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Stakeholders' Perceptions Sought to Inform the Development of a Low-Cost Mobile Robot for Older Adults: A Qualitative Descriptive Study

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Abstract

Creative solutions are needed to support community-dwelling older adults residing in a variety of settings including their house, apartment, or Supportive Apartment Living (SAL) to promote independence and reduce the risk of nursing home replacement. The objective of this study was to gain an understanding of older adults' needs for physical, mental, and social activities to support the design and functionality of a low-cost mobile assistive robot. A qualitative descriptive study was designed which included three stakeholder focus groups (caregivers, clinicians, and older adults). We held three focus groups with a total of 19 participants: one with paid caregivers (n = 6), one with interdisciplinary clinicians (n = 8), and one with older adults residing in SAL (n = 5). Conventional content analysis was the analytical technique. Four themes emerged: (a)

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Declaration of Conflicting Interests

Dr. Cacchione is the Editor of Clinical Nursing Research to address this a Dr. Helen Lach served as Decision Editor. She was chosen from the Editoral Board. Dr. Tessa Lau works for Savioke the company who makes the low cost robotic base. To address this she did not participate in the focus groups.

Accomplishing Everyday Tasks: activities of daily living (ADLs) and instrumental activities of daily living (IADLs) were important from the perspectives of all three groups for the older adults to accomplish daily, as well as the “use it or lose it” attitude of the older adults; (b) Personal Connections and Meaningful Activities: for the older adults, it was important for them to engage in socialization and leisure activities, and for the caregivers and clinicians, they work to build personal relationships with the older adults; (c) Cognitive Interventions: the clinicians provided cognitive tools (including reminders, routine and designing interventions) to older adults so they can remain as safe and independent as possible in the SAL; and (d) Safety Measures: encompassed clinicians addressing safety and injury prevention and the caregivers checking in on the older adults in their SAL apartments. This work contributed to the design and functionality specifications for an autonomous low-cost mobile robot for deployment to increase the independence of older adults.

Keywords

stakeholders; older adults; robot design; qualitative research; activities of daily living

Introduction

Approximately 5.5 million older adults in the United States live in settings other than their own homes. Two and a half million live within retirement or senior housing and 3 million are equally divided among independent living, assisted living (AL) and nursing home (NH) settings (Freedman & Spillman, 2014). Across these settings, older adults struggle to care for themselves independently and experience unmet needs. According to The National Health and Aging Study, these unmet needs include self-care, mobility, and managing their household (Freedman & Spillman, 2014). Within the AL settings, 42% of older adults experience unmet needs (Freedman & Spillman, 2014). Well-designed, low-cost mobile robots could potentially meet the needs of these older adults.

Programs of All-Inclusive Care for the Elderly (PACE) is a national program in the United States (over 100 programs) that provides person-centered interprofessional team-based care where PACE is both the older adults’ provider and insurer remaining continuously responsible for the participants’ health and well-being (Sullivan-Marx, Bradway, & Barnsteiner, 2010). PACE provides services to older adults 55 years and older, who are impoverished, insured by Medicaid only or Medicaid and Medicare, and who are NH eligible (Sullivan-Marx et al., 2010). The program supports these older adults so they can continue to live in the community safely.

Supportive Apartment Living (SAL) is similar to AL. In SAL, the older adult rents the apartment and PACE provides the caregiver support compared with AL where the caregiver support, housing, and oversite are provided by the AL facility. SAL is an innovative type of low-income senior housing established through one urban PACE located in the Northeast. In Pennsylvania, PACE regulations prohibit participants from living in AL facilities. This PACE identified a need to coordinate affordable housing for those who required 24-hr caregiver supervision and assistance with activities of daily living (ADLs) without admitting

these participants to NHs. Older adults who live in this SAL must be deemed safe enough to be left unattended for up to 3 hr at a time. The caregiving staffing model in the SAL supports older adults in their apartment for personal care needs. There is a 10:1 older adult to caregiver ratio. Innovative technology would benefit older adults' by supporting their independence within their SAL apartments and augment caregiver assistance. Some technology currently exists to assist older adults in the home including: home safety monitoring, communication devices, cognitive stimulation (Marasinghe, Lapitan, & Ross, 2015), telehealth monitoring systems, robots providing home assistance, moving heavy objects, grocery delivery, or garbage collection (Lattanzio et al., 2014). However, the cost of these interventions impedes access for older adults with limited financial resources.

A low-cost mobile robot could be useful with tasks such as fetching small items, distributing food and beverages, encouraging physical activity, providing reminders, and escorting older adults to appointments. Interdisciplinary teams are necessary to successfully design a low-cost robot. These teams include robotic engineers, rehabilitative engineers, and interdisciplinary clinicians. It is also essential to include the stakeholders (older adults, caregivers, and interdisciplinary clinicians) in the development of robotic interventions that meet the needs of older adults physically, mentally, and socially.

The purpose of this study was to gain an understanding of older adults' needs for physical, mental, and social activities to support the design and functionality of a low-cost mobile assistive robot. Specifically, the research questions were the following:

> **Research Question 1**: What are routines of older adults and those assisting the older adults?
>
> **Research Question 2**: What does each group perceive as important for the older adults to accomplish physically, mentally, and socially daily?

This was the first step of a larger mixed-methods study that has the goal of developing a low-cost (<$15,000) mobile robot. Information learned from these focus groups will inform the interdisciplinary team to determine (a) what tasks are a priority for older adults to accomplish each day and (b) which tasks can realistically be developed and executed by a low-cost mobile robot to assist older adults.

Method

Design

A qualitative descriptive design (Kim, Sefcik, & Bradway, 2016; Sandelowski, 2000) was used to learn what is important for older adults to accomplish daily: physically, mentally, and socially from the perspectives of older adults, clinicians, and caregivers. This approach was selected for its design features of illuminating important everyday key activities and reporting the findings in the rich, comprehensive descriptive language of the participants (Neergaard, Olesen, Andersen, & Sondergaard, 2009; Sandelowski, 2000). Focus groups were selected to gain insights of opinions, and it was believed the interactions among the participants would provide more insight compared with individual interviews (Walden,

2012). The participants completed a brief, self-administered demographic survey prior to their focus group.

Setting and Participants

This study focused on discerning the needs of older adults enrolled in one Northeastern urban PACE who lived in SAL from the perspective of the older adults and their paid caregivers and clinicians. Older adults eligible to live in SAL are those who need assistance with ADLs without complex medical needs; have family support to shop for food and supplies; can be left unattended for 3 hr at a time; cannot be bedfast; cannot be a danger to themselves or others; and if incontinent must be manageable by toileting and appropriate hygiene. Older adults in SAL are low-income and with multiple comorbidities and functional limitations. They typically spend 5 days a week in the PACE day center where they receive nursing and medical care (i.e., assessments, treatments, medications), rehabilitation, engage in activities, and are provided two snacks and lunch. This Northeastern urban PACE had two SALs with 50 individual apartments. The paid caregivers provide ADL care to the older adults within SAL. The clinicians provide discipline-specific interventions to the older adults living in SAL.

A purposive sample of participants was recruited for this study. Older adults living in the SALs were invited to participate if they had a Mini–Mental Status Examination (MMSE; Folstein, Folstein, & McHugh, 1975) score of ≥24 and a Short Orientation–Memory–Concentration Test (Wade & Vergis, 1999) score of ≤ 9, indicating an intact level of memory and thinking sufficient to engage in meaningful group conversation. Paid caregivers who were employed by a home care agency to provide personal care to the older adults in the SALs were invited to participate if they spoke English and were free to meet between day shift and evening shift. The clinicians were from primary care (either MD or NP), nursing, physical therapy, and occupational therapy employed by PACE. The clinicians were invited to participate with the goal of having two representatives from each discipline in the clinician focus group.

Participant Characteristics

There were three focus groups with a total of 19 participants: one SAL caregiver focus group (n = 6); one interdisciplinary clinician focus group (n = 8) who provided home visits in the SALs and worked with those older adults when they attended the PACE center; and one older adult focus group (n = 5). All of these older adult participants were residing in SAL based on criteria of being NH eligible and classified as having a low income. These older adults were all African American, reflecting the demographics of those enrolled overall at the PACE center (95% African American). Demographic information is displayed in Table 1.

Procedures

This study was approved by the University of Pennsylvania Institutional Review Board and the PACE center's Committee on Education and Research. Approval was also obtained from the PACE's Council of Elders, a group of cognitively intact group of PACE members responsible for vetting all research carried out within this PACE center's participants. The

PACE staff identified potential older adults for the study who lived in either of the two SALs. The Director of Research (P.Z.C.) approached potential participants to ask whether they would be willing to participate, verified cognition level, and obtained written informed consent. The focus group for the older adults was scheduled during a convenient time when participants were normally at the PACE center. Caregivers were recruited through their home care agency. The caregiver focus group was held at change of shift between day and evening shift. Clinicians were invited to participate by the Director of Research through email with the focus group held after work hours. All focus groups were held in a private PACE center conference room, and all participants used a pseudonym to help maintain confidentiality.

The focus groups were conducted in the fall of 2014. The research team developed a semistructured interview guide. A similar interview guide was used for all three groups, with minor alterations to reflect each group. The interview guide was developed based on the technology acceptance model and a questionnaire developed to query clinicians and older adults on a therapeutic mobile robot (Chuttur, 2009; Davis, 1989; Wilk & Johnson, 2014). The focus groups were led by an experienced moderator (J.S.S.) who read the ground rules of the discussion, posed questions from the interview guide, and probed participants further on their answers as needed. Another team member (N.V.) was present to assist and take notes. The focus groups averaged 81 min and were digitally audio recorded. At the conclusion, all participants received a $25 stipend. The recordings were transcribed verbatim by a confidential professional service and were reviewed line-by-line to verify their accuracy and correct discrepancies.

Coding and Data Analysis

Conventional content analysis was the analytical technique chosen to attain insight into what activities were important for older adults to accomplish physically, mentally, and socially daily (Elo & Kyngas, 2008). This technique involved several steps: initial immersion into the data, reading the transcripts to derive highlighted key thoughts (known as codes), sorting the codes into categories based on how the codes relate, and then clustering the emergent categories into themes (Graneheim & Lundman, 2004; Hsieh & Shannon, 2005).

The transcripts were uploaded into ATLAS.ti 7, qualitative software used for data storage, retrieval, coding, and management. The lead author and a research assistant immersed themselves in the data and completed all coding. An initial coding scheme of categories was developed from initial impressions, and first-level coding which was reviewed with the larger team. Once the codebook was refined, transcripts were coded independently by the two team members. Through regular meetings, codebook refinement continued and all coding was compared and reconciled to match agreement between the two coders. Then the categories were clustered together by the team to represent four themes.

Trustworthiness

The rigor of this study was guided by Lincoln and Guba (1985). To establish and improve the credibility of the findings, we used three techniques: investigator triangulation, peer debriefing, and member checks. Throughout the study, including development of the interview guide and data analysis, the interdisciplinary team provided investigator

triangulation to reduce bias. The lead author engaged in peer debriefing through an Advanced Qualitative Collective: A group of faculty, postdoctoral and predoctoral students who were not involved in the study provided a process of debriefing and challenging of the findings (Abboud et al., 2017). Member checks involved a team member (N.V.) returning to the participants to discuss the emergent findings. For those who could be contacted (four caregivers, eight clinicians, four older adults), they conveyed that the findings resonated with them. The participants also helped select theme names from a small list of potential themes developed by the team. The theme names identified most were used within this article to describe the findings. The dependability and confirmability of the study has been established through an audit trail, which is a record of all decisions made during the coding and analysis phase of the study.

Results

Four themes emerged from the analysis of the three focus groups: (a) Accomplishing Everyday Tasks, (b) Personal Connections and Meaningful Activities, (c) Cognitive Interventions, and (d) Safety Measures.

Accomplishing Everyday Tasks

Important perspectives from all three groups (caregivers, clinicians, and older adults) supported this theme. These perspectives from the stakeholder groups described tasks for older adults to accomplish daily, as well as the “use it or lose it” attitude of the older adults keeping physically active. Under the theme of Accomplishing Everyday Tasks emerged tasks that the older adults’ routines consisted of completing activities of daily living (ADLs) and instrumental activities of daily living (IADLs) either independently or with assistance from caregivers, clinicians, or family members. Completing ADLs and IADLs daily was important from the perspectives of all three groups (caregivers, clinicians, and older adults). The older adults expressed wanting to complete ADLs and IADLs for themselves as they were able. However, when physical disabilities and chronic pain interfered with their independence, they had to rely on assistance from others. Our older adult participants had a wide range of functional limitations from being nearly independent to requiring extensive assistance to complete everyday tasks.

ADLs and IADLs—During analysis, we characterized the important everyday tasks for older adults to accomplish daily we heard from the three groups as ADLs and IADLs. In broad categories, the important ADLs consisted of bathing and grooming, eating, selecting proper attire and putting on clothing, toileting, transferring, and walking. Likewise, the broad categories for important IADLs were ability to use a phone and other communication devices, food preparation, handling finances, handling transportation, housekeeping, laundry, opening bottles, responsibility for own medications, and shopping. The ADLs all three stakeholder groups specifically mentioned as important daily were ambulation, bathing and showering, transferring into chairs, and repositioning in chairs. The important IADLs all three stakeholder groups specifically mentioned were cleaning, laundry, and preparing meals. One caregiver reported the older adult needed “the basic things like cleaning the bathroom, mopping, washing dishes and wiping down counters.”

Routines—Caregivers told us their routines with the older adults in SAL, depending on the time of day, consisted of helping them get ready to go to the PACE center, “ready for church or for a doctor’s appointment,” or helping them get ready for bed. Routines included providing personal care, assisting with meals, assisting with transfers in and out of bed and/or wheelchairs, ambulating with the older adults, and escorting them to the PACE van. When transferring older adults, a second caregiver may be present and/or a mechanical device such as a Hoyer Lift may be used which requires physical work to maneuver a lift sling underneath the person. Even with assistance and the use of mechanical devices, caregivers told us that the task of transferring older adults put a lot of stress and strain on their bodies. Caregivers also shared that they respond to medical issues and emergencies within the SAL. Examples given were older adults falling on the floor when walking, rolling out of bed, vomiting, or having difficulty breathing.

The clinicians’ routines with the older adults involved completing routine and as needed health and physical assessments within the PACE center and in SAL. Like the caregivers, the clinicians spoke about the physical assistance they provide to the older adults, who are wheelchair bound, or need assistance out of a chair, or move in bed. They also discussed turning and repositioning older adults to prevent pressure ulcers, pulling them up in bed, and helping them in and out of bed. Physical transferring of the older adults’ in different situations was mentioned including in the clinic, in the physical therapy room, in and out of chairs in the craft room, and to the bathroom. The clinicians talked about some older adults having a routine to come to their offices for assistance with tasks they cannot do for themselves, such as putting compression stockings on their legs. A clinician noted “they can’t get the leg up and they can’t hold the stocking, hands aren’t strong enough to pull.” Clinicians explained that they and the caregivers may also give showers at the PACE center if the older adults refused to shower at their SAL or showering can’t be done safely in the SAL, for instance needing a two person assist and only one caregiver present.

Need for assistance—Older adults’ need for assistance with accomplishing everyday tasks was related to physical challenges from either functional disabilities, visual impairments, or chronic pain. Both caregivers and clinicians discussed those with visual impairments needed help with reading their mail. Clinicians also mentioned communication challenges they have when working with older adults with hearing deficits which can make conversations difficult and frustrating. In addition, the clinicians mentioned that some of the older adults have difficulty with their hands affecting their ability to put on items and manipulate zippers.

The older adults spent time talking about their own physical challenges. Examples were difficulty bending down because of a hip replacement and being unable to use one side of their body due to a stroke. These challenges created difficultly with transferring themselves, bending down to pick up something they dropped or taking care of their legs and feet (i.e., applying lotion). Older adults also mentioned their arthritis and “aches and pains” interfering with their independence. One participant mentioned that it was a struggle for her to walk because of pain. Another participant reported that opening cans was a challenge because of “numbness in the tips of my fingers and arthritis and carpal tunnel.”

Use it or lose it—Caregivers expressed that it is important to encourage and remind the older adults to "use it or lose it." One caregiver told us, "… just to remind them to use what they have—their limbs and everything. Use everything because if you don't use it, then you're gonna lose it. Just remind 'em to keep as active as they can." Keeping the older adults active was described as taking them for walks, dancing with them, and encouraging range of motion to their joints and for the older adults to do as much for themselves as possible. The clinician group also spoke about their role of training older adults to be as independent as possible. This is done through working individually with older adults on ADLs such as walking and stair climbing and leading exercise groups.

The older adults expressed that they wanted to continue to do as much as possible for themselves, despite physical challenges related to disabilities and pain. One participant talked about sweeping his floor daily despite being chair bound with use of one side of his body because of a stroke. Another participant shared that when she is "not in too much pain," she will prepare her own meals. Several participants talked about daily exercise being important for them such as walking in the hallway. However, almost all of the participants discussed needing to modify their exercise because of pain or disability. For example, one older adult with limited ability to walk talked about sitting in her recliner and exercising her feet, although she expressed wishing she could participate in more exercise.

All the older adults talked about their physical function in terms of continuing to be active with the exception of one older adult. She told us it was important for her to make time for word search puzzles as she explained, "You know how they say the mind is a terrible thing to lose. Well, I'm not trying to lose it if I can help it."

Personal Connections and Meaningful Activities

Having personal connections with others and engaging in meaningful activities daily emerged as important for older adults from the perspectives of all three groups. Personal Connections and Meaningful Activities included the older adults sharing that it was important to engage in socialization and leisure activities. The caregivers and clinicians shared that they work to build personal relationships with the older adults, offer support, and boost moods. Older adults told us routinely engaging in socialization and leisure activities was important. Caregivers and clinicians focused on personal relationships they have built with the members, the encouragement provided to the older adults to socialize with others, and the use of techniques such as humor and discussions on their faith to bolster their moods. They also encourage older adults to participate in activities they enjoy. A poignant point heard from caregivers and clinicians was about the diminished mental health of some of their older adults related to feelings of loneliness and depression. One nurse talked about visits to the PACE participants' homes and them not wanting her to leave because they were lonely. This was corroborated by an older adult who stated "hardly anybody visits me."

The older adults mentioned they engaged socially with those living in their SAL building, their family members, members of their church, and people in the community. These social contacts were described as being in-person and on the phone. One woman spoke about staying connected to others through social media which was unique to the other older adults in the focus group: "I go to Instagram, Facebook, Twitter, all of them."

Specific leisure activities the older adults enjoyed included physical activities such as exercise programs, going for walks, and dancing. Older adults found taking occasional trips meaningful and something they enjoyed if they were able. Examples were trips: shopping, theater, casino, and attending a ball game. Independent activities that the older adults engaged in daily included watching television (particularly sporting events for one male participant), watching movies, listening to the radio, reading, playing word games, and using a computer. For those who were religious, routinely attending church, reading religious materials, listening to religious recordings, and sharing religious messages with others were important.

Both the caregivers and clinicians discussed the importance of building personal relationships with the older adults. For caregivers, this meant personally knowing the older adults, their routines and preferences. This allowed them to recognize mood changes which were then reported to the PACE nurses. From the clinicians' perspectives, personal relationships were built through "developing a clinical relationship" with those under their care and building trust with them. Through these personal relationships, the clinicians knew when something was wrong with the older adults just by looking at them or learning that their routine had been disrupted. The caregivers shared that when the older adults were lonely and depressed, beyond reporting to the nurses, they offered companionship through conversation. Providing a "listening ear" to the older adults and encouraging them to talk when there is something on their mind was also important. Humor and encouragement was described as an effective technique to boost the older adults' moods and to lift their spirits. One caregiver shared,

> We support them, when they feelin' down, they wanna give up and they just being negative. You gotta encourage them to keep trying, not to give up, and keep the faith. Yes. We try to talk about religion with 'em. We just talk about family—when they're feeling alone and lonely, they just say I just wish I would die, and I don't have to go through this, and we tell 'em that they have a purpose. We keep letting 'em know they're here for a reason and let them know that they are important.

Other techniques that the caregivers shared as important for them to do routinely was to encourage the older adults to not stay in their rooms by themselves and to visit each other in the SAL building. Caregivers talked about the coordination of birthday parties and bingo games within the building and encouraging attendance. Furthermore, the caregivers talked about encouraging the older adults to go to the PACE center to engage in the activities offered there or to be seen by their nurse practitioners when ill.

One clinician told us that conversations with the older adults at the PACE center was an essential activity including offering support. A clinician shared,

> … sometimes just sitting and talking to them. You'd be surprised how much these members go through at home and their only outlet is here. Some of them will come here every day and talk to you about their families and how they're feeling and how they feel alone and the only support they get is from us. So just to have a listening ear and to talk to them is important …

Clinicians also shared that it is important for them to encourage older adults to talk to each other when at the PACE center and to participate in different group activities. They work to increase opportunities for socialize, such as during group exercise classes. The clinicians spent less time focusing their conversation on the mental health of the older adults than the caregivers. Instead clinicians focused on cognition.

Cognitive Interventions

The Cognitive Interventions theme is derived from hearing the clinicians say that it is important that they give older adults the cognitive tools they need to continue to be as safe and independent as possible in SAL. Cognitive interventions included the clinicians giving cognitive tools to older adults so they can remain as safe and independent as possible in SAL. The cognitive tools were reminders, establishing a routine and designing interventions through trial and error for each individual.

The clinicians said that many of the PACE members “are forgetful sometimes,” have poor judgment, have difficulty, or are unable to follow directions due to their cognitive impairment. These cognitive challenges can be frustrating for clinicians and caregivers at times resulting in having to continuously repeat directions and answer the same questions including orientation information on the day, time, season, and important events. These cognitive challenges also created hurdles for the members to be adherent with their established plan of care including adherence to their medication regimen.

For clinicians, it is important to provide daily reminders to the older adults who are capable of completing their ADLs and IADLs independently once cued. Examples given included reminders to take medications, to go to the bathroom, to reposition themselves, to eat, and to drink fluids. One of the main cognitive interventions used was providing alarm clocks to remind people to reposition or use the bathroom. A similar intervention mentioned to promote safety was speaking bed alarms giving directions not to get up without assistance.

Clinicians discussed working with members to develop and implement clinical interventions such as those listed above by providing the cognitive tools necessary for the older adults’ safety and independence. One clinician told us,

> So it’s matching their cognitive ability with the task that needs to be accomplished and making whatever modifications, giving somebody an alarm clock or something like that so they will take their medication on time. Or some people can use written instructions, other people can’t. Some people you have to go over and over and over it for several weeks and then they’ll learn it.

Safety Measures

Safety Measures encompassed clinicians working with older adults on safety and injury prevention and caregivers checking in on older adults in SAL.

From the perspectives of the clinicians and caregivers, we learned that a top priority for the older adults was safety and injury prevention. A key activity for the clinicians was

developing safe care plans to keep the older adults safe in SAL. For the caregivers, routinely checking in with the older adults when they were in their apartments was important.

Clinicians focused on fall prevention within the PACE center including training on safe transfers and ambulation safety. Instruction on proper use of walkers was particularly important for those with dementia who need additional reminders to keep their walkers with them and used appropriately according to the clinicians.

The occupational and physical therapists shared that they completed evaluations in SAL and "see if they [the older adults] need any equipment or any modifications in their home to make them safer." At times, furniture in apartments needed to be moved to make safe, clear pathways for ambulation. In addition to discussions around preventing physical injury, one nurse talked about being worried during the summer months about the older adults having the heat on in their apartments or poor ventilation. This places them at risk for dehydration and heat stroke and she spoke about having to check temperature levels to make sure they were safe.

From the caregivers, we learned that a key activity for them was checking in with the older adults every 2 hr while they were in their SAL apartment. These check-ins were described as checking to see if the older adults needed help with anything and determine if medications had been taken. As part of a check-in a caregiver explained their routine included "… make sure they have their call light before you leave. And then you make sure their bed is at the lowest level just in case [they] roll out." In addition, checking in at meal times was important and involved preparing meals for the older adults if they could not do it themselves, cutting food into chewable bites to prevent choking, making sure that there were fluids with the food, and checking that a meal had not been missed.

All of the older adults shared that they were being checked on with the exception of one member who felt she was not being checked on enough. She expressed concerns that she might experience a medical emergency and the caregivers would not be aware of it. The caregivers shared with us that their routine is to make sure that the older adults had their call bell in reach before leaving the room so they could be called back if needed. The same older adult who felt she was not being checked on enough did mention that she used the call bell when she needed assistance with something such as retrieval of items in her apartment and when her movement was restricted during a flare-up of chronic pain.

Discussion

We learned from this study important activities for the older adults (who live in SAL) to accomplish daily physically, mentally, and socially, from the perceptions of older adults, caregivers, and interdisciplinary clinicians. Through focus groups with the three stakeholder groups, we identified four themes which provided a better understanding of the needs and routines of older adults with multimorbid conditions. These themes are (a) Accomplishing Everyday Tasks, (b) Personal Connections and Meaningful Activities, (c) Cognitive Interventions, and (d) Safety Measures. We also learned current approaches that caregivers and clinicians used to meet the needs and the gaps in meeting the needs of older adults.

From health care professionals' perspectives, it is no surprise that ADLs and IADLs were important for the older adults to accomplish daily. However, the details of the individual tasks the older adults needed and wanted to accomplish to get ready for the day or night is precisely what was important for an interdisciplinary team to review and understand when developing a mobile robot aimed at assisting older adults in SAL.

The clinicians and caregivers spoke about how important it was for them to provide socialization during contact and to encourage socializations among the older adults. However, the older adults discussed socialization with other residents in their SAL building, their family members, members of their church, and people in their community. They did not talk about socialization with their nurses or caregivers at their SAL as being important to them. They also did not speak about social interactions with clinicians or other staff at the PACE center with the exception of one member who reminisced about going to a baseball game with one of the nurse practitioners. We learned that there is a difference between what the clinicians and caregivers saw as socialization compared with the older adults. The older adults referred to their family and friends and not professionals (caregivers or clinicians) when discussing socialization. Despite the older adults being surrounded by people in SAL and at the PACE center, they felt lonely, and "listening ears" provided by clinicians and caregivers was not sufficient for meeting their socialization needs.

This study provides insight into how a robot could potentially provide socialization by connecting older adults with their family or friends. One can argue that in this age of social media and relatively low-cost mobile phones and personal computing technology that connecting older adults with their family should be easy and may not require a robot. Unfortunately, the cost of remaining connected via mobile phones, personal computers, and the Internet is one that many of the older adults in SAL cannot afford, suggesting an issue of technology divide and access inequity. One solution for supporting the older adults entails the deployment of a relatively low-cost robot such as the Vgo (Cesta, Cortellessa, Orlandini, & Tiberio, 2012; Jayawardena et al., 2010; Michaud et al., 2007). The Vgo would be able to move around SAL, be an access point for the Internet, allow multiple users to share its access, which provides a vehicle for social communication. The Vgo robot could be dedicated to supporting this one task of communication; however, the older adults would need another robot to support ADL tasks. The goal of our larger study was to develop a low-cost robot that is able to support a subset of ADLs as well as provide options for socialization.

The finding that clinicians and caregivers provide reminders, establish a routine, and use trial and error when designing interventions for those with memory and cognitive issues is also not surprising. The older adults themselves did not report concerns about reminders or establishing routines; however, they were cognitively intact per study protocol in hopes that they could engage in a meaningful focus group conversation. Coping strategies involving technology (i.e., alarms for reminders) have become popular interventions. Robots are best at providing these services as computational machines that can store vast amount of information without risk of degradation. The key issue with this interface is when and how to store and retrieve these data. The theme of safety for older adults was so prominent in highlighting the importance of taking safety into consideration when developing technology

for older adults. Any device developed which could be perceived by older adults, caregivers, or clinicians as unsafe would decrease the willingness to engage in the use of the technology. Safety in the development of service robots should be addressed in a variety of ways, including forcing the robots to maintain safe distances from the user, minimizing movement speed, and employing sensors that can detect when the user is approaching the robot. Our development goal was to employ many of these standard methods of human–robot interactions while determining the best strategy for increasing engagement with the robot and reassuring users of the safety. Focusing on ADLs and tasks that do not require the application of large forces is also inherently safer as a robot with weak actuators is not capable of mistakenly applying a strong force at the wrong time in the wrong place. Next steps for the interdisciplinary research team are to use these findings to inform the selection of features to incorporate into the development and testing of a prototype low-cost mobile robot to assist older adults.

Limitations

Throughout this study, rigorous qualitative methods were applied; however, there are some limitations. All participants were a convenience sample from one PACE center and all spoke English. This PACE center was associated with a university and supported research as part of its mission. Prior to this study, a humanoid robot was demonstrated to older adults at the same center which may have produced preconceived notions during our focus groups. The study included a small sample of cognitively intact multimorbid, functionally impaired older adults who were NH eligible living in SAL which is a very specific population. Older adults with cognitive impairment were not included due to our qualitative methods. However, insights were gained from caregivers and clinicians on the needs of older adults with cognitive impairment. We have provided rich descriptions so others can judge the transferability of the findings (Lincoln & Guba, 1985). This study had a discovery focus and the information learned is foundational for future work on the larger mixed-methods study (Wu, Thompson, Aroian, McQuaid, & Deatrick, 2016). A strength of this study is that the older adults had a diverse range of function abilities from being fairly independent in their apartments to requiring extensive assistance with ADLs and IADLs.

Conclusion

This qualitative descriptive study aimed to determine routines and important activities older adults should accomplish physically, mentally, and socially from the perspective of the three stakeholder groups (older adults, paid caregivers, and clinicians). Presented are four themes detailing the various activities that represent routines and the needs of the older adults. Results from our focus groups provided valuable information for designing and specifying functionalities for a low-cost mobile assistive robot for deployment in older adults' apartments to aide in increasing their independence at home.

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References

Abboud S, Kim SK, Jacoby S, Mooney-Doyle K, Waite T, Froh E, … Kelly T-A. Co-creation of a pedagogical space to support qualitative inquiry: An advanced qualitative collective. Nurse Education Today. 2017; 50:8–11. [PubMed: 28002756]

Cesta, A., Cortellessa, G., Orlandini, A., Tiberio, L. Addressing the long-term evaluation of a telepresence robot for the elderly. Proceedings of the 4th International Conference on Agents and Artificial Intelligence - Volume 1: SSIR, (ICAART 2012); 2012. p. 652-663.

Chuttur MY. Overview of the technology acceptance model: Origins, developments and future directions. Working Papers on Information Systems. 2009; 9(37):9–37.

Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly. 1989; 13:319–340.

Elo S, Kyngas H. The qualitative content analysis process. Journal of Advanced Nursing. 2008; 62:107–115. DOI: 10.1111/j.1365-2648.2007.04569.x [PubMed: 18352969]

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; 12:189–198. [PubMed: 1202204]

Freedman VA, Spillman BC. The residential continuum from home to nursing home: Size, characteristics and unmet needs of older adults. The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences. 2014; 69(Suppl. 1):S42–S50. DOI: 10.1093/geronb/gbu120

Graneheim UH, Lundman B. Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. Nurse Education Today. 2004; 24:105–112. DOI: 10.1016/j.nedt.2003.10.001 [PubMed: 14769454]

Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qualitative Health Research. 2005; 15:1277–1288. DOI: 10.1177/1049732305276687 [PubMed: 16204405]

Jayawardena, C., Kuo, IH., Unger, U., Igic, A., Wong, R., Watson, CI., … Warren, J. Deployment of a service robot to help older people. Paper presented at the 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); Taipei, Taiwan. 2010 Oct 18–22.

Kim H, Sefcik JS, Bradway C. Characteristics of qualitative descriptive studies: A systematic review. Research in Nursing & Health. 2017; 40:23–42. [PubMed: 27686751]

Lattanzio F, Abbatecola AM, Bevilacqua R, Chiatti C, Corsonello A, Rossi L, … Bernabei R. Advanced technology care innovation for older people in Italy: Necessity and opportunity to promote health and wellbeing. Journal of the American Medical Directors Association. 2014; 15:457–466. DOI: 10.1016/j.jamda.2014.04.003 [PubMed: 24836715]

Lincoln, YS., Guba, EG. Naturalistic inquiry. Vol. 75. Newbury Park, CA: SAGE; 1985.

Marasinghe KM, Lapitan JM, Ross A. Assistive technologies for ageing populations in six low-income and middle-income countries: A systematic review. BMJ Innovations. 2015; 1:182–195. DOI: 10.1136/bmjinnov-2015-000065

Michaud, F., Boissy, P., Labonte, D., Corriveau, H., Grant, A., Lauria, M., … Royer, M-P. Telepresence robot for home care assistance. Paper presented at the AAAI Spring Symposium: Multidisciplinary Collaboration for Socially Assistive Robotics; Stanford. March; 2007.

Neergaard MA, Olesen F, Andersen RS, Sondergaard J. Qualitative description—The poor cousin of health research? BMC Medical Research Methodology. 2009; 9(1):52. [PubMed: 19607668]

Sandelowski M. Focus on research methods-whatever happened to qualitative description? Research in Nursing and Health. 2000; 23:334–340. [PubMed: 10940958]

Sullivan-Marx EM, Bradway C, Barnsteiner J. Innovative collaborations: A case study for academic owned nursing practice. Journal of Nursing Scholarship. 2010; 42:50–57. [PubMed: 20487186]

Wade D, Vergis E. The Short Orientation–Memory–Concentration Test: A study of its reliability and validity. Clinical Rehabilitation. 1999; 13:164–170. [PubMed: 10348397]

Walden GR. SAGE Benchmarks in Social Research Methods: Focus group research. 2012; 4 doi: http://dx.doi.org/10.4135/9781446286111.

Wilk, R., Johnson, MJ. Usability feedback of patients and therapists on a conceptual mobile service robot for inpatient and home-based stroke rehabilitation. Paper presented at the 2014 5th IEEE RAS & EMBS International Conference on Biomedical Robotics and Biomechatronics; Sao Paulo, Brazil. 2014 Aug 12–15.

Wu YP, Thompson D, Aroian KJ, McQuaid EL, Deatrick JA. Commentary: Writing and evaluating qualitative research reports. Journal of Pediatric Psychology. 2016; 41:493–505. [PubMed: 27118271]

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Table 1

Demographics of Older Adults, Caregivers, and Clinicians.

Demographic characteristics	*n*	%
Older adults	5	
Male	2	40
Female	3	60
Age range		
66–75 years	1	20
76–85 years	2	40
85 years	2	40
African American	5	100
Caregivers	6	
Female	6	100
Age range		
< 30 years	2	33.3
30 to 50 years	2	33.3
50 years	2	33.3
Caregiver type		
Certified nursing assistant	5	83.3
Home health aid	1	16.7
African American	6	100
Clinicians	8	
Male	1	12.5
Female	7	87.5
Age range		
30 to 50 years	4	50
50 years	4	50
Clinician type		
Nurse	3	37.5
Nurse practitioner	1	12.5
Physical therapist	2	25
Occupational therapist	2	25
African American	1	12.5
Caucasian	7	87.5