

Understanding healthcare providers' perceptions of a personal assistant robot

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T.L. Mitzner, L. Tiberio, C.C. Kemp, W.A. Rogers. Understanding healthcare providers' perceptions of a personal assistant robot. Gerontechnology 2018;17(1):48-55; <https://doi.org/10.4017/gt.2018.17.1.005.00> To successfully deploy a robot into a healthcare setting, it must be accepted by the end users. This study explored healthcare providers' perceptions of a mobile manipulator class personal robot assisting with caregiving tasks for older adult patients. Participants were 14 healthcare providers with an average of 12 years of continuous work experience with older patients. Quantitative and qualitative methods were used. Participants indicated a willingness to use a mobile manipulator robot as an assistant, yet they expressed discretion in their acceptance for different tasks. Benefits of robot assistance noted by participants included saving time, being accurate when conducting medical tasks, and enabling them to be more productive. Participants expressed concern about robots being unreliable, hazardous to patients, and inappropriate for performing some tasks (e.g., those that involve close patient contact). These findings provide insights into healthcare providers' attitudes and preferences for assistance from a mobile manipulator robot.

Keywords: robot assistance, healthcare, technology acceptance, caregiving tasks, aging, long-term care

INTRODUCTION

The spread of technological innovation in healthcare has great potential to improve the quality of life of older people and their caregivers by providing support for healthcare tasks¹. Developments in robotics are gaining particular momentum in healthcare. Robotic systems have been developed for surgery, diagnosis, rehabilitation, and for assisting in orthotic and prosthetic patient care for those with disabilities². Some of the first robotic systems to emerge in the medical field were focused on assisting with medical surgeries or procedures³ and these types of applications are expected to continue to gain momentum in the future. A commonly known example is the da Vinci system robot which assists surgeons in performing minimally invasive surgeries. However, there is a growing trend in robot development toward the application of robots to support the needs and care of people with disabilities and older adults. Emerging robot developments focus on addressing issues such as rehabilitation⁴, mobility (e.g., exoskel-

eton systems⁵), and prosthetics⁶, as well as mild cognitive impairment⁷, self-care, interpersonal interaction, and relationships⁸.

An application of critical need is the use of robots to assist healthcare workers in providing care for older adults. Such a healthcare robot can facilitate the execution of repetitive and time-consuming activities by sharing the workload with healthcare personnel and thus contributing to the greater efficiency and quality of nursing and assistance tasks^{9,10}. Mobile manipulator robots are a class of robots that have robot arm(s) onboard a mobile robotic platform¹¹. Given that these robots can move within a setting (such as a healthcare center or long-term care facility) and manipulate objects and tools, they have great potential for assisting healthcare workers in their job duties.

When a technological innovation is introduced in the healthcare system, it is essential to assess its acceptance by users^{12,13}. In this role, it is critical to understand the potential users' willingness to accept

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the robot and the factors influencing its adoption and successful implementation¹³⁻¹⁵. There has been some research about service and assistance robotics providing support for healthcare professionals¹⁶⁻¹⁸, yet more research is needed to investigate a variety of healthcare providers and contexts.

The present research aimed to understand the perspective of professional healthcare providers about assistance from a mobile manipulator robot in the context of working with older adults in care facilities. Given current healthcare workforce shortages and the momentum in healthcare robot development, it is quite possible that robotic healthcare assistants could become more commonly used in the near future. Healthcare providers may not have a choice in terms of whether they work with a robot assistant, yet they may play a role in deciding/managing which tasks the robot performs. There is some evidence that older adults are open to receiving assistance from a robot¹⁹⁻²¹; it is unclear whether their professional care providers are open as well. Hence, the main objectives of this study were to gain insight about healthcare providers' preferences for assistance (human vs. robot) for a wide variety of healthcare tasks, and their acceptance of and attitudes about robotic assistance. We employed qualitative methods given their ability to provide rich information about the nature of individuals' preferences for and attitudes about emerging technologies, such as robots^{19,21,22}. The results provide useful guidance

for deploying robotic aids to assist healthcare professionals who care for older adults.

Personal Robot 2 (PR2)

The mobile manipulator robotic assistant depicted in this study was the PR2, developed by Willow Garage, Inc. (*Figure 1*). The PR2 is an example of an assistive robotic platform falling within the specific Assistive Mobile Manipulators (AMMs) category, which includes aids capable of providing assistance to people through physical and social interaction²³. The PR2 is capable of autonomously navigating around an environment and manipulating objects.

Studies have examined the suitability of the PR2 as an assistive aid for those who have a disability²³, as well as the acceptance of the PR2 by older adults²¹. The present study assessed the point of view of a group of professional healthcare providers, in terms of attitudes and technology acceptance, regarding a robotic assistant for nursing tasks in residential skilled nursing facilities.

METHOD

Participants

Professional healthcare providers (N = 14) were recruited by posting flyers at residential skilled nursing facilities in the metropolitan area of Atlanta and through postings made on social networking sites. Almost all participants were of African-American ethnicity (93%); 57% were employed in nursing homes, whereas 43% worked in residential care facilities. Participants had an average of 12 years (SD = 9.2) work experience with older patients, who required partial or total support for daily activities.

Research Procedure and Materials

To achieve the objectives of the research, combined methods of collecting quantitative and qualitative data were used to understand (1) preferences for assistance (human vs. robot), (2) acceptance of robotic assistance, and (3) attitudes (positive and negative) about robotic assistance. All questions were framed in a healthcare context for nursing and assistance tasks for older patients. The questionnaires and structured interview are described below; the sequence of assessments is detailed in *Figure 2*.

Pre Questionnaires: Prior to their interview, participants completed a home questionnaire which contained: informed consent, demographics, health, and work experience questionnaire, Assistance Preference Checklist (adapted from²¹), Technology Experience Questionnaire (adapted from²⁴ to include healthcare technologies used for caregiving tasks), Robot Experience Questionnaire²¹, Robot Opinions Questionnaire



Figure 1. PR2 mobile manipulator robot

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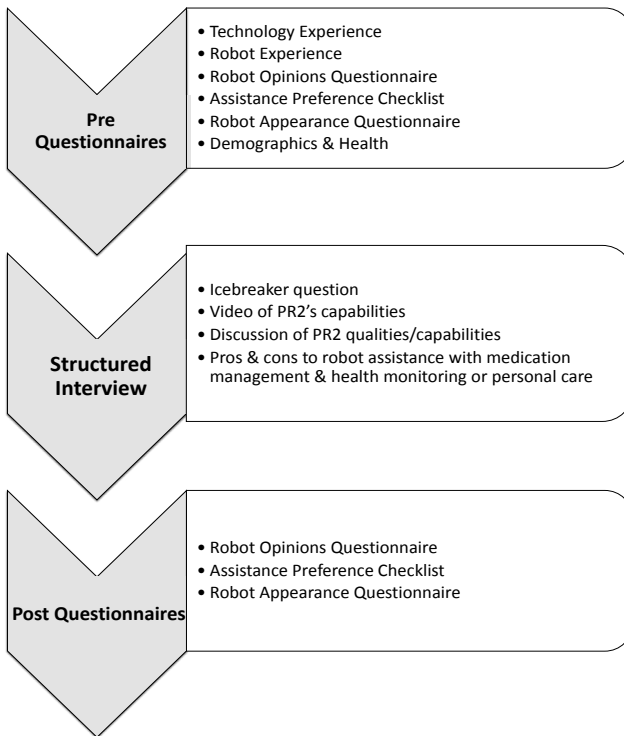


Figure 2. Phases of the research

(adapted from^{12,25}), and Robot Appearance Questionnaire (adapted from²⁶).

Structured Interview: Before the interview, a short (7 min 23 sec) demonstration video of the PR2 robot and of some of its features and capabilities was shown to the participants, as a way to stimulate the subsequent discussion²¹. Participants were instructed to express their opinions and attitudes about robots assisting them in professional caregiving activities.

Post Questionnaires: After the interview, a second battery of questionnaires was administered, which contained the Assistance Preference Checklist, Robot Opinions Questionnaire, and Robot Appearance Questionnaire. After the post-questionnaires, participants were asked to briefly re-examine their general attitude related to using a robot assistant in their work.

RESULTS

Overview of results

To address the research questions of the present paper, the focus below is on the interview questions related to acceptance of a robot assistant and the Assistance Preference Checklist and Robot Opinions Questionnaire. There were no significant differences between pre- and post-interview means for either of these questionnaires, therefore only the post-interview results will be presented.

Assistance Preference Checklist

Participants were asked to indicate their preference for robot or human assistance for a wide variety of healthcare tasks (on a scale of 1 to 5, with 1 = only a human, 3 = no preference, 5 = only a robot). The 39 tasks from the assistance preference checklist were in five domain categories: activities of daily living, instrumental activities of daily living, nursing activities, medical device use, and communication/administrative activities. Given previous findings of item level differentiation in human versus robot preferences^{21,27}, preferences were examined on the task level. The mean scores for each task are presented in Figure 3.

For each task, a one-sample Wilcoxon test was computed on the item level data to examine if participants' preferences for assistance were significantly different from no preference (= 3). The responses indicated that participants did not have a significant preference for human or robot assistance for most

tasks (p values $> .01$, using a Bonferroni correction to control for Type I error). However, there were three exceptions to this finding: Participants had a preference for a robot assistant for light housework (Mdn = 4, $Z = -2.97$, $p < .01$) and a preference for a human assistant for using an infusion pump device (Mdn = 2, $Z = -2.74$, $p < .01$) and for IV tasks (Mdn = 2, $Z = -2.63$, $p < .01$).

In sum, the data from the assistance preference checklist showed that the healthcare providers did not have preferences when comparing human or robot assistants, with the exception of light housework (preference for robot), IV use (preference for human), and infusion pump devices (preference for human).

Robot Opinions Questionnaire

Participants were asked to respond to 12 statements related to robot acceptance; 6 items measured perceived usefulness and 6 measured perceived ease of use (on a scale of 1 to 7, with 1 = extremely unlikely, 4 = neither likely or unlikely, 7 = extremely likely). The opinions questionnaire median was 6 (i.e., quite likely). A one-sample Wilcoxon test on the median was calculated to examine if participants' overall acceptance was significantly different from neutral (= 4). The median was significantly greater ($Z = -2.47$, $p < .05$) than the mid-point of neutral. Therefore, participants were generally positive about accepting

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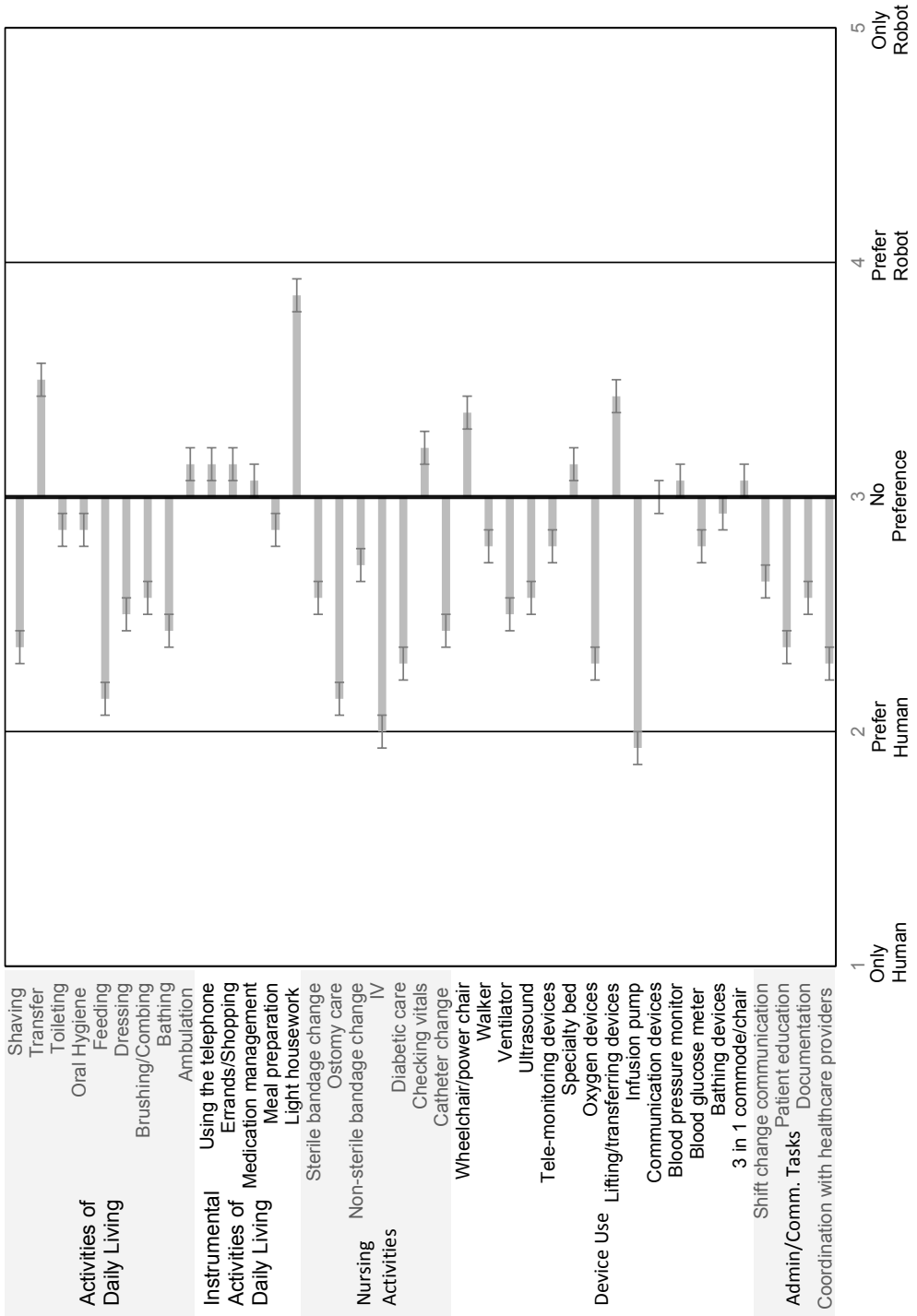


Figure 3. Mean scores (and standard errors) for each assistance preference task

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robot assistance in the context of their work.

Participants also responded to a single item related to feeling vulnerable to losing their jobs to robots (i.e., I would be concerned about a robot replacing me in my job.). Almost 60% of participants responded to this question with 1 (i.e., extremely unlikely), indicating that, overall, they were not concerned about a robot replacing them in their job.

Structured Interview

The interviews were transcribed verbatim and segmented to identify each relevant response given by the 14 healthcare providers. A coding system was developed to reflect the main themes²⁸. Two researchers independently coded each segment in the transcripts; then disagreements were discussed and an agreement was made as to the most appropriate code.

All participants stated that they were willing to use a robotic assistant as support in their daily work tasks. Each of the 14 interviewees answered in the affirmative to the question: "Would you be willing to use a robot in your daily work?" Participants' responses to the question "If you were going to be given an assistant, would you rather it be a human or a robot?" revealed that 61% of the healthcare providers would prefer a robot assistant. One participant stated this preference was because "...[the robot] can reduce those number of tasks by taking responsibility for those instead of the nurse doing all those tasks." Another participant stated, "Because sometimes humans just aren't reliable" and one provided the reason that "...because of medication, because of the lifting, and sometimes individuals don't like to [have] their diaper to be changed,

so they fight sometimes. So that would keep down on the staff actually getting hurt." The rest of the participants (39%) preferred a human assistant because, for example, "I know a human just about would know what I know. And I know what humans do, but a robot, I don't..." Other reasons provided for choosing a human assistant were, "You can teach a person how to do everything... a robot can't do everything." and "I think if [a human assistant was] from the same background as me, they'd have a better understanding of how to go about treating a client. And I think they would be able to relate more to the client and what the client wants and needs and be able to produce that [as compared to a robot]." One of the healthcare participants did not state a clear preference.

To assess positive and negative attitudes, participants were asked, "While thinking about your daily job tasks, I would like you to describe your point of view on the pros and cons of having a robot as an assistant." Tables 1 and 2 show the categories of pros and cons that were identified, together with a definition of the categories and some selected examples of quotes.

The predominant positive themes or "pros" were that a robot would save time, provide accuracy, and be a "third hand." Specifically, participants discussed the benefit of a robot assistant to help them perform work tasks more quickly and to reduce their workload. They viewed a robot as being able to perform tasks accurately, and in some cases more accurately than humans (e.g., dispensing medications). Lastly, participants discussed how a robot could assist them with certain tasks, particularly tasks that are physically challenging (i.e., transfer).

Table 1. Pros of having a robot assistant from the healthcare providers' point of view

Pros	Definition	Example Quotes
Save time	A robotic assistant could be a way to manage work time more effectively.	"That would help to make the task more time efficient." "Time management." "...The robot could help you out to take that time off and give you less stress." "Save us time on giving the medication."
Accuracy	A robotic assistant could perform daily work tasks with more precision.	"Getting accurate readings, precise readings because robots are supposed to be trained to make no mistakes." "It would be a lot more accurate. If I'm doing something quickly, and I'm not paying attention, I may put the wrong thing in the wrong place. But, if you have this program and it's a robot, it's not going to make mistakes that we would make."
"Third hand"	A robotic assistant could enable multiple tasks to be accomplished at one time.	"While I'm showering a patient, the robot could get the things that I need, such as towels, clothing, undergarments." "At meal times, if the robot could be able to set out the glasses for the amount of people that we will be serving." "That would be helpful around doing certain tasks, such as housekeeping and stuff like that." "If the robot is helping me transfer the client, I'm less likely to get injured and have a back injury or something."

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Table 2. Cons of having a robot assistant from the healthcare providers' point of view

Cons	Definition	Example Quotes
Unreliability/ distrust	A robotic assistant may not respond safely and reliably.	"What if it malfunctions and...it stops working properly, and the robot has that record of the patient's medication and something happens to the robot."
		"Not knowing the person who is taking the medicine, or just not giving it to them in the right way. Like if they need an insulin shot, giving it to them in the right spot."
		"Dysfunction, like, if it stopped working at a certain time, [and didn't] get things right."
		"Because it's a computer, it malfunctions, and, sometimes gives the wrong medication."
Hazard for the patients	A robotic assistant may not be accepted by the patients, which could result in negative psychological outcomes.	"The patient would be one of my concerns, because they might be fearful of the robot, if this is the robot form. If it's someone in a uniform [they are] familiar with that."
		"How the resident [would] perceive the robot, would they accept it or [not], because most of them in older age start to have recognition [difficulties] and another state of mind. Those are the issues I see, the resident not complying with the robot. The robot is not there to talk them in to taking [their medication] like a human being might do."
Inappropriate ness	A robotic assistant may not be appropriate to carry out some activities related to direct care of older patients.	"I would see a problem with maybe giving a patient a full bath. I don't know if the patient would have a problem with it, but they may, getting naked in front of a robot to take a bath, but they may not."
		"A con would be that some of the individuals, their weight might be a little heavy, so would the robot be able to lift a heavy weighted person?"
		"If someone needed to be cleaned, or have clothes put on them, the robot might not know the right way, to clean them the right way, or dress [them] the right way."

The predominant negative themes regarding robot assistance were unreliability/distrust, a hazard for the patients, and inappropriateness. Participants expressed concern about a robot's reliability (e.g., making mistakes if it malfunctioned). They also stated concern about the hazards a robot could cause an older patient if it malfunctioned. Participants viewed a robot as possibly inappropriate for some tasks, especially for those tasks requiring close contact with patients (e.g., bathing, dressing).

DISCUSSION

Given the expanding aging population and healthcare workforce shortages¹, robot assistants have potential to play a role as a member of a healthcare team. This research was undertaken with the intent to expand the knowledge base on attitudes and factors influencing the technological acceptance of a mobile manipulator robot by professional healthcare providers, in particular, those who provide care for older adults.

Participants expressed predominantly positive opinions and openness to having mobile manipulator robot assistance for caregiving tasks. Educating potential users about these benefits

will be an important aspect of successful deployment. Participants discussed relatively few negative views, such as fears of their jobs being replaced by these types of robots. All participants declared their willingness to use a mobile manipulator robot as an assistant in their daily work tasks. However, when asked to choose a human or robot assistant for a variety of caregiving tasks, participants were neutral in their preferences with a few exceptions. Participants preferred a robot assistant for light housework. However, they preferred human assistance for IV use tasks and infusion pump devices. A possible interpretation of these results is that care providers are more inclined to prefer the assistance of a robot for those activities requiring physical exertion (e.g., housekeeping) and other laborious tasks²⁹, in which the robot could help to save time and provide a "third hand."

In contrast, for those assistance activities directly related to the safety and health of the patient and involving fine dexterity (e.g., IV use, use of infusion pump devices), the participants preferred to rely on the support of a human assistant. The preferences of the healthcare providers may

have been influenced by their lack of confidence in the interaction capability of a robot and the concern that it may not respond in a completely safe and reliable manner. Such perceptions were revealed in the interview data and have been noted in the human-robot interaction literature²⁹. However, participants' perceptions of the mobile manipulator robot's capabilities may not match the true potential of what robots can offer. For example, an IV compounding robot has been successfully implemented³⁰. Participants also declared some concern about the use of a mobile manipulator robot for older patients, believing that it could pose a danger to their physical and psychological safety or that these patients may not accept the interaction with a robot. This research represents a small number of healthcare professionals and will need to be

extended to larger samples. Future research is also necessary to include different categories of healthcare professionals, to assess the impact of role and profession on attitudes toward a healthcare robot. In addition, more research is needed to understand to a greater depth the attitudes of healthcare providers with respect to robot competencies, and their comfort and attitudes after physically experiencing and interacting with robots. Lastly, additional research is needed to assess how attitudes might vary as a function of the type of robot. Our findings would be expected to generalize to other mobile manipulator robots, however some types of robots are quite different in appearance and function, such as companion robots²² or robotic beds³¹ and may, therefore, elicit a different pattern of attitudes.

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