as a visual memory aid*. This benefit was identified by staff and as a potential benefit by family members. For example, S5 said of the residents watching a Tai Chi video “they’ll copy what they see.” By having a video with someone performing moves, staff were able to provide the opportunity for residents to engage in a novel and beneficial activity.

Another benefit was the resident gaining *self-esteem* through the use of the system. This was due to using a computer as well as winning games. Finally, residents benefitted by having *something to which to look forward*. This was only noted by FM1 about R1, as other family members said that their relatives most likely did not remember them occurring.

Staff benefited from using the system because of the *convenience and availability of information and media*. S1 noted that “they like those older movies, and it’s hard to get them from Netflix . . . we can click on any one of them and we would know that hey, that’s an older movie, they’ll like that.” Staff members also mentioned the convenience of having multiple types of materials on a single system, which was seen as reducing the chance of losing peripherals such as DVDs or the remote. The system was also seen as *relieving pressure* from staff. Staff were able to engage in new activities that they did not necessarily have expertise in through use of the system:

“On Mondays we don’t have an activity [director present] so we have someone that comes up . . . and we have our schedule already. And she’s like ‘What’s Tai Chi?’ and I’m like ‘We actually have this computer thing.’ We taught her how to set that up, so she does Tai Chi with them.”

The MCU has a very involved activity director, and S1 mentioned that:

“We use the [system] more when [activity director is] not here. It’s helpful, at least when we’re trying to struggle to figure out what to do, what kind of activity . . . And we know that it’s always available for us to use.”

Another benefit was that the system *replaced or augmented activities*. Many features of the system were noted by FM3 to be “what they [staff in the MCU] do already.” Similarly, S5 noted “it’s just an improvement on what things they were already using.” However, the system also provided new types of activities and interactions. S3 noted that having the system “helps me think of some things outside of the box that I wasn’t thinking about.”

Challenges

In addition to the many benefits of using the system, there were also challenges associated with its use. The most problematic challenges pertained to *technical issues and issues with the user-friendliness of the system*. These issues were especially significant in the first few months of the study, and staff reported that these issues reduced their use of the system in early interviews. S2 explained how the short attention span of MCU residents affected her likelihood to use a system with technical issues:

“I think it’s not getting used as much as it could be because of the frustration of it freezing or going too slow, because they’ll lose interest so quickly. And start getting antsy and want to do other things . . . I would be more willing to use it if I knew the games I had talked up were going to work when I opened them.”

Issues related to staff not knowing how to use features or where applications were as well as system failures. Once the technical issues were resolved and staff became more familiar with where applications were located, staff reported more use and had better opinions of the system. Both staff and family members noted that a lack of user-friendliness and technical issues would be especially frustrating for people with dementia. S3 noted “if we’re having a hard time using it, it’s definitely gonna be hard for [residents].”

The next most significant challenge with using the system was the *lack of resources*, especially time and personnel. The additional needs of residents due to cognitive impairments compounded this. S1 said:

“I really wish I just [had] more people to actually use it with the resident. And I’m pretty sure [we should] have one dedicated person to use it with the resident, because our residents won’t just go there and use it by themselves. They have to be guided.”

Other challenges related to *cognitive impairments* arose. Applications that might be well designed for the general population were ill-suited for some of the residents. For example, one set of exercise videos had three people on the screen doing the same exercise at varying levels of intensity, which staff mentioned was confusing to residents.

In addition to challenges due to cognitive impairments, challenges arose due to *disease-related disabilities*. Two of the participating residents were in wheelchairs, and the station height did not decrease enough for one participant to comfortably reach the keyboard, and the foot pads of the wheelchair had to be moved to the side so another could get close to the system. Additionally, R3 had a stroke during the study and no longer had use of her dominant hand, and her hand would tire quickly when using the system. Other difficulties related to functional level arose when using specific applications: some exercise videos were viewed as too strenuous for residents; S3 said “I was feeling it after doing it . . . so I knew they must have been feeling it, and they were complaining a little about that.”

An additional challenge using the system was *ethical concerns* staff and family members had about the system. Some of these concerns were assuaged as the study went on. S5 said that initially:

“the idea seemed like would [the system] then replace an activity person . . . But I think it just enhanced [conducting activities] or made it easier . . . not necessarily replaced it.”

S3 said that she could imagine staff in a different facility using the system as a “babysitter” if they weren’t comfortable working with people with dementia. Another concern brought up by FM1 was that R1 would be very upset once the sessions ended. This reflects a concern of implementing an intervention with vulnerable populations only to withdraw it when the study ends. Another issue, voiced by S3 during several interviews, was that clicking on links to the Internet might result in something inappropriate “Cause it might say something like laughing babies but then you get some something weird, sexual or something.” Family members did not mention concerns about inappropriate content.

Other challenges arose regarding content, with some content seen as *boring* to both staff and residents. Staff appreciated that some content, such as movies and TV shows, was rotated monthly, but many found that there were too few episodes or movies. S5 said few episodes were an issue “Because they probably don’t remember that they’ve already seen it . . . but I’ve played this three times already in the past day.” Though residents may not have noticed the repetitiveness of content due to their memory impairments, staff were bored by limited content.

Finally, some challenges arose related to the *physical aspects of the system*. One such issue was ownership, as the content was all on a single system (as opposed to a service that could be accessed from various computers). FM3 said she used the system with R3 a few times without the authors, but “a lot of times it’s just kind of difficult because they’re either using it to show a movie to the group, so then I’m not going to interrupt that, or it just doesn’t seem like there’s a time and place where I can pull it.” On the other hand, S5 said that having the system unavailable when the first author was using it with residents was not problematic because “we could find something else to do.” As opposed to staff, the family member found it more important to use the system at a specific time,

perhaps because she came at specific times of day. Other issues related to the physical nature of the system were that it was considered ugly and flimsy by S3 and bulky by FM1.

Influencers

A third theme that arose from analysis of the transcripts was that many factors affected the experience of use of the system, which will be referred to as influencers. One influencer was identified as the *facilitator* using the system with the resident. The facilitator was typically staff or the first author, and occasionally family members who came to sessions or used the system with residents independently. The involvement of a facilitator was key because, as both the authors and staff observed, residents were unable to use the system on their own due to cognitive impairments and the complexity of the system. Residents needed frequent instruction to use the system and did not usually retain information between sessions. Thus, they required prompting from another individual to successfully interact with the system. Who the person was that was assisting the resident was important. FM3 recalled:

“One time when I was using [the system], and [R3] was playing blackjack, I had to leave, and I said ‘You know you can still keep playing’ and she’s like ‘No, I don’t want to’, and one of the staff members even said ‘Well, I’ll watch you for a while,’ but I think she just lost interest after I left.”

In this case, the presence of FM3 may have been a component of what made the activity enjoyable for R3. FM1 highlighted the importance of the characteristics of the person assisting residents in using the system, stating that one has to:

“have to have the right person. If you don’t have . . . someone with a nice personality that is enthusiastic about it, if you took one of the employees here that is assigned to do it and they don’t want to do it or they are scared of technology and don’t know how to do it themselves, it’s gonna be a complete failure. You have to have someone that’s knowledgeable with the equipment, someone that has a good personality to deal with people with dementia, and someone that has just the right overall attitude.”

As the above quotes indicate, facilitators were important not just to assist the resident in the technical aspects of using the system, but to provide encouragement in its use. Another influencer of a positive experience was *whether the system was used one-on-one or in a group*. Many staff pointed out that the system would probably be more beneficial in a one-on-one setting or small group. They attributed this in part to the varying levels of dementia of residents: S3 said the games on the system would be more beneficial in a one-on-one setting “Because, you know where that person’s at, physically and mentally. When you’re in a group, I have such a variety of levels and it’s hard to meet everyone’s need.” Additionally, many of the applications, such as puzzles, could only be used by one person. Another factor believed by staff and family members to influence system use were *attitudes toward or experience with computers*. Two family members said that since their relatives were not familiar with modern technology, they might be uninterested or unable to use the technology. Additionally, S2 brought up an incident where the system did not work and residents said, “‘Why do we have to use computers all the time’ . . . It gets them riled up and then they start complaining about computers and stuff like that.” Residents’ negative attitudes of technology may have contributed to them being more impatient or expressing more negative thoughts about the situation. On the other hand, FM1 thought R1 enjoyed using the computer “because she knew computers are a big deal and only young kids can do those but she was smart because she could use a computer.” During sessions with residents, however, it was not obvious to us that negative (or positive) attitudes affected their enjoyment of the system.

Some influencers had to do with the continued use of the system, such as *frequency of use*. FM3 thought she hadn’t seen any effects on the quality of life for her relative “just because she hasn’t been using it consistently enough.” FM5 said that 1 hour a week would have “absolutely minimal effect.” On the other hand, FM1 thought that having the first author come weekly had huge benefits for her relative; however, her relative participated in more sessions and more consistently than the other residents. Another influencer related to the continued use of the system was the *effect of time*. Staff

had a strikingly different attitude toward the system at the beginning of the study and at the end, including their assessment of the how user-friendly the system was and whether they thought the system would replace human care. As S3 said, there was also a “learning curve,” as might be expected for any new technology.

Discussion

This study has contributed to the body of research on multifunctional systems for dementia in several ways. First, it involved individuals with mild-to-moderate dementia where previous studies have focused mainly on people with early dementia. We do note, however, that this inclusion led to increased subject withdrawal from the study due to residents moving to more involved care settings. This should be a consideration for future investigators to consider in either the environment or the length of procedures. Second, staff used the system in an immersive MCU for 6 months, which is a long-term study with this population. The length of the study allowed us to see how staff opinions changed over time, which was very valuable as many staff members initially had negative opinions of the system which became much more favorable as the study went on. Another strength is that we evaluated the tool with three user groups where other studies typically examined just one or two of these user groups. One especially important finding from the perspective of the family member and reinforced by the staff was the importance of the facilitator’s personality in using the tool with people with dementia. Future work using systems in these settings should report on the specific role and qualifications of the facilitator/interventionist. Additionally, this study included a system with applications that satisfied all of the categories of RLAs, thereby allowing us to see which types of activities were used and how.

Another important finding was that though the system may not alter the fundamental elements of the relationships family and staff have with the person with dementia, it did provide opportunities to support interactions, particularly around reminiscence. In particular, the finding that others benefited from the use of the system through finding out new information about people with dementia is echoed in a study by Gowans et al. who found that when caregivers used a system to support reminiscence therapy with a person with dementia, they heard stories they had not heard before (35). Utilizing a device to support interactions between people with dementia and caregivers is a very different usage of a device than other studies, such as by Lim et al., whose motivation to have people with dementia use tablets was to provide them with an activity to do on their own to provide respite to caregivers (23). While it is important to create activities that people with dementia can do on their own, we found that having the caregivers using the system with residents was actually a way for them to engage in a mutually enjoyable activity. This may be partially attributable to the family members in this study being distant caregivers, who did not have the same need for respite, as well as some self-selection in who decided to take part in the study and attend sessions with relatives in the MCU.

Finally, the use of a tool with many applications allowed us to tailor the RLAs in order to involve and capture the diverse interests of a group of individuals. With a variety of applications on a single device, it was possible to use with both individuals and groups, and to meet interests in a more personalized fashion which may not have been possible with a different device. Consistent with activity theory, people with dementia were able to find meaning in applications that were tailored to their interest and which often reflected past interests.

Many studies have used older materials with people with dementia to prompt reminiscence (17,35). While older materials were greatly enjoyed by residents, not all content should be from past eras, as interest in RLAs change over time and the introduction of novel media such as “zoo cams” was also found to be highly enjoyable. We also found that certain applications such as music, videos, and TV were used with larger groups, while games were used and said to be more feasible one on one.

Facilities that might be interested in using similar systems should realize that staff may take several months to integrate the system into their activity planning. Further, to support increased

uptake, it is extremely important to determine if technical problems and the user-friendliness of the system are affecting use at the onset and to remedy them as soon as possible. It is very important in the introduction of such a system to be clear on the intent of use, as fears related to the system replacing staff may reduce its acceptance and create a barrier to use and adoption. This type of device may also be of particular benefit in settings with fewer available resources where a full-time activity director is not available, as activity directors may have a complete set of activities that they already find beneficial for residents and may have little need for a new system. Last, during planning for rollout of similar systems, facilities should plan on the need for staff, volunteers, or family members to work with residents, as it is unlikely that persons with cognitive impairments will use the system on their own. It should also be decided whether staff will be given time to use the system in one-on-one settings or in smaller groups.

Limitations of the study include the small sample size, which did not power for statistical analysis of the quantitative measures as well as lack of a control group. Additionally, only one resident completed 6 months as residents either dropped out or enrolled several months into the study. Future research should overenroll and involve multiple communities to increase sample size in order to make quantitative measurements more interpretable and test such systems against control (e.g., attention group) to draw out whether positive effects of the intervention are due to the role of the facilitator or the system itself. Additionally, the study took place in a single facility catering to people in the upper socioeconomic strata, with limited diversity in terms of family member racial and ethnic groups. Further work should look to examine the perceptions of other racial/ethnic groups and other socioeconomic levels of system use and integration.

Conclusion

In this article, we discuss an evaluation of a multifunctional technology tool used in a MCU for 6 months. We analyzed interviews with family members and staff to generate themes regarding perceptions and use of the system. We describe the benefits such as enjoyment for residents and staff, mental stimulation for residents, and the facilitation of interactions for residents, family members, and staff. Challenges of the system such as technical issues as well as ethical issues are also discussed. Finally, we outline influencers of system use such as single or group use. Findings can inform researchers using multimedia and multifunctional technology systems in MCUs as well as designers and users of such systems.

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Declaration of interest

The authors report no conflicts of interest.

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References

1. World Health Organization. Dementia. World Health Organization; 2015. [<http://www.who.int/mediacentre/factsheets/fs362/en/>].
2. Brooker D, Duce L. Wellbeing and activity in dementia: A comparison of group reminiscence therapy, structured goal-directed group activity and unstructured time. *Aging & Mental Health* 2000;4(4):354–58.
3. Schreiner AS, Yamamoto E, Shiotani H. Positive affect among nursing home residents with Alzheimer's dementia: The effect of recreational activity. *Aging & Mental Health* 2005;9(2):129–34.
4. Buettner LL, Lundegren H, Lago D, et al. Therapeutic recreation as an intervention for persons with dementia and agitation: An efficacy study. *American Journal of Alzheimer's Disease and Other Dementias* 1996;11(5):4–12.
5. Cheng S-T, Chow PK, Song Y-Q, et al. Mental and physical activities delay cognitive decline in older persons with dementia. *The American Journal of Geriatric Psychiatry* 2014;22(1):63–74.
6. Volicer L, Simard J, Pupa JH, et al. Effects of continuous activity programming on behavioral symptoms of dementia. *Journal of the American Medical Directors Association* 2006;7(7):426–31.
7. Khan F, Curtice M. Non-pharmacological management of behavioural symptoms of dementia. *British Journal of Community Nursing* 2011;16(9):441–9.
8. Centers for Medicare & Medicaid Services. 42 CFR Part 483, 2001.
9. Alzheimer's Association. Alzheimer's disease facts and figures. *Alzheimer's Dement.* 2012. doi:10.1016/j.jalz.2012.02.001.
10. Hancock GA, Woods B, Challis D, Orrell M. The needs of older people with dementia in residential care. *International Journal of Geriatric Psychiatry* 2006;21(1):43–9.
11. Moyle W, Venturto L, Griffiths S, et al. Factors influencing quality of life for people with dementia: A qualitative perspective. *Aging & Mental Health* 2011;15(8):970–77.
12. Wood W, Harris S, Snider M, Patchel SA. Activity situations on an Alzheimer's disease special care unit and resident environmental interaction, time use, and affect. *American Journal of Alzheimer's Disease and Other Dementias* 2005;20(2):105–118.
13. Marshall M. Dementia and technology: Some ethical considerations. In: Mollenkopf H, ed. *Elderly people in industrialized societies: social integration in old age by or despite technology*. Berlin, Germany: Edition Sigma, Rainer Bohn Verlag; 1996:207–15.
14. Topo P. Technology studies to meet the needs of people with dementia and their caregivers: A literature review. *Journal of applied Gerontology* 2008;28(1):5–37.
15. Topo P. Assessment of a music-based multimedia program for people with dementia. *Dementia* 2004;3(3):331–50.
16. Tobiasson H. Physical action gaming and fun as a tool within elderly care: Game over or play it again and again. *Proceedings of the International Ergonomics Association 2009 Conference (IEA 2009)*; Beijing. Beijing: 2009.
17. Yasuda K, Kuwahara N, Morimoto K. Remote reminiscence talking and scheduling prompter for individuals with dementia using video phone. *Proceedings of the 5th International Conference Universities. Access Human-Computer Interact. Addressing Divers. Part I Held as Part HCI International 2009 (UAHCI '09)*. San Diego, CA, USA: Springer-Verlag; 2009. 429–38 pp.
18. Mokhtari M, Aloulou H, Tiberghien T, et al. New trends to support independence in persons with mild dementia: A mini-review. *Gerontology* 2012;58(6):554–63.
19. Meiland FJM, Reinersmann A, Bergvall-Kareborn B, et al. COGKNOW: Development and evaluation of an ICT-device for people with mild dementia. In: Bos L, Blobel B, eds. *Medical Care Number 4*. 2007;127:166–77.
20. Kerssens C, Sattler M, Monteiro A. Managing dementia symptoms and needs using technology. *Journal of Gerontological Nursing* 2014;40(2):16–20.
21. Yamagata C, Coppola JF, Kowtko M, Joyce S. Mobile app development and usability research to help dementia and Alzheimer patients. *IEEE Long Island Systems, Applications and Technology Conference 2013*; Farmingdale, NY. Farmingdale, NY: 2013.
22. Jordan P, Silva PA, Nunes F, Oliveira R. MobileWAY – A system to reduce the feeling of temporary loneliness of persons with dementia and to foster inter-caregiver collaboration. *46th Hawaii International Conference System Sciences 2013*; Wailea, Hawaii:2474–2483.
23. Lim FS, Wallace T, Luszcz MA, Reynolds KJ. Usability of tablet computers by people with early-stage dementia. *Gerontology* 2013;59(2):174–82.
24. Mitseva A, Peterson C, Dafoulas G, et al. ISISEMD evaluation framework for impact assessment of ICT pilot services for elderly with mild dementia, living in the community and their relatives. *Proceedings of the ASTMA NAEC, 2010*; Riva del Garda, Italy:1–23.
25. Haesner M, O'Sullivan JL, Gövercin M, Steinhagen-Thiessen E. Requirements of older adults for a daily use of an internet-based cognitive training platform. *Informatics for Health and Social Care* 2014;0:1–15.
26. Zaccarelli C, Cirillo G, Passuti S, et al. Computer-based cognitive intervention for dementia. *Sociable: Motivating platform for elderly networking, mental reinforcement and social interaction*. *Proceedings of the 2013 7th International Conference on Pervasive Computing Technologies for Healthcare (Pervasive Health) 2013*:430–35.

27. Havighurst RJ. Successful aging. *Gerontologist* 1961;1:8–13.
28. Courage C, Baxter K. *Understanding your users: A practical guide to user requirements: Methods, tools, and techniques*. San Francisco, CA: Morgan Kaufmann; 2005.
29. Folstein MF, Folstein SE, McHugh PR. “Mini-Mental State”: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* 1975;12:189–98.
30. Logsdon RG, Gibbons LE, McCurry SM, Teri L. Assessing quality of life in older adults with cognitive impairment. *Psychosomatic Medicine* 2002;64(3):510–9.
31. Alexopoulos GS, Abrams RC, Young RC, Shuman CA. Cornell scale for depression in dementia. *Biological Psychiatry*. *Biological Psychiatry* 1988;23(3):271–284.
32. Luttenberger K, Graessel E. RUD-FOCA from Luttenberger 2010. *International Psychogeriatrics* 2010;22(Special Issue 8):2–4.
33. Bengtson VL. Positive affect index: Subjective solidarity between parents and children. *Research Instruments Society Gerontology* 1982;2(93):129–33.
34. Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. *Qualitative Health Research* 2005;15(9):1277–88.
35. Gowans G, Campbell J, Alm N, et al. Designing a multimedia conversation aid for reminiscence therapy in dementia care environments. *Ext. Abstr. Hum. Factors Comput. Syst. (CHI EA '04)*. New York, NY: ACM Press; 2004:825–36.