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Pragmatic Innovations in Post-Acute and Long-Term Care Medicine

Feasible new, practical products or approaches intended to improve outcomes or processes in post-acute or long-term care

A Robotic Device to Enhance Nursing Home Provider Telepresence During and After the COVID-19 Pandemic



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ABSTRACT

The COVID-19 pandemic presented significant challenges to face-to-face communication with people residing in post-acute and long-term care (PALTC) settings. Telemedicine is an alternative, but facility staff may be overburdened with the management of the equipment. Here we introduce the use of a mobile HIPAA-compliant telepresence robot (MTR) to bridge this barrier, which may be beneficial to reimagine options for PALTC in the future.

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Keywords: Telemedicine, robotics, long-term care, COVID-19, nursing home staff burden

Problem/Significance

Despite the negative effects of COVID-19 for post-acute and long-term care (PALTC), opportunities to reimagine care for vulnerable aging adults exist. Telemedicine is a vital tool but has barriers and challenges for implementation.^{1–3} In our practice, the greatest barrier was dependence on overburdened nursing home (NH) staff to assist with telehealth activities. Therefore, we sought a method to provide telemedicine that did not add burden to NH staff.

Innovation

A mobile HIPAA-compliant telepresence robot (MTR), which the clinician operates (henceforth “drives”) remotely, facilitates telemedicine visits with minimal staff training or involvement (Figure 1).^{4,5} The MTR, which clinicians independently navigate in the NH, provides a broad field of view and the option to zoom in on body

areas. As compared with nonmobile audiovisual devices (eg, tablets), the MTR eliminates the need for staff to arrange appointments or to set up, deliver, retrieve, or hold the device during visits.^{2,5,6} The clinician can operate the MTR through a computer, tablet, or smart phone via mouse pad, touch screen, or keyboard. Because the MTR is operated remotely, staff do not need to don personal protective equipment, there is theoretically less risk for device contamination (the MTR does not need to touch any surface other than the floor), and patient privacy is enhanced. There are a variety of MTR options available on the market. Price, availability, portability, HIPAA compliance, option for multiple users, and functional simplicity were the factors we used to choose the MTR.

A Nebraska Geriatric Workforce Enhancement Program supplement funded this project. The University of Nebraska (UNMC) institutional review board approved the project as quality improvement.

Implementation

Before first MTR use, local experts in infection prevention and control provided disinfection recommendations (Supplementary Table 1). Disinfecting wipes can be used over all portions of the MTR.

We used rapid Plan-Do-Study-Act cycles to implement the MTR, starting with one medical director (MD#1) and then extending to other healthcare professionals. Users (clinicians) were educated about the MTR by MD#1 and later by medical director #2 (MD#2) via email/text/phone and rarely by remote telepresence meeting, based on individual need. Users were sent an access link via email through the MTR website and were also provided the disinfection recommendations. When logging onto the MTR there is a short instructional pictorial and there are also tutorial videos on the website.

J.B.B. and M.Y.S. contributed equally and share the second author position.

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All other authors have no conflict of interest to report.

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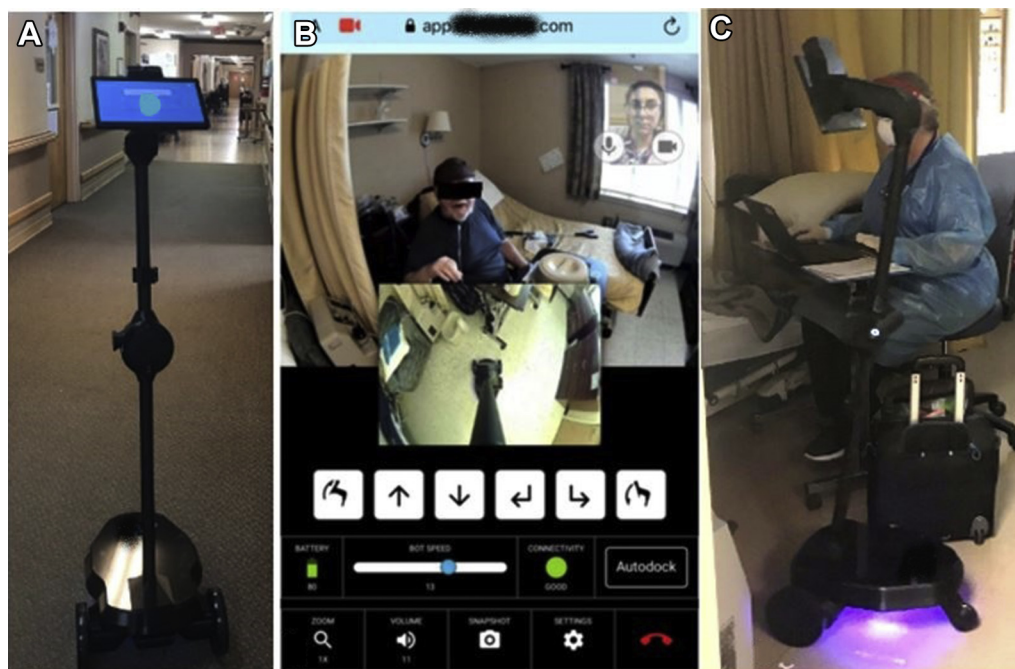


Fig. 1. (A) Front view of MTR. (B) Clinician view while providing telemedicine services remotely via a clinician's smart phone. (C) Hospice nurse providing bedside care together with hospice social worker via MTR. A downloadable PDF of this form is available at www.sciencedirect.com.

NH-level requirements include dependable Wi-Fi and a safe, accessible place for the robot to sit idle on the charger. Staff were educated by phone/point-of-care regarding 3 items: (1) where to find the on-button, (2) not to manually move the robot's "head," and (3) MTR disinfection. The MTR needs a person to open/close doors.

We piloted the MTR (MTR #1) in a single-level 63-bed NH (NH #1) where the UNMC-employed MD#1 was the physician for most residents. The NH was not having a COVID-19 outbreak. Local enthusiasm for the MTR led to the geriatric division's purchase of 2 additional MTRs to enhance care and facilitate fellowship training during the pandemic. The second MTR (MTR#2) went to a single-level 183-bed NH (NH #2) during a COVID-19 outbreak with another UNMC-employed MD (MD#2). The third MTR (MTR#3) was used by MD#1 at a third NH (NH#3), a single-level rural NH with 64 beds. Of note, MTR#3 had very little use because of lack of interest from NH leadership and the robot frequently being bumped off the charger and losing its charge.

Supplementary Figure 1 demonstrates a step-by-step workflow for a clinician needing to perform a patient visit.

Evaluation

Robots were used for formal telemedicine visits by medical directors, attending physicians, a nurse practitioner, and geriatric and palliative care fellows; hospice social work and chaplain visits; medical director interdisciplinary meetings and infection control rounds; and by NH staff during quarantine (eg, MDS nurse worked from home while quarantined). One family NH resident's wife used MTR#1 to visit twice (visit times for wife was 21 minutes and 10 minutes).

MTR usage data were monitored through the MTR website's dashboard (dashboard access requires a monthly fee). A total of 26 health professionals were sent an invitation link during August 2020 to August 2021, of whom 10 used the MTR. The average time spent per "encounter" was 33 minutes (multiple patient encounters may have occurred during those 33 minutes). One provider (MD#1) tracked billable patient encounters with the MTR. Between August 1, 2020,

and March 31, 2021, MD#1 had 38 billable patient encounters using MTR#1. Other providers were not asked to track their billable visits (to avoid added work burden). Visit types included new patient admissions, regulatory visits, acute visits, discharge visits, and goals of care conversations. We did not track patient-level outcomes (eg, hospitalizations) with MTR use.

Within the first several times of using the MTR, we identified several pros and cons of the MTR compared with a handheld device. These are listed in **Table 1**.

Because of these initial observations, we created questionnaires to capture quantifiable perceptions from MTR operators (henceforth "drivers") and NH staff in NH#1 and NH#2. We did not survey staff in NH#3 for 2 main reasons: (1) MTR#3 was used very little at NH#3 and so many staff were unaware of MTR#3, and (2) logistical issues with MD#1 providing the in-person surveys at the rural location. Questionnaires were created based on literature review and our initial observations.^{1,7–10} NH residents were not surveyed because of concern for social distancing. MTR drivers (n = 8 responders: 4 from each facility) were surveyed via email using Microsoft Forms. NH staff were surveyed with pen/paper. Approximately 120 NH staff were offered the questionnaire. At NH#1, the form was available during the staff COVID-19 vaccination clinic, and at NH#2 the form was left at the nursing stations for 2 days. Twenty-one staff members returned the questionnaire. Survey data were analyzed descriptively with means and standard deviations (continuous variables) and frequencies and percentages (categorical variables) using SPSS version 26. Open-ended qualitative data were independently analyzed for common themes by R.S.C., J.B.B., and N.A.M. and then individual notes were discussed and compared until consensus was reached about interpretation of comments.

To evaluate MTR usability for drivers (n = 8), we used the System Usability Scale (SUS), a standardized, 10-question technology acceptance scale.¹¹ The mean SUS score was 67.2 (SD 18.3), indicating average level of usability (**Supplementary Table 2**). There were also open-ended questions to assess likes/dislikes.

Mean driver overall satisfaction (1 = not satisfied; 5 = very satisfied) was 3.6 (SD 1.4), whereas mean NH staff overall satisfaction was 4.5

Table 1
Pros and Cons of the MTR in the NH for Telehealth as Compared With a Handheld Telepresence Device

Pros	Cons
<ul style="list-style-type: none"> - The only physical contact the MTR requires is the wheels on the floor (analogous to a clinician's feet touching the floor) - Avoidance of burdening NH staff - Clinician does not depend on NH staff to keep the MTR charged (unless the charger is in a location where the MTR gets nudged off the charger) - NH staff do not have to log-on or initiate the calls - Clinician does not need to set up appointment times, but instead can "show up" at will, even when NH staff are busy - MTR provides a larger field of view and clinician control over the viewing area, thus improving nonverbal communication and cues - Increased visualization of the entire environment and body parts other than the person's face - Enhanced privacy during telepresence visits (because MTR does not need anyone to hold it) - Ability to zoom in on body parts - Increased capability of providing any telehealth (when providers offered telepresence with handheld devices, NH staff at each home did not want to do telehealth because of time burdens) - Multiple options for add-on features (eg, tray for item delivery, extra microphone, basket) - Option for multiple people to join a patient encounter via virtual meeting platform - Ability to have a goals of care conversation/attend meetings while easily being able to address various people in the room - Having the ability to navigate throughout the building to monitor infection control practices, staff stress levels 	<ul style="list-style-type: none"> - MTR cost (approximately \$3000 each) - Identifying an easily accessible place to store the MTR and keep it attached to the charger - Relying on staff to open/close doors - Depending on staff to push the on-button - Depending on staff to disinfect the MTR - In areas of the building with low Wi-Fi strength: <ul style="list-style-type: none"> - Zoom function can become blurry - MTR may freeze and lose connection with the driver, requiring a phone call to NH staff to request manual assistance - Volume was often not loud enough for the resident/staff and frequently required someone to manually press the volume button on the speaker - Some attachments (eg, extra speaker) require an additional attachment from the MTR company - If the need arises for a staff member to assist with positioning the resident, then it may require a phone call to facility to ask for help - Fear of breaking the MTR - Staff may feel concerned for decreased work privacy - Time required for initial set up and delivery of the MTR to the NH - MTR troubleshooting requires a person who feels comfortable with the MTR and who may need to be physically present

(SD 0.6). Staff were surveyed regarding their perceptions of the MTR on behalf of the NH residents (Supplementary Table 3, n = 19 responders) and themselves (Supplementary Table 4, n = 21 responders) via Likert scale. Generally, staff reported feeling comfortable with the presence of the MTR, positive perceptions about the audiovisual functions of the MTR, and ease of use regarding the MTR technology.

Open-ended responses among "drivers" (total n = 8) indicated that remote access to patients was a benefit (n = 7), in addition to minimizing virus exposure (n = 3) and maintaining a presence with residents (n = 2). Driver dislikes included connectivity issues (n = 5), features (volume/visibility issues; n = 3), need to use staff support (n = 3), and concern about inferior care (n = 2). Among NH staff (n = 16 responders provided open-ended comments), remote care (n = 7), convenience/accessibility (n = 4), resident likes/enjoyment (n = 4), and minimizing virus exposure (n = 2) were common likes. Staff dislikes included features (volume issues; n = 6), need for staff support (n = 2), and connectivity issues (n = 2); 4 staff respondents made comments specifically stating they did not have any dislikes.

Comment

This article describes early efforts to improve telemedicine services via MTR in 2 academic-affiliated midwestern NHs. Our primary aim was to provide telemedicine without depending on NH staff. In our experience, we were able to provide more telemedicine visits with the MTR than with a handheld telepresence device because the MTR was seemingly no more disruptive to NH staff workflow than actual provider presence. Another study also described excessive time burden on staff as a barrier to NH telemedicine.² They managed the problem by splitting the visit into 2 parts: a synchronous audiovisual segment with assistance from NH staff for the patient examination and a telephone (audio only) segment to obtain more history from the patient, which did not require NH staff presence.² Our study differs in that we aimed to have even less dependence on staff during a telemedicine visit.

Although there has been increased use of telehealth in the NH since 2020, we have not found publications on the use of MTR for

telehealth in the NH.³ In the care of older adults, MTR and other forms of robotics have largely been studied for psycho-social purposes.⁵

Challenges to incorporating the MTR into the PALTC setting were drivers' initial apprehensions about "breaking" the MTR; gaining buy-in from clinicians, training MTR "drivers," dependence on staff to open doors and clean the MTR; need for adequate Wi-Fi signal strength (can remedy with hotspot); and need for louder speaker volume (can remedy with add-on speaker). These technological problems have also been cited with handheld devices^{1,2,4} and similar interventions.¹² In NH#3, low interest from NH leadership was also a challenge. A champion for the MTR is an important component for successful implementation. Our recommendation is that whoever initially desires to use the MTR, should be the champion to help others work through initial concerns, set up, and troubleshooting. The best champion would be a health care provider using the MTR, as the intent is for NH staff and residents to be passive beneficiaries of the MTR. In the future, it will be important to research medical economics of an MTR (eg, number of patient encounters needed to pay for an MTR.)

The survey results were limited by a low number of respondents; however, it seemed inappropriate to push for additional survey responses during an ongoing pandemic. It will be beneficial to garner more feedback in the future. Also, because of the nature of the authors being some of the clinicians driving the MTR, 3 of the drivers surveyed are also authors of this article. The concern for this limitation is lessened in that the survey responses were completely blinded and not overwhelmingly positive in perception, suggesting honest responses. The primary author did not fill out a questionnaire.

Aside from provision of billable visits, medical directors and providers provide a wide array of care in a NH, including infection control oversight, observation of staff workflow, stress levels, and gaining understanding of resident home life.¹³ With scheduled and structured telehealth encounters, a medical director can see patients but is less able to "stroll" through the halls to perform nonclinical medical director tasks. With the MTR, the medical director can fulfill these responsibilities, while limiting the burden placed on already stressed NH staff.

Outside of the pandemic, we have found the MTR helpful for clinician visits for acutely ill patients and during inclement weather

with poor road conditions. In the future, the MTR will also be helpful during other outbreak situations (eg, influenza). Another unintended benefit of the MTR is the potential to broaden access for learners to the NH. For example, entire classrooms could experience the inside of an NH during a lecture. In this way, the MTR may provide a route to gain interest from future health care workers to care for those in PALTC.

Future research will look further at medical economics of MTR use and health outcome measures (eg, antibiotic prescribing, psychotropic prescribing, hospital readmissions). The MTR could also improve clinician access to rural and remote NHs.

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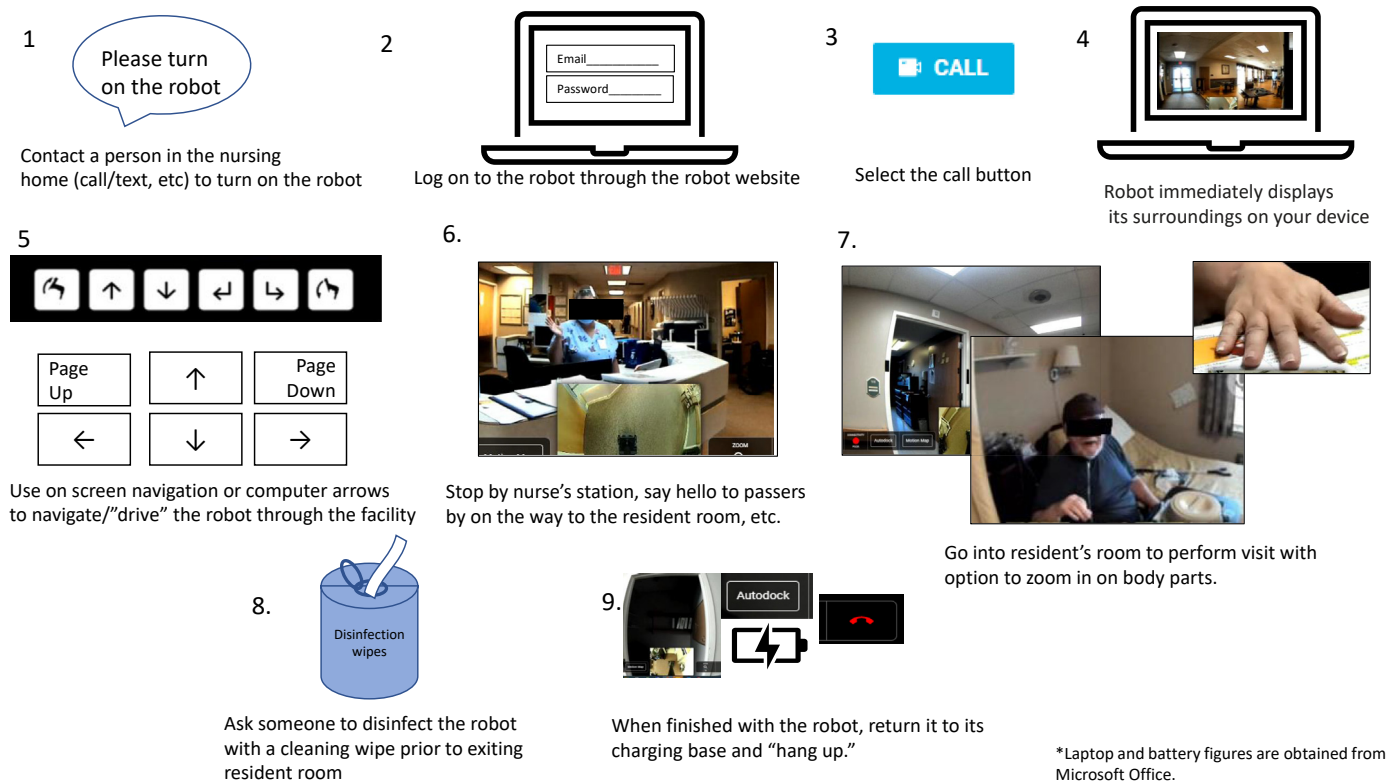
Supplementary Data

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.jamda.2021.11.013>.

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The pragmatic innovation described in this article may need to be modified for use by others; in addition, strong evidence does not yet exist regarding efficacy or effectiveness. Therefore, successful implementation and outcomes cannot be assured. When necessary, administrative and legal review conducted with due diligence may be appropriate before implementing a pragmatic innovation.



Supplementary Fig. 1. Workflow process for robot use.

Supplementary Table 1

Nebraska Infection Control and Prevention Program Mobile Telepresence Robot Cleaning Recommendations for NH Telemedicine Rounds

Green Rooms/Zones	Yellow/Gray Rooms/Zones	Red Zones
<p>Clean and Disinfect:</p> <ul style="list-style-type: none"> - at least twice a day - after someone touches it - after an encounter where someone was close enough for droplets to settle on the robot (eg, within 6 feet of a resident who was not wearing a mask) 	<p>Clean and Disinfect before it leaves each resident's room</p>	<p>Clean and Disinfect:</p> <ul style="list-style-type: none"> - at least twice a day - after someone touches it or is close enough to shed droplets on it - Before it leaves the Red Zone

Green Zone = Areas of the building where there is no one with active concern for COVID-19 infection; Gray Zone = Observation area where residents are being quarantined without a known exposure but because of being at high risk of exposure in the past 14 days (eg, a new admission when community had moderate to severe COVID-19 transmission); Yellow Zone = area where residents with known exposures to someone with COVID-19 are being quarantined; Red Zone = Rooms or units where residents with suspected or confirmed COVID-19 infection are being isolated.

For all situations: Avoid being in the room if aerosolizing procedures are happening (if presence required during aerosolizing procedure, then would be best to cover it and disinfect afterward). Be sure to use the cleaning product per the manufacturer's instructions so that the wet time following disinfectant use is consistently met. Disinfection before leaving the rooms is also recommended for those rooms where the residents are in transmission-based precautions for other pathogens.

Supplementary Table 2

SUS by MTR Operators (“Drivers”)

Items	Mean (SD)		
	NH #1 (n = 4)	NH #2 (n = 4)	ALL (n = 8)
I found the robot unnecessarily complex.	2.5 (1.7)	3.0 (0.8)	2.8 (1.3)
I thought the robot was easy to use.	2.5 (1.0)	1.8 (0.5)	2.1 (0.8)
I think that I would need the support of a technical person to be able to use the robot.	4.0 (0.8)	3.8 (0.5)	3.9 (0.6)
I found the various functions in the robot were well integrated.	2.5 (1.0)	2.3 (1.3)	2.4 (1.1)
I thought there was too much inconsistency with the robot.	3.5 (1.0)	3.8 (0.5)	3.6 (0.7)
I would imagine that most people would learn to use the robot very quickly.	2.3 (1.3)	2.5 (1.3)	2.4 (1.2)
I found the robot very cumbersome to use.	4.0 (1.4)	4.0 (0.0)	4.0 (0.9)
I think that I would like to use this robot frequently.	2.0 (1.4)	2.5 (1.0)	2.3 (1.2)
I felt very confident using the robot.	3.8 (1.3)	1.8 (1.3)	3.8 (1.2)
I needed to learn a lot of things before I could get going with the robot.	2.3 (0.5)	1.8 (0.5)	2.0 (0.5)
SUS Summary Score	65.6 (26.2)	68.8 (9.2)	67.2 (18.3)

Note: Both nursing homes had 4 respondents for the SUS, so 8 in total. The SUS is a standardized scale used to evaluate usability of any new technology. Respondents answer each question on a Likert scale where 1 is “strongly disagree” and 5 is “strongly agree.” Each of the responses is then transformed where the final score is on a scale from 0 to 100. A score of 68 is considered average. Our results show that the robot users generally felt that the robot had an average level of usability.

Supplementary Table 3

Staff Perceptions of the MTR on Behalf of the NH Residents via Likert Scale (1 = Strongly Disagree; 5 = Strongly Agree)

Question	Mean Score (SD)
They like the robot	4.0 (0.8)
They like getting visits with the robot	4.0 (0.8)
They feel comfortable in the presence of the robot	3.7 (0.7)
The robot can help decrease social isolation	4.0 (0.9)
The robot can improve their health care	4.0 (0.6)
They are able to see the visitor with the robot	3.8 (0.7)
They are able to hear the visitor with the robot	3.4 (0.9)
They feel concerned in the presence of the robot	2.6 (1.0)
The residents have privacy concerns with the robot	2.0 (0.8)
The resident does not have enough control to end/refuse a call	2.4 (0.8)
The residents react negatively to the robot (confused, frightened)	2.1 (0.8)

n = 19 total (n = 14 from NH #1 and n = 5 from NH #2).

Supplementary Table 4

Staff Perceptions of the MTR via Likert Scale (1 = Strongly Disagree; 5 = Strongly Agree)

Question	Mean Score (SD)
I like the robot	4.4 (0.8)
I like when there is a visit with the robot	4.2 (0.7)
I would like to see the robot used frequently	4.0 (0.8)
The robot makes NH telehealth visits easier for me	4.0 (0.8)
The robot helps me to provide care for the residents more effectively	3.8 (0.8)
The robot requires very little effort from staff	4.1 (0.7)
I am able to see the visitor with the robot	4.2 (0.9)
I am able to hear the visitor with the robot	4.1 (1.1)
I think the robot is easy to use	3.9 (0.9)
I feel concerned in the presence of the robot	1.8 (1.1)
I have privacy concerns about the robot	1.7 (0.7)
I am concerned the robot will be used inappropriately	1.4 (0.5)
I am concerned the robot will decrease human interaction	2.3 (1.4)
The robot gets in my way	1.8 (1.0)
I find the robot very cumbersome to use	2.5 (1.0)

N = 21 total: n = 14 for NH #1, and n = 7 for NH #2.