

Satisfaction and Technology Evaluation of a Telehealth Robotic Program to Optimize Healthy Independent Living for Older Adults

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Abstract

Background and Purpose: With the growth in the aging population, and shortage of primary care providers, telehealth programs are needed to optimize healthy independent living for older adults. The purpose of this study was to evaluate a nurse-led intervention program delivered through a telepresence robot to promote healthy lifestyles and address chronic illness management among older adults living independently in a retirement community. Telepresence robots provide two-way video-mediated communication with remote in-home navigation.

Design and Methods: Satisfaction and technology evaluation ratings of the Telehealth Community Health Assistance Team (T-CHAT) program, as well as qualitative data from open-ended questions, were obtained from 26 older adults and 7 nurse practitioner students.

Findings: On a scale from 1 = *strongly disagree* to 5 = *strongly agree*, satisfaction ratings were positive for usefulness ($M = 3.90$), ease of use ($M = 4.16$), and acceptability ($M = 4.06$). Technology evaluation ratings were high for all sessions ($M = 4.35$). Older adults and nurse practitioner students were highly complementary of the program. Areas for improvement were identified.

Conclusions: The T-CHAT program demonstrated high ratings for satisfaction (usefulness, ease of use, acceptability) and for evaluation of the telepresence robot technology. Further refinement of the T-CHAT program is warranted, as is testing outcomes of this potentially viable mode of healthcare delivery.

Clinical Relevance: Robotics is the wave of the future and provides an innovative mode of delivery to address health promotion and chronic illness management in older adults. Satisfaction and technology evaluation of robotic technology is paramount prior to implementation of such programs into practice.

Worldwide, the number of people 60 years of age and above will grow from an estimated 900 million in 2015 to over 2 billion in the year 2050 (World Health Organization, 2018). All countries will face

major challenges in preparing health and social systems to address this major shift (World Health Organization, 2018). In the United States, the number of persons 65 years of age and older is estimated

to double in the next 25 years, with approximately two thirds of older adults expected to have multiple chronic conditions (Administration on Aging, 2016; Centers for Disease Control and Prevention, 2013; Vincent & Velkoff, 2010). To escalate the problem, there is a growing shortage of primary care providers whose scope of practice is to address health promotion and chronic illness management needs in older adults (U.S. Department of Health and Human Services, 2013). Registered nurses, nurse practitioners, and nurse practitioner students are particularly well suited to provide essential services in the areas of health promotion and chronic illness management, yet access to these services remains a challenge. Telehealth is rapidly expanding to increase access to services, particularly for those living in rural settings; however, patient satisfaction is a growing concern (Kruse, Krowski, Rodriguez, Tran, Vela, & Brooks, 2017). For example, satisfaction of telehealth services through remote monitoring has been reported by seniors receiving care from homecare agencies, although lower levels of satisfaction of these services have been found in assisted living facilities (Grant, Rockwood, & Stennes, 2015). Aside from traditional primary care and remote monitoring through telehealth services, programs are needed that address healthy lifestyle behaviors and management of chronic conditions to support healthy independent living among older adults.

The most commonly and widely cited program that addresses chronic illness management is Lorig's Chronic Disease Self-Management Program (Brady et al., 2013; Lorig, Ritter, Laurent, & Plant, 2006; Lorig, Ritter, Moreland, & Laurent, 2015; Lorig et al., 1999). This evidence-based program has been found to improve self-efficacy for managing chronic disease, symptoms, depression, aerobic exercise, and self-rated health (Brady et al., 2013). However, the Chronic Disease Self-Management Program is delivered face to face through small group settings (Brady et al., 2013; Lorig et al., 1999) or through online resources (Lorig et al., 2006), which may not be easily accessible by many older adults. One study showed that simply mailing Lorig's Living a Healthy Life with Chronic Conditions Toolkit (Lorig et al., 2012) to older adults fostered medication adherence and resulted in fewer depressive symptoms, unhealthy days, and physician visits (Lorig et al., 2015); however, a mailed toolkit may not be sufficient for some older adults, and many prefer two-way interaction with healthcare providers.

Telepresence robots could be a viable mode of delivery of lifestyle and chronic illness management interventions for older adults living independently in the

community. A recent systematic review of 58 studies categorized problems experienced by the aging population, then described the types of robots that have been used to address these problems (Shishehgar, Kerr, & Blake, 2017). Problems included social isolation, dependent living, physical or cognitive impairments, mobility problems, poor health monitoring, lack of recreation, need for medication or appointment reminders, and falls. The most commonly used and effective robots found to address these problems were companion robots, followed by telepresence robots (Shishehgar et al., 2017). Companion robots are usually humanoid, or in the shape of a pet, such as a cat or a seal. These robots have been used to address social isolation or cognitive impairment, or to provide entertainment for older adults (Shishehgar et al., 2017). Telepresence robots provide two-way video-mediated communication with remote in-home navigation to connect older adults with informal caregivers (e.g., family or friends) and healthcare providers. In addition to reducing social isolation, telepresence robots allow informal caregivers and healthcare providers to monitor and address the health and safety of older adults from a distance (Shishehgar et al., 2017). From a single location, healthcare providers can drive telepresence robots into the homes of older adults residing in retirement communities, reducing travel time, cost, and improving accessibility of healthcare. The use of telepresence robots to address health promotion and chronic illness management needs of older adults is innovative and warrants more research. Patient satisfaction is a key indicator of telehealth success (Shishehgar et al., 2017), and therefore is a key component to include in the design of future research using telepresence robots.

The purpose of this study was to evaluate a newly developed program called the Telehealth Community Health Assistance Team (T-CHAT), a nurse-led intervention designed to promote healthy lifestyles and address chronic illness management delivered through a telepresence robot (VGo Communications, Inc., 2013). For this study, nurse practitioner students served as T-CHAT coaches to deliver the intervention, and an engineering student provided technological support. The following research questions were addressed:

1. How satisfied (usefulness, ease of use, acceptability) were the older adults with the newly developed T-CHAT program?
2. How did the older adults and T-CHAT coaches rate the technology of the telepresence robot?
3. What were the strengths and weaknesses of the T-CHAT program delivered through the telepresence

robot from the perspectives of older adults, T-CHAT coaches, and the engineering student?

Design and Methods

Design

A multimethod design involving the collection of both quantitative and qualitative data (Miles, Huberman, & Saldana, 2013) was used for program evaluation of the T-CHAT program, with emphasis on client satisfaction (Royse, Thyer, Padgett, & Logan, 2001). Satisfaction and technology evaluation ratings, as well as qualitative data through open-ended questions, were obtained from 26 older adults, seven nurse practitioner students who served as T-CHAT coaches, and an engineering student who provided further qualitative input.

Participants

Older adults were recruited from independent living apartments in a large multi-tier retirement community in the Midwest using convenience sampling. Recruitment strategies included presenting the study opportunity at social events, conducting robot demonstrations, and placing flyers in the mailboxes of each resident. Inclusion criteria included: older adults 60 years of age and older; ability to hear, speak, and read in the English language; ability to pass a hearing screening through the telepresence robot; and ability to pass a six-item cognitive screener with a score of 4/6 (Callahan, Unverzagt, Hui, Perkins, & Hendrie, 2002). Older adults were excluded if they were receiving hospice care, or had a history of Alzheimer's disease or dementia. The study was approved by an institutional review board, with older adults providing informed consent prior to participation. Referrals were made to health-care providers for any health-related concerns.

The T-CHAT coaches were nurse practitioner students enrolled in an accredited master's of science in nursing, adult-gerontology nurse practitioner program who volunteered and were recommended by faculty. The T-CHAT coaches were required to have an active registered nurses license. The engineering student who provided technology support for the project was enrolled in a master's of engineering program, and had considerable experience working with telehealth robots.

Data Collection and Study Instruments

Satisfaction ratings and qualitative data regarding the T-CHAT program were collected at the end of

the study through face-to-face interviews with 26 older adults in their homes by a separate data collector to avoid bias. Technology evaluation ratings with additional qualitative data were collected from the 26 older adults after each of the T-CHAT sessions by the T-CHAT coaches to troubleshoot ongoing technology issues with the telepresence robot. Technology evaluation ratings and qualitative data from the seven T-CHAT coaches and the engineering student were collected by self-administration with written responses to open-ended questions after each of the T-CHAT sessions.

Satisfaction of the T-CHAT program was measured using an adapted version of the Satisfaction Questionnaire (Bakas et al., 2009), consisting of nine items (usefulness four items; ease of use three items; acceptability two items) rated on a response scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. Evidence of internal consistency reliability has been reported in a sample of 40 family caregivers of stroke survivors evaluating the Telephone Assessment and Skill-building Kit (Cronbach's alpha = .93 for the total scale, usefulness .83, ease of use .75, acceptability .76; Bakas et al., 2009). Minor rewording of the items was instituted to adapt the measure to the T-CHAT program (Table 1). Designed specifically for this study, investigator-designed rating forms were used to obtain technology evaluation ratings from the perspectives of both the older adults and the T-CHAT coaches after each T-CHAT session (Tables 2 and 3). The technology evaluation ratings employed the same response scale as the satisfaction items. Because the technology evaluation ratings were developed specifically for this study, no prior reliability and validity information was available; however, items were reviewed by the research team consisting of experts in instrument development and telehealth prior to administration. Open-ended questions were asked to determine strengths and weaknesses of the T-CHAT program: "What suggestions do you have that would help us make the visits from the T-CHAT coach better?"; "Overall, was the program helpful (why or why not)?"; and "Would you recommend the program to others (why or why not)?" Open-ended questions after each T-CHAT session included, "What do you like most about using the robot?"; "What do you like least?"; and "What further comments do you have?"

T-CHAT Procedures

The T-CHAT program consisted of a face-to-face history and physical visit with the older adult, followed by three T-CHAT health coaching visits using

Table 1. Satisfaction Ratings by Older Adults After the Three T-CHAT Sessions (N = 26)

	M (SD)	Range
Usefulness subscale	3.90 (0.70)	2.25–5.00
The Chronic Illness Toolkit addressed the problems I was having.	3.92 (0.76)	2.00–5.00
The Chronic Illness Toolkit worked well for me.	3.84 (0.99)	1.00–5.00
The T-CHAT coach addressed things I wanted to know.	4.00 (0.87)	2.00–5.00
The visits from the T-CHAT coach using the telehealth robot helped me.	3.79 (0.83)	2.00–5.00
Ease of Use subscale	4.16 (0.61)	3.00–5.00
The Chronic Illness Toolkit was easy to use.	4.16 (0.80)	3.00–5.00
I plan to use the Chronic Illness Toolkit as a reference for the future.	3.96 (1.06)	1.00–5.00
The visits from the T-CHAT coach using the telehealth robot were convenient.	4.36 (0.57)	3.00–5.00
Acceptability	4.06 (0.81)	2.00–5.00
I liked the Chronic Illness Toolkit.	4.08 (1.00)	1.00–5.00
I liked getting visits from the T-CHAT coach using the telehealth robot.	4.04 (1.02)	1.00–5.00
Total satisfaction scale	4.01 (0.65)	2.56–5.00

Note. Items were rated on a scale with 1 = *strongly disagree*; 2 = *disagree*; 3 = *neither agree nor disagree*; 4 = *agree*; 5 = *strongly agree*. T-CHAT = Telehealth Community Health Assistance Team.

the telepresence robot (VGo Communications Inc., 2013). At the conclusion of the history and physical visit, older adults received Lorig's Living a Healthy Life with Chronic Conditions Toolkit, consisting of a textbook and two CDROMs containing relaxation and

physical activity exercises (Lorig et al., 2012). The three weekly T-CHAT sessions consisted of the T-CHAT coach and the older adult discussing and selecting a goal on which to create an action plan incorporating Lorig's work (Lorig et al., 2012). The creation of action plans were designed to foster a healthier lifestyle with better management of chronic conditions. The T-CHAT coaches reviewed results from the history and physical and made referrals to healthcare providers as appropriate. The face-to-face history and physical visit lasted approximately 60 min. The 3 weekly T-CHAT sessions through the telepresence robot lasted approximately 30 min each. Because the robot did not have arms to ring the doorbell or knock, an appointment was made with the older adults so that they would open their door at the appointed time. If the older adults did not open the door within 5 min of their appointed time, a call was made to let them know that the robot was waiting outside. The principal investigators trained the T-CHAT coaches and closely monitored treatment fidelity of the T-CHAT intervention delivered by the T-CHAT coaches to the older adults (Bakas et al., in press).

Data Analyses

Satisfaction and technology evaluation ratings were summarized using descriptive statistics (i.e., means, standard deviations, ranges). Deductive coding was used to analyze qualitative data obtained from open-ended questions using a provisional "start list" of codes based on the three categories of satisfaction (usefulness, ease of use, acceptability) to mirror the Satisfaction

Table 2. Technology Evaluation Ratings by Older Adults After Each of the Three T-CHAT Sessions (N = 26)

	T-CHAT Session 1 M (SD) Range	T-CHAT Session 2 M (SD) Range	T-CHAT Session 3 M (SD) Range
I had a great overall experience using the T-CHAT telepresence robot this session.	4.38 (0.57) 3–5	4.50 (0.51) 4–5	4.28 (0.84) 1–5
I was able to clearly hear my T-CHAT coach through the telepresence robot.	4.43 (0.86) 2–5	4.46 (0.88) 1–5	4.32 (0.75) 3–5
I was able to see everything through the telepresence robot that my T-CHAT coach wanted me to read and view.	4.19 (1.10) 2–5	4.08 (1.02) 1–5	4.28 (0.84) 2–5
I think the T-CHAT telepresence robot worked well during the visit that I had with the T-CHAT coach.	4.50 (0.71) 2–5	4.50 (0.59) 3–5	4.24 (0.72) 2–5
I could maintain eye contact with the T-CHAT coach through the telepresence robot.	4.23 (1.24) 1–5	4.54 (0.93) 1–5	4.32 (0.95) 1–5
Total average	4.35 (0.64) 3–5	4.42 (0.53) 3–5	4.29 (0.54) 3.2–5.0

Note. Items were rated on a scale with 1 = *strongly disagree*; 2 = *disagree*; 3 = *neither agree nor disagree*; 4 = *agree*; 5 = *strongly agree*. T-CHAT = Telehealth Community Health Assistance Team.

Table 3. Technology Evaluation Ratings by Nurses After Each of the Three T-CHAT Sessions (N = 7)

	T-CHAT Session 1	T-CHAT Session 2	T-CHAT Session 3
	M (SD)	M (SD)	M (SD)
	Range	Range	Range
I had a great overall experience using the telepresence robot for this T-CHAT session.	4.31 (0.88) 2–5	4.46 (0.59) 3–5	4.04 (0.89) 2–5
I was able to clearly hear the older adult through the telepresence robot.	4.38 (0.90) 2–5	4.50 (0.89) 2–5	4.16 (0.75) 2–5
The older adult was able to hear me through the telepresence robot.	4.38 (1.02) 2–5	4.50 (0.89) 2–5	3.88 (0.88) 2–5
I was able to visualize everything I needed during the visit.	4.19 (1.13) 1–5	4.63 (1.01) 1–5	4.32 (0.99) 1–5
Total average	4.32 (0.73) 2.5–5	4.52 (0.59) 3–5	4.10 (0.70) 2–5

Note. Items were rated on a scale with 1 = *strongly disagree*; 2 = *disagree*; 3 = *neither agree nor disagree*; 4 = *agree*; 5 = *strongly agree*. Average among all three sessions was $M = 4.35$. T-CHAT = Telehealth Community Health Assistance Team.

Questionnaire (Bakas et al., 2009; Miles et al., 2013). Areas of improvement were identified as a fourth category. An evaluation coding process was then instituted where positive and negative evaluations were delineated within each of the four categories (Miles et al., 2013; Royse et al., 2001). A matrix template was created where direct quotes were inserted into the four categories by one member of the research team, and then verified by two additional team members who independently reviewed and confirmed the coding process. Consensus was achieved on the most representative quotes for each code for inclusion in the manuscript. No additional themes or categories emerged, indicating that the predetermined “start list” was broad enough to be applicable to this study. Trustworthiness of the qualitative data was established by adhering to the criteria of credibility, reliability, and confirmability (Davies & Dodd, 2002; Miles et al., 2013; Royse et al., 2001). An audit trail was created to track each step of the coding process and decisions made during the analyses, ensuring credibility to minimize investigator bias (Royse et al., 2001). Reliability was based on the consistency of procedures, analyses, and conclusions made throughout the study (Davies & Dodd, 2002). Confirmability was enhanced by checking for representativeness (i.e., all older adults who participated in the T-CHAT program were interviewed), minimizing researcher effects (i.e., separate data collectors were used to collect satisfaction data), and triangulating across data sources and methods (i.e., comparing ratings and responses to open-ended questions; comparing responses between the older adults and the T-CHAT coaches; Miles et al., 2013; Royse et al., 2001).

Findings

Sample

A total of 36 older adults were screened, of whom 27 were eligible and agreed to participate (75%; Bakas et al., in press). One participant withdrew due to time constraints; therefore, the sample for this study consisted of 26 older adults with an average age of 85 years (range 77–95). Most of the older adults were female ($n = 17$, 65%), married ($n = 12$, 46%), or widowed ($n = 13$, 50%). All of the older adults were non-Hispanic Caucasians with an average education of 16 years (range 12–22). Most perceived their income level to be “comfortable” ($n = 20$, 77%), with fewer having “just enough to make ends meet” ($n = 6$, 23%). On average, older adults had about four chronic conditions (range one to seven), with the most common being arthritis ($n = 19$, 73%), cancer ($n = 16$, 62%), high blood pressure ($n = 13$, 50%), a heart condition ($n = 9$, 35%), or a thyroid problem ($n = 9$, 35%). Others reported a gastrointestinal condition ($n = 5$, 19%), stroke ($n = 3$, 12%), chronic lung condition ($n = 3$, 12%), depression ($n = 3$, 12%), diabetes ($n = 2$, 8%), or asthma ($n = 2$, 8%).

Satisfaction and Technology Ratings

Table 1 displays satisfaction ratings from the older adults, collected face to face after completion of the T-CHAT program by a separate data collector to avoid bias. Ratings for usefulness ($M = 3.90$, $SD = 0.70$), ease of use ($M = 4.16$, $SD = 0.61$), and acceptability ($M = 4.06$, $SD = 0.81$) were all above the midpoint of 3.0,

indicating that there was agreement with each item and subscale. On a scale from 1 to 5, with 5 being strongly agree, the total satisfaction mean was 4.01 ($SD = 0.65$). In Table 2, the T-CHAT coaches collected technology evaluation ratings from the older adults following each T-CHAT session. These ratings were used to troubleshoot technology issues before the next session. On a scale from 1 to 5, with 5 being *strongly agree*, ratings were all above 4.0, indicating agreement with each item. The total average was 4.35 ($SD = 0.64$) for T-CHAT Session 1, 4.42 ($SD = 0.53$) for T-CHAT Session 2, and 4.29 ($SD = 0.54$) for T-CHAT Session 3. In Table 3, the T-CHAT coaches provided technology evaluation ratings from their own perspectives for each of the T-CHAT sessions they completed with the 26 participants. A total of seven T-CHAT coaches were involved in the project. The total average for the T-CHAT coaches was 4.32 ($SD = 0.73$) for T-CHAT Session 1, 4.52 ($SD = 0.59$) for T-CHAT Session 2, and 4.10 ($SD = 0.70$) for T-CHAT Session 3 (average across all sessions $M = 4.35$, $SD = 0.67$). Overall, the T-CHAT coaches indicated that they had a "great overall experience using the telepresence robot" ($M = 4.31$, $SD = 0.88$ for Session 1; $M = 4.46$, $SD = 0.59$ for Session 2; and $M = 4.04$, $SD = 0.89$ for Session 3). These ratings were very similar to those of the older adults of having a "great overall experience using the telepresence robot" ($M = 4.38$, $SD = 0.57$ for Session 1; $M = 4.50$, $SD = 0.51$ for Session 2; and $M = 4.28$, $SD = 0.84$ for Session 3). Mean ratings of common items were also similar between the T-CHAT coaches and the older adults regarding the ability to "clearly hear my T-CHAT coach/older adult through the telepresence robot" and ability to "visualize everything/see everything I needed through the telepresence robot" (see Tables 2 and 3).

Qualitative Findings

Qualitative data analyses revealed rich descriptions of usefulness, ease of use, and acceptability of the T-CHAT program by the older adults and their T-CHAT coaches. Areas of improvement were offered as well, particularly with regard to connectivity issues of the robot, and additional robotic functions that would further enhance the program. The following subsections detail representative quotes from the older adults and the T-CHAT coaches that fell within each of the four major categories (usefulness, ease of use, acceptability, and areas for improvement).

Usefulness

The older adults found the T-CHAT program to be useful in terms of health promotion and chronic

illness management, as well as for setting goals for a healthy lifestyle. One older adult stated, "I can see the benefit to the program as it increased my awareness to a healthier, more active independent life." Another stated, "The program helped me to set goals and accomplish those goals." An additional comment was, "To receive an answer with a real-time conversation will save time, decrease unnecessary visits to the doctor or ER, and help people who are shut-ins." One of the T-CHAT coaches said, "Overall, great technology to aid the gap between patients and health care, especially at a time when they don't need acute medical attention." It was evident from both the ratings and open-ended questions that the older adults and the T-CHAT coaches viewed the T-CHAT program as a valuable way to improve health care for older adults.

Ease of use

The T-CHAT program was easy to use from the perspectives of both the older adults and the T-CHAT coaches. Older adults provided comments such as, "Convenience was one of the main factors" and "It was easy to talk with the coach, she was able to answer questions I had." T-CHAT coaches found the robot easy to use, with comments like, "I can answer questions and concerns of the patient just as if I were sitting next to the patient" and "Once knowing how to operate it, it is easy to drive the robot." These quotes were consistent with the high ease-of-use ratings from the Satisfaction Questionnaire.

Acceptability

The older adults enjoyed the T-CHAT program, particularly the interaction with their T-CHAT coaches, and the excitement and humor of being involved in testing a telepresence robot. An older adult said,

My friends have been asking me about the program and if I enjoyed being involved in the study. I told them yes, very much. I like the interaction and communication, and thought of knowing I am part of something that may shape future service to benefit older people.

Others liked how the T-CHAT coach was able to drive into their apartment, and one of the older adults found humor in the experience, "We laughed a lot when the coach had trouble driving the robot. It reminded me of learning how to drive a stick shift." The T-CHAT coaches enjoyed the experience as well. One of the T-CHAT coaches remarked, "I loved being

in their environment because I could get a lot more information about their personal health, and one of the questions is whether their surroundings are safe." The open-ended responses regarding acceptability mirrored the high ratings for "great overall experience using the telepresence robot."

Areas for improvement

Not all open-ended responses were positive from the perspectives of the older adults and the T-CHAT coaches. Several comments were offered regarding connectivity issues. "The only issue I noticed was during certain moments the robot would freeze up. There was interference from another source. I hope they can fix that." Another said, "When the robot didn't work, and the connection was bad, I [the older adult] didn't know if you [the T-CHAT coach] could hear me ... I didn't know if you were there." The T-CHAT coaches expressed frustration with connectivity issues with comments such as, "Great when technology works, frustrating when it doesn't," "Relies heavily on both parties' Internet connection to work properly," and "It disrupted the flow of conversation when the connection was lost." One T-CHAT coach said, "I don't like it when the robot's inadequacies reflect upon me as a provider or operator of the robot." The technology technician, an engineering graduate student assigned to the project, attended each T-CHAT session to resolve connectivity issues on the spot. At times, there were issues "caused by V-Go's [the corporate name of the telepresence robot device used; V Go Communications Inc., 2013] hardware" and "the fact that the V-Go processor got overloaded ... V-Go was restarted and the load on the processor was reduced." There was also an instance where "the IT staff performed an upgradation of the entire system and had a few failures while doing so ... hence, bad Wi-Fi connectivity issues across the entire campus [residential community]." These issues were resolved during the T-CHAT visits.

Aside from connectivity issues, there were a number of other suggestions for improvement. Older adults wished that the robot could "check my blood pressure, temperature, pulse ox [pulse oximeter readings], and record it for later" or "put a pill dispenser on it and have it go from place to place to give people their meds." Even though older adults had to pass a hearing test through the telepresence robot prior to the T-CHAT sessions, a few struggled hearing their T-CHAT coach; whereas, a few others had trouble seeing. One of the older adults suggested "closed captioning as part of the nurse robot visit," and another

wanted a larger screen that "makes the person on the other side more life-like and feels like you're physically with the person." On the other hand, average ratings were relatively high for ability to hear and see through the robot for both older adults and T-CHAT coaches (see Tables 2 and 3). As far as physical properties of the robot, a T-CHAT coach wanted a nametag on the robot to better identify her to visitors. There were several comments that alluded to the need for robotic arms as a valuable addition. For example, an older adult said, "I expect them to open and close the door" and one of the T-CHAT coaches said, "It can't ring the door or knock." One of the older adults said, "It's just I can't give you a hug." The T-CHAT coach suggested, "It might be better if the future telepresence robot has warm hands and arms to shake hands with patients and give them a hug if they want one."

Discussion

The projected growth in the aging population (Administration on Aging, 2016; Centers for Disease Control and Prevention, 2013; Vincent & Velkoff, 2010; World Health Organization, 2018), along with the dwindling supply of primary care providers (U.S. Department of Health and Human Services, 2013), underscore the importance of health promotion and chronic illness self-management programs for older adults. Guided by Lorig's evidence-based Living a Healthy Life with Chronic Conditions Toolkit (Lorig et al., 2012), the T-CHAT program was designed as a new and innovative intervention to promote healthy independent living among older adults using a telepresence robot. Obtaining satisfaction and technology evaluation data during the early stages of intervention development is paramount before embarking on larger efficacy trials, and before implementation of new programs into practice. This study was unique in that satisfaction and technology evaluation data were obtained from both the older adults and the T-CHAT coaches delivering the intervention. Further input was provided by the engineering student who provided technical support for the project. Lacking in most studies is gaining input from those who deliver the intervention (Borrelli et al., 2005; McLennon et al., 2015). Involving all stakeholders in the early development of robotic programs for older adults is necessary to promote successful aging, as well as to promote the acceptance of robots in society (Shishehgar et al., 2017).

Overall, the older adults in this study found the T-CHAT program to be useful and easy to use, and

they liked the program. These results are consistent with those from other studies that have evaluated health promotion and chronic illness management programs (Brady et al., 2013). Based on a recent systematic review of the literature on robotics and aging, these results are also consistent with programs that used robots with older adults (Shishehgar et al., 2017). The older adults were enthusiastic about how the T-CHAT program helped them to set goals for a healthier, more active independent life, and the convenience of getting their questions answered by a professional without having to leave their homes. The T-CHAT coaches felt that the T-CHAT program was an innovative way of making health care more accessible to older adults, and they enjoyed using the telepresence robot to answer questions and address the concerns of older adults within their home environment. According to Shishehgar and colleagues (2017), only 11 out of a total of 58 studies (18%) on robotics and aging were conducted in the home setting, which was considered to be a limitation given that a majority of older adults live independently at home. The T-CHAT program was successful in highlighting the perceived benefits of using a telepresence robot for health promotion and chronic illness management in older adults within their own homes.

From a technology standpoint, despite high ratings obtained from both older adults and their T-CHAT coaches, connectivity issues were apparent. Older adults expressed concerns regarding interference and moments when the robot would freeze up. The T-CHAT coaches became frustrated when communication was disrupted. These findings underscore the importance of having technology support available during each of the telepresence robot sessions. The engineering student was able to address most technology issues during the sessions. The use of today's telepresence robots requires a strong WiFi connection and technology support personnel to ensure quality connectivity (Shishehgar et al., 2017).

Aside from connectivity issues, older adults and T-CHAT coaches suggested future enhancements for the telepresence robot. The ability to assess vital signs and administer medications from a distance would be particularly useful to enhance the care of older adults in their homes (Shishehgar et al., 2017). Moreover, older adults and T-CHAT coaches expressed the need for a more personal touch through the telepresence robot. There are many types of robots that have been used in studies with older adults, with companion robots and telepresence robots being most common (Shishehgar et al., 2017). The T-CHAT program might be further enhanced by using a robot that not only

has telepresence capability, but also has arms and can serve as a companion robot that can give hugs when needed. As the future unfolds, robots are being programmed with artificial intelligence to serve as companion robots that can read emotions and respond appropriately (Shishehgar et al., 2017). Other types of robots can manipulate objects (e.g., fetching a pill box), monitor health status (e.g., blood pressure, pulse), or provide reminders (e.g., medications, appointments; Shishehgar et al., 2017). Advances in robotic technologies are certain to evolve over the coming years. Robots that can serve multiple functions will have the greatest impact on the care of older adults.

Clinical Relevance

Robotics is the wave of the future and provides an innovative mode of delivery to address health promotion and chronic illness management needs in older adults (Shishehgar et al., 2017). Satisfaction and technology evaluation of robotic technology is paramount prior to implementation of such programs into practice. This study not only provided satisfaction and technology evaluation data regarding the T-CHAT program to address the health promotion and chronic illness management needs of older adults, but also served as an example of how to evaluate new programs in practice. Both quantitative ratings and qualitative input from the older adults, the T-CHAT coaches, and the engineering student provided important satisfaction and technology evaluation perspectives from all stakeholders. Similar methods can be used to evaluate other programs before widespread implementation into practice (Royse et al., 2001).

Limitations

The sample was small; therefore, findings regarding satisfaction of the T-CHAT program and the use of the telepresence robot should be interpreted with caution. The small sample size did not allow for testing reliability and validity of the adapted Satisfaction Questionnaire and the technology evaluation ratings used in this study. It is also possible that the older adults and the T-CHAT coaches may have influenced each other in responding to the technology evaluation ratings and open-ended responses after each T-CHAT session. Moreover, this study provided results through a program evaluation of the T-CHAT program using a predetermined "start list" to guide coding procedures based on the Satisfaction Questionnaire (Miles et al., 2013; Royse et al., 2001). A stronger, more rigorous qualitative

design is suggested to more fully illuminate participant experiences in future studies. Generalizability is limited by a Caucasian, actively engaged sample who had higher socioeconomic and educational levels. Reported elsewhere (Bakas et al., in press), feasibility testing of the T-CHAT program showed medium to large improvements in unhealthy days, depressive symptoms, sleep, quality of life, and confidence and self-efficacy among older adults. Further research is needed with a larger, more representative sample to refine and test efficacy of the T-CHAT program, while continuing to track satisfaction and technology evaluation ratings from all stakeholders for more conclusive results. Furthermore, usability of the T-CHAT program from a healthcare systems perspective is needed before widespread implementation into practice settings.

Conclusions

This study provided an in-depth program evaluation of the T-CHAT program that involved the use of a telepresence robot for health promotion and chronic illness management in older adults within the home setting. The T-CHAT program was found to be useful, easy to use, and acceptable in a sample of 26 older adults and seven nurse practitioner students who served as T-CHAT coaches. Positive comments were made by participants, and areas for improvement were identified. The satisfaction and technology evaluation data obtained from this study will be used to enhance future versions of the T-CHAT program for future testing and program implementation. In conclusion, further refinement of the T-CHAT program is warranted, as is testing outcomes of this potentially viable mode of healthcare delivery.

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Clinical Resources

- Living a healthy life with chronic conditions. Complete toolkit: Chronic Disease Self-Management Program: Tool Kit for Active Living, 2015. <https://www.bullpub.com/catalog/Chronic-Disease-Self-Management-Program-Tool-Kit-for-Active-Living>
- SMRC Self-Management Resource Center. <http://www.selfmanagementresource.com/>
- VGo Communications, Inc. (2013). <http://www.vgocom.com/>.

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