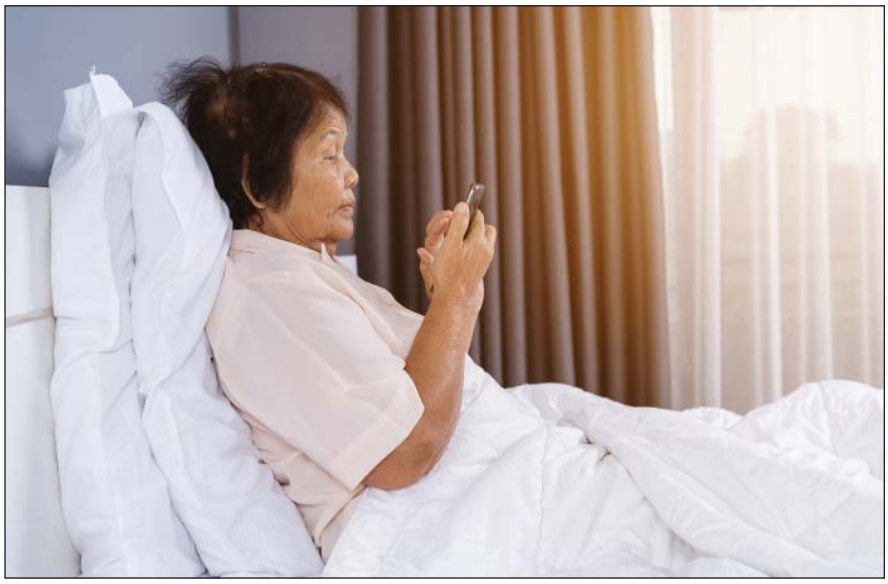
Evaluating the Usability and Acceptability of Communication Tools Among Older Adults



ABSTRACT

Acutely ill patients may have trouble communicating their symptoms and needs verbally. The current study evaluated the usability and acceptability of six commercially available communication tools with older adults in a non-clinical, controlled setting. Participants evaluated various communication boards and communication applications (apps) by using the tools to communicate needs and symptoms in various scenarios. Participants completed a modified technology acceptance questionnaire and selected the tool they perceived as most useful and easy to use. Bivariate analysis was used to compare communication boards and apps. Performance on most tasks was significantly better using communication boards compared to communication apps. However, participants reported that given more time and training, the apps could be used effectively. A feasibility study is needed to determine whether acutely ill older adults can use these communication tools to successfully convey their symptoms and needs in a hospital setting [*Journal of Gerontological Nursing, 44*(9), 30-39.]

Use of mobile technologies, including smartphones and tablet computers, has increased rapidly over the past 5 years. The Pew Research Center (2015, 2018) estimates that ownership of smartphones has approximately doubled from 2011 to 2014 (2011 ownership = 35%, 2014 ownership = 59%) and an even greater increase has been seen for tablet computer ownership (2010 ownership = 3%, 2015 ownership = 45%). The drastic increase in mobile technology use by the general population is expected to continue and has contributed to a proliferation of mobile health technologies and applications (apps) designed to target health priorities and assist in health care delivery (Steinhubl, Muse, & Topol, 2013). Unfortunately, many of these new technologies and apps are developed without the older adult user in mind (de Barros, Leitao, & Ribeiro, 2014).

Older adults tend to use mobile technology less than the general population, with only 30% owning a smartphone and 32% owning a tablet (Anderson, 2015); however, technology adoption among older adults continues to rise (Pew Research Center, 2017). Lower use of these technologies

Marci Lee Nilsen, PhD, RN, CHPN®; Allison Morrison, DPT, PT, ATC; Jennifer H. Lingler, PhD, CRNP; Brad Myers, PhD; Jonas T. Johnson, MD; Mary Beth Happ, PhD, RN, FAAN, FGSA; Susan M. Sereika, PhD; and Annette DeVito Dabbs, PhD, RN, FAAN

in older adults has been attributed to physical challenges with the devices, skeptical attitudes toward the technology, and difficulty learning new tasks without assistance (Gell, Rosenberg, Demiris, LaCroix, & Patel, 2015; Pew Research Center, 2014). It is essential that older adults are considered and consulted in the development and testing of mobile technologies and apps to facilitate adoption within this demographic.

During critical illness, patients may require mechanical ventilation to meet their respiratory needs, and consequently may lose the ability to use vocal speech to communicate. Patients who lose this ability are forced to rely on alternative methods (e.g., mouthing, gesturing, writing) to meet their communication needs (Happ, Roesch, & Kagan, 2005). These alternative methods can be unreliable (Leathart, 1994; Menzel, 1998) and difficult for health care providers and family to interpret (Menzel, 1998; Patak, Gawlinski, Fung, Doering, & Berg, 2004). Augmentative and alternative communication (AAC), both unaided (e.g., gestures, head nods, sign language) and aided (e.g., communication boards, speech generating devices), assist individuals who have limited natural speech with communication (Beukelman & Mirenda, 2005). Companies that have previously produced printed communication boards are now expanding to provide communication apps for tablet computers, including iPads®. Many of these apps are commercially available for purchase. However, the usability and acceptability of communication apps and their superiority over communication boards remain unknown (Happ et al., 2014). Increased knowledge of the differences in usability and acceptability is especially pertinent for older adults, who may learn and use apps on electronic devices differently than their younger counterparts. Older adults are more likely to need AAC devices, as they have an increased risk of communication difficulties, secondary to cognitive changes, sensory alterations, and functional limitations (Ebert & Heckerling, 1998; Gates, Cooper, Kannel, & Miller, 1990).

In general, small feasibility studies of non-speaking patients have found high satisfaction with communication boards (Stovsky, Rudy, & Dragonette, 1988) and application-based AAC tools (Happ, Roesch, & Garrett, 2004; Rodriguez & Rowe, 2010; Rodriguez et al., 2012). However, a secondary analysis of a communication intervention trial showed that older participants were unlikely to use either type of AAC tool (Nilsen et al., 2014). The reasons AAC use was limited among older adults have not been explored. It is therefore necessary to identify AAC tools that older adults may find useful and evaluate their acceptance, potential barriers, and impact on promoting effective communication of older adults' symptoms and needs. The aim of the current study was to evaluate the usability and acceptability of communication boards and apps among older adults in a controlled setting.

METHOD

Design

The current researchers conducted a usability study for six commercially available, commonly used communication tools designed to address the needs of hospitalized older adults. The three communication apps included the VidaTalk™ (version 1.3), the Health Care Communication application (version 2.0), and the Intensive Care Unit (ICU) Patient Communicator (version 1.0), all of which were loaded onto an iPad. These commercially available apps were selected for testing because they all include features that allow patients to create novel messages. The apps differed in the messages, pages, and features available, as well as in the arrangement of their user interfaces. Updates to the apps were installed as they became available throughout the study; no significant changes in the user interfaces were noted over time. The communication boards included the Vidatak EZ Board™, the Picture Board™, and the Health Care Communication Board, all of which were forms of printed communication tools. The features of each tool are presented in **Table 1**. All tools were commercially available and designed to aid critically ill patients with limited natural speech to communicate their needs in a hospital setting. University of Pittsburgh Institutional Review Board approval was obtained for this study.

Sample

A total of 30 adults >60 years old were recruited for the study, including 15 older adults without any history of cancer as well as 15 older adults who had undergone surgery within the past 12 months for head and neck cancer, which impaired their ability to communicate vocally. The sampling technique of including both head and neck cancer patients and community-dwelling older adults was used to obtain participants with a variety of characteristics and experiences. The sample size was chosen based on evidence from human–computer interaction research showing that most usability issues can be identified from a sample of 15 users; however, researchers increased the sample size to account for the multiple tools being tested (Faulkner, 2003; Nielsen, 1993).

Participants without a history of head and neck cancer were recruited through a Gerontological Research Registry at the University of Pittsburgh. The registry coordinator screened a convenience sample of 21 participants for eligibility and contacted 19 (90.5%) potential participants by telephone to inform them of the study. Of participants contacted, 17 (89.5%) agreed to be contacted again by the research team. The research team conducted further telephone screening to determine whether participants met eligibility criteria, which included: (a) ability to read and understand English, (b) abil-

TABLE 1

COMMUNICATION TOOLS AND FEATURES

Name	Features
Communication Boards	
Vidatak's EZ Board™	Two-sided board with phrases • 90 words or phrases divided into categories (i.e., "I am...", "I want...") • Pictures of the body to indicate needs in a certain area • Color-coded pain intensity levels with corresponding 0 to 10 scale • Letters for spelling words • Numbers (0 to 9) and symbols (i.e., +, -)
	Dry-erase construction with dry-erase marker
	Overall size: 11 x 17 inches
Vidatak's Picture Board™	Two-sided board with pictures and corresponding words or phrases • 68 pictures divided into categories (i.e., "I am...", "I want...") • Pictures of the body to indicate needs in a certain area • Color-coded pain intensity levels with corresponding 0 to 10 scale • Alphabet for spelling out words • Numbers (0 to 9) and symbols (i.e., +, -)
	Dry-erase construction with dry-erase marker
	Overall size: 11 x 17 inches
Greenhouse Publications' Health Care Communication Board	Two-sided board with pictures and corresponding phrases • 68 pictures • Drawing of the body to indicate needs in a certain area • Pain intensity scale with corresponding numbers and facial depiction • Alphabet for spelling out words • Numbers (0 to 9) to report numerical information
	Overall size: 8.5 x 11 inches
Communication Applications	
Society of Critical Care Medicine's Intensive Care Unit Patient Communicator	More than 30 pictures and phrases divided into nine categories related to care needs and well-being (i.e., breathing, feelings) • Pictures of the body to indicate needs in a certain area • Sliding pain intensity scale with corresponding numbers and facial depiction • Ability to generate novel messages through typing • No audible text-to-speech generation
Greenhouse Publications' Health Care Communication	More than 200 picture-based icons with corresponding phrases divided into seven pages (i.e., questions page, emotions page) • Pictures of the body to indicate needs in a certain area • 0 to 10 pain scale • Ability to generate novel messages through typing • Text-to-speech for novel message generation
Vidatak's Vidatalk™	More than 75 picture-based icons with corresponding phrases (i.e., "Home", "I am...") divided into five main pages • Pictures of the body to indicate needs in a certain area; application generates corresponding phrase when part of the body is selected (i.e., "I have pain in my back" generated after "back" is selected) • 0 to 10 pain scale with corresponding descriptors of *none*, *moderate*, *severe* • Ability to generate novel messages through typing • Text-to-speech for novel message generation • Drawing capabilities

ity to use at least one upper extremity, (c) no history of cognitive impairment or dementia, and (d) normal cognition as determined by a score >26 on the Montreal Cognitive Assessment (MoCA), which is a screening test for mild cognitive impairment (Nasreddine et al., 2005).

A convenience sample of 15 patients with a history of head and neck cancer was recruited from the Ear, Nose, and Throat (ENT) Specialist at the University of Pittsburgh Medical Center over a period of 12 months. Members of the research team, who had access to records as part of their clinical role, screened patients for eligibility. Potential patients were informed of the study by the head and neck surgeon at the conclusion of their clinical visit and asked if they would be willing to discuss the study with a research team member. The research team conducted further screening of potential participants to determine whether they met eligibility criteria, which were the same criteria used for participants without history of cancer. If patients had limited ability to communicate, a six-item cognitive screening tool (Callahan, Unverzagt, Hui, Perkins, & Hendrie, 2002) was used instead of the MoCA. Inclusion of older adults without history of cancer and patients who had experienced head and neck cancer surgery allowed for a sample comprising participants who had and patients who had not experienced the potential for acute communication difficulty. All patients provided written informed consent before participating in the usability session.

Usability Testing in a Controlled Setting

The usability sessions for the older adults without history of cancer were conducted in the School of Nursing at the University of Pittsburgh and sessions with patients with history of head and neck cancer were conducted in the ENT clinic. All sessions were performed in a private room and videorecorded. Participants were shown six communication tools and given the opportunity to explore them before the testing session began. However, to test the intuitiveness of the communication tools, no other instructions or guidance were given. Testing scenarios were read aloud, and participants were asked to complete individual tasks. Each participant completed three scenarios and a total of six tasks.

The order for testing the tools was randomly selected from seven predetermined sequences. Participants were instructed to perform the tasks in each scenario as if they were in the hospital and unable to speak. Participants were encouraged to use the "think-aloud" method to vocalize their actions/reactions, thoughts, and decisions while using the tool to complete the tasks (Nielsen, 1994, p. 385). This method helped establish participants' expectations of the devices and identify points of confusion or barriers to completing the task.

Before initiation of task scenarios, participants were reassured that the focus of the study was on their evaluation of the tool, not their performance as the user. Scenarios for each tool used a predetermined script asking participants to use the tool to communicate pain, frustration, and the need to use the bathroom. These specific scenarios were selected because they are common issues that patients experience and may have difficulty communicating while in the hospital (Rodriguez & Blischak, 2010; Rodriguez & VanCott, 2005). Participants were permitted to complete the tasks using any available feature on the tool. For example, if participants could not find an icon on the tool to complete the task, they could use spelling on the communication boards or typing/drawing on the communication apps.

After testing each tool, participants completed a questionnaire on ease of use and perceived usefulness. After participants completed the test scenarios with all tools, they were asked to select the tool they perceived to be most useful and easy to use if they were hospitalized and experiencing difficulty communicating.

Measures

Sample Characteristics. Demographics (i.e., age, gender, race, education, and income); clinical characteristics (e.g., self-reported visual impairment, including glasses or contact use; hearing impairment and hearing aid use; arm/hand mobility; previous hospitalization); and prior use of technologies (e.g., desktop computer, mobile telephone, smartphone, downloading apps, e-reader, laptop, tablet) were collected at the end of the usability session. For participants who underwent surgery for head and neck cancer, surgical site and procedure were also collected from the medical record.

Ability to Communicate Symptoms and Needs. Participants were asked to use each tool to complete three scenarios and accompanying tasks related to communicating symptoms and needs. Scenario 1 comprised three tasks: Can you tell me that you are having severe pain (Task 1a) in your back (Task 1b) and need pain medication (Task 1c)? In Scenario 2, participants were asked to complete two tasks: Can you tell me that you are frustrated (Task 2a) and want to see your family (Task 2b)? In Scenario 3, participants were asked to express that they needed to use the bathroom (Task 3).

Each task was rated as *completed* or *not completed*. The number of tasks completed within each test scenario was summed to calculate the score. For example, if a participant completed all three tasks in Scenario 1, a score of 3 would be recorded; if they completed none of the tasks, the score would be 0.

Technology Acceptance. The Technology Acceptance Model (TAM), a 12-item, self-report questionnaire, was used to assess users' perspectives of the factors that influence acceptance and ultimate adoption of each communication tool (Davis, Bagozzi,

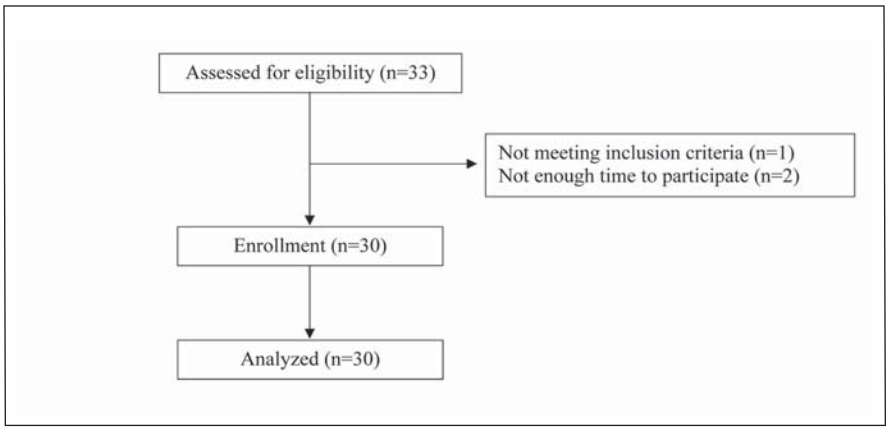


Figure. Consort diagram of participant recruitment.

& Warshaw, 1989). The TAM has been used across cultures and information systems (Kowitlawakul, 2011; Poelmans, Wessa, Milis, Bloemen, & Doom, 2008) and comprises four subscales: perceived ease of use, perceived usefulness, attitudes toward using the technology, and intention to use the technology. Questions were modified to represent the information system of interest: communication tools. The TAM subscales (with the exception of the intention to use subscale) were administered after participants evaluated each AAC tool. The three subscales—perceived ease of use, perceived usefulness, and attitudes toward using the technology—have four items each. Scores range from 1 to 7 for each item, with lower scores indicating more positive responses. An average was calculated across the items in each subscale. Reliability and validity of the TAM is well established (Davis et al., 1989; Poelmans et al., 2008).

Tool Preference. Participants were asked to select the communication tool they perceived would be most useful and easy to use overall. They were then asked to select one tool from each category (i.e., communication boards and apps) that they believed was the most useful and easy to use. At the end of the usability session, participants were asked to describe overall impressions of each tool individually and in terms of the tool categories as a whole.

Data Analysis

Data analysis was conducted using SPSS version 24.0. Descriptive statistics were used to describe the sample demographics, clinical characteristics, task performance, technology acceptance, and tool preferences. Data were first screened for accuracy, missing values, outliers, and underlying statistical assumptions. Continuous variables were summarized using frequencies, means, and standard deviations. Frequency counts, percentages, and ranges were calculated for categorical variables. For ordinal variables, medians and interquartile ranges were also computed. To compare the difference between the communication device categories (i.e., communication boards versus apps), the scenarios, individual task completion scores, and the TAM subscale scores were averaged across the three tools in each category. Due to the non-normal distribution of the data, bivariate nonparametric analysis using Wilcoxon signed-rank test was performed to determine differences in scenario score, task completion, and the TAM subscale between the two categories of communication tools.

RESULTS

Sample

Of 33 participants approached, one (5.5%) patient fell below the cut-off point of the cognitive screen, and two (11.1%) patients who were deemed eligible refused participation in the study (**Figure**). Participants were an average age of 71.9 (*SD* = 6.7 years), predominantly White, and split equally between men and women (**Table 2**). Most participants were highly educated, with more than one half (n = 20, 67%) having at least some college education. The following impairments were reported: visual (n = 24, 80%), hearing (n = 10, 33%), and physical limitations of the arm/hand (n = 6, 20%). Most participants had a previous hospitalization (n = 29, 97%). Whereas most participants had experience with a computer (desktop: n = 25, 83%; laptop: n = 17, 57%) or mobile technology (mobile telephone: n = 25, 83%), two (6.7%) participants reported no use of technology. As expected, all patients with head and neck cancer reported difficulty communicating during the post-surgical hospitalization period; in addition, two (6.7%) participants without history of cancer reported difficulty communicating during a previous hospitalization.

Ability to Perform Test Scenarios and Accompanying Tasks

A summary of the successful completion of tasks is reported in **Table 3**. Successful task completion was established when participants were able to perform the scenario without assistance. Participants were not given a time limit to complete tasks. Participants who stated that they could not complete the task or who wanted to move on with the session were considered unsuccessful at completing the task.

Although participants could report the severity of their pain and request pain medication using either tool, they had greater difficulty indicating back pain using the communication boards (p = 0.035). A high number of participants were unable to complete the back pain task using the Picture Board, yet later in the sequence, seven of eight patients were able to communicate the same task on a similar tool (EZ board). Only one participant was un-

able to complete the back pain task on either of the similar tools. When the number of successful completions of the three components of the pain task was averaged (range = 0 to 9 tasks successfully completed), there was no significant difference in task completion between the communication boards and communication apps ($p = 0.376$).

Participants could successfully communicate the feeling of frustration ($p = 0.001$) and the desire to see their family ($p = 0.013$) more frequently when using the communication boards. When the number of successful completions of the two tasks within this scenario was averaged (range = 0 to 6 tasks successfully completed), the significant difference for completion remained, with more patients successfully completing the scenario using the communication boards ($p < 0.001$).

Finally, the test scenario that focused on the participant communicating need to use the bathroom was completed at significantly higher rates when using the communication boards compared to the communication apps ($p < 0.001$). Of the six tools, two did not have a designated bathroom icon, although both had alternative means for communicating need for the bathroom. The EZ Board did not specifically have a bathroom icon, but it did have bedpan and urinal icons, both of which were accepted as completing the task. Most participants were able to identify these alternate icons, or pointed to letters on the keyboard to spell "bathroom" for devices without an icon for the bathroom. The VidaTalk did not have options such as bedpan or urinal. Although it did have a keyboard and drawing feature, few participants were able to locate and use these options. The small size of keyboard icons (Health Care Communication application, VidaTalk) and lack of directions for drawing features (VidaTalk) may have contributed to higher success in task completion with communication boards compared to communication apps.

TABLE 2
CHARACTERISTICS OF SAMPLE POPULATION (*N* = 30)

Characteristic	*n* (%)
Age (mean [*SD*])	71.9 (6.7)
Gender (male)	15 (50)
Race (White)	29 (96.7)
Education	
Some high school	3 (10)
High school degree	7 (23.3)
Some college	10 (33)
College degree	4 (13.3)
Some graduate school	3 (10)
Master's degree	3 (10)
Visual impairment	24 (80)
Glasses	26 (86.7)
Hearing impairment	10 (33)
Hearing aids	3 (10)
Limited movement of arms/hand	6 (20)
Previous hospitalization	29 (96.7)
Difficulty communicating	17 (56.7)
Intensive care unit	14 (46.7)
Mechanical ventilation	7 (23.3)
Technology use	
Desktop	25 (83.3)
Mobile telephone	25 (83.3)
Laptop	17 (56.7)
Tablet	16 (53.3)
Smartphone	12 (40)
Downloaded applications	10 (33)
No technology use	2 (6.7)

Technology Acceptance

The TAM subscale scores for each tool are presented in **Table 4**. Although all subscale scores reflected relatively high acceptance, ease of use subscale scores were significantly better for the communication boards versus apps ($p = 0.002$). No significant differences were found between communication boards and apps for perceived usefulness ($p = 0.085$) and attitudes toward use ($p = 0.269$).

Communication Tool Preference

The Picture Board, VidaTalk application, and EZ Board, in descending order, were the most preferred communication tools (**Table 5**). The ICU Patient Communicator application was the only tool not selected by any participants. However, one participant did not select a communication tool, reporting that any of the communication apps would be more useful than a communication board. In general, participants thought communication boards were simpler, quicker, and easier to use. However, participants had

TABLE 3

SUCCESSFUL COMPLETION OF COMMUNICATION TASK AND GROUP COMPARISON OF TASK COMPLETION: COMMUNICATION BOARDS VERSUS APPLICATIONS (*N* = 30)

	n (%)					
	Scenario 1: Pain			Scenario 2: Emotional Support		Scenario 3: Bathroom
Tools	Task 1a Severe Pain	Task 1b Back Pain	Task 1c Pain Medication	Task 2a Frustrated	Task 2b Family	Task 3 Bathroom
Communication Boards						
EZ Board™	29 (96.7)	28 (93.3)	26 (86.7)	30 (100)	30 (100)	30 (100)
Picture Board™	28 (93.3)	22 (73.3)	30 (100)	30 (100)	30 (100)	30 (100)
Health Care Communication Board	29 (96.7)	30 (100)	30 (100)	29 (96.7)	29 (96.7)	30 (100)
Task completion[a] (mean [*SD*])	2.87 (0.35)	2.67 (0.61)	2.87 (0.35)	2.97 (0.18)	2.97 (0.18)	3.00 (0)
Communication Applications						
Intensive Care Unit Patient Communicator	30 (100)	29 (96.7)	24 (80)	22 (73.3)	30 (100)	29 (96.7)
Health Care Communication	28 (93.3)	28 (93.3)	30 (100)	19 (63.3)	22 (73.3)	29 (96.7)
VidaTalk™	29 (96.7)	30 (100)	30 (100)	29 (96.7)	28 (93.3)	16 (53.3)
Task completion[a] (mean [*SD*])	2.90 (0.31)	2.90 (0.31)	2.8 (0.41)	2.33 (0.80)	2.67 (0.55)	2.47 (0.57)
Wilcoxon signed-rank test	0.564	0.035*	0.414	0.001*	0.013*	0.001**

[a] *Task completion is a score that accounts for the successful completion of each task across the three tools in the category. Scores could range from 0* (task was not completed on any of the tools) *to 3* (task was completed on all three tools).

*p < *0.05*; **p < *0.001*.

trouble with the order and grouping of icons on the boards, reporting that the organization made them cluttered and slower to use. For example, words on the EZ Board were not alphabetical, and pictures on the board were not organized intuitively. Participants generally reported that pictures were better than words and preferred tools that had a variety of options. Print size was a problem for both communication boards and apps. The biggest issue with communication apps was navigating the pages and finding/using all available features. However, participants reported that they could learn to use the communication apps and noted the increase in options as a positive component of communication apps. Participants also reported that speech generation, drawing, and keyboard features would be beneficial.

TABLE 4
TECHNOLOGY ACCEPTANCE MEASURES OF COMMUNICATION TOOLS

Tool Type	Median (Interquartile Range)		
	Perceived Ease of Use	Perceived Usefulness	Attitudes Toward Use
Communication Boards			
EZ Board™	1.50 (1.00)	1.50 (1.25)	1.00 (1.00)
Picture Board™	1.25 (1.00)	1.25 (1.00)	1.00 (1.00)
Health Care Communication Board	1.50 (1.00)	1.75 (0.81)	1.25 (1.00)
Communication Applications			
Intensive Care Unit Patient Communicator	2.00 (0.88)	1.75 (0.81)	1.38 (1.13)
Health Care Communication	1.88 (1.75)	2.00 (1.50)	1.13 (1.00)
VidaTalk™	2.00 (1.50)	1.88 (1.38)	1.50 (1.25)

TABLE 5
NUMBER OF PARTICIPANTS WHO SELECTED COMMUNICATION TOOLS AS USEFUL AND EASY TO USE (*N* = 30)

Communication Tool	*n* (%)
Picture Board™	11 (37)
VidaTalk™	9 (30)
EZ Board™	5 (17)
Health Care Communication Application	3 (10)
Health Care Communication Board	1 (3)
Any communication application	1 (3)
Intensive Care Unit Patient Communicator	0 (0)

Note. One participant reported that any communication application would be more useful than a communication board, but did not specify a specific application.

DISCUSSION

The purpose of the current study was to evaluate the usability and acceptability of commercially available AAC tools in an older adult population. The tools evaluated in this study have been designed to aid patient communication in a hospital setting; however, little reported literature is available on usability testing, especially in the context of older adult users. As older adults account for approximately 35% of hospitalized adults (Weiss & Elixhauser, 2014), it is important that older adult patients are involved in the design and usability testing of patient-facing health care technologies and implementation of these technologies into practice.

Overall, study participants could complete more tasks using communication boards compared to communication apps on a tablet computer. These results reinforce prior reports that older adults encounter difficulty when using new technology (Charness & Boot, 2009; Czaja & Lee, 2009). Although a majority of older adults say they need assistance when it comes to using new digital devices such as smartphones or tablets, the majority indicate they are willing to learn if someone helps them through the process (Pew Research Center, 2014), which is a notion reflected by older adults in the current study. Older adults have reported lack of knowledge on how to navigate touchscreen mobile devices, including features such as scrolling, which can impact their ability to complete a task (Page, 2014; Ziefle, Himmel, & Holzinger, 2013). All three of the application-based AAC tools had multiple pages that required different navigation techniques to locate and complete tasks. For example, when using the Health Care Communication application, participants were required to find "family" on one page, then navigate and scroll down a second page to complete the task. However, the page with the frustration icon had no indicators (e.g., a scrollbar, arrows) for scrolling, and many participants were unsuccessful at this part of the task because of lack of intuitiveness and visibility. Further test-

ing in a hospital setting is needed to determine additional barriers to use. For patients scheduled for surgery, preoperative testing and tool selection could occur. The patient would be followed to identify tool use and potential barriers in the real-world setting. In hospital settings, patients may have other barriers (e.g., physiological and mental status changes, environmental barriers) in addition to challenges of the communication device identified in the current study, which may hinder access to features.

In accordance with the trends in task completion, patients reported that communication boards were easier to use than communication apps. Although patients had increased difficulty completing tasks with the communication apps, many participants expressed interest in the new technology, stating that it would be beneficial to them if they were given more instruction and time to practice with the tools. They specifically expressed interest in having more time and training to learn the advanced options on the communication apps. Although participants had difficulty using the drawing, speech generation, and keyboard features, these were some of the most well-liked features after the task had ended and instructions were provided for proper use. No instructions were provided and limited practice time was given to participants prior to testing to evaluate the intuitiveness of communication tools and mimic the experience of unexperienced users in clinical practice.

LIMITATIONS

The scenarios and accompanying tasks selected for the current usability study represent real-world scenarios that acute and critically ill patients may experience; however, not all communication tasks could be completed solely by selecting an icon on every tool. First, although tasks had multiple avenues for completion on each tool, the lack of icons on some tools may have inadvertently increased the level of complexity for tasks that required multiple steps (e.g., pain, frustration) for completion on specific tools. Second, a subgroup of patients had difficulty separating the task at hand from past hospital experiences. They focused on what they had wanted to convey during their past experience instead of completing the scenario, regardless of attempts made to redirect participants. Another limitation was a sequencing effect with some tools that may have influenced the ability of participants to correctly complete the back pain task. Randomization of tool order was meant to account for all sequencing effects. However, after testing each tool, difficulties with using the device were discussed and instructions were given on how to correctly navigate the tool if the patient had not been successful with task completion. Because seven of eight patients were not able to complete the back pain task on one tool, but were then able to complete the same task on a similar tool later in their particular sequence, it cannot be determined whether participants would have been successful on the second tool if instruction from the first tool had not been given. This pattern was not observed with any other tasks or scenarios Finally, the current sample was less diverse then the general head and neck cancer population regarding race (comprising 97% White individuals) and level of education (with 63% of participants having completed at least some college), which may limit the generalizability of findings to other groups of older adults. In addition, this group was fairly technology savvy, with most having experience with desktop computers and mobile devices.

CONCLUSION

As mobile technology continues to advance and become more prevalent in health care settings, it is imperative that the design of these technologies and the training provided to use them take into consideration needs of the burgeoning older adults as end users. The current study concludes that although communication boards may be easier for older adults to use, older adults believe that with additional time and training, communication apps can be efficient and useful, and offer more options and features. Older adults as a population do not have negative attitudes toward new technology as previously thought, but often require more practice and individualized training to become proficient. Future investigation should be aimed toward instruction and practice methods with older adults, as well as evaluating the use of communication tools in a hospital setting.

REFERENCES

Anderson, M. (2015, October 29). *Technology device ownership: 2015.* Retrieved from http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015

Beukelman, D.R., & Mirenda, P. (2005). *Augmentative and alternative communication: Supporting children and adults with complex communication needs* (4th ed.). Baltimore, MD: Brookes Publishing.

Callahan, C.M., Unverzagt, F.W., Hui, S.L., Perkins, A.J., & Hendrie, H.C. (2002). Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Medical Care, 40*, 771-781. doi:10.1097/01.mlr.0000024610.33213.c8

Charness, N., & Boot, W.R. (2009). Aging and information technology use. *Current Directions in Psychological Science, 18*, 253-258. doi:10.1111/j.1467-8721.2009.01647.x

Czaja, S.J., & Lee, C.C. (2009). Information technology and older adults. In J.A. Jacko (Ed.), *Human computer interaction handbook* (2nd ed.) (pp. 777-792). Waretown, NJ: CRC Press.

Davis, F.D., Bagozzi, R.P., & Warshaw, P.R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*, 903-1028. doi:10.1287/mnsc.35.8.982

de Barros, A.C., Leitao, R., & Ribeiro, J. (2014). Design and evaluation of a mobile user interface for older adults: Navigation, interaction and visual design recommendations. *Procedia Computer Science, 27*, 369-378. doi:10.1016/j.procs.2014.02.041

Ebert, D.A., & Heckerling, P.S. (1998). Communication disabilities among medical inpatients. *New England Journal of Medicine, 339*, 272-273. doi:10.1056/NEJM199807233390416

Faulkner, L. (2003). Beyond the five-user assumption: Benefits of increased sample sizes in usability testing. *Behavior Research Methods, Instruments, & Computers, 35*,

379-383. doi:10.3758/bf03195514
Gates, G.A., Cooper, J.C., Jr., Kannel, W.B., & Miller, N.J. (1990). Hearing in the elderly: The Framingham cohort, 1983-1985: Part 1. Basic audiometric test results. *Ear & Hearing, 11*, 247-256.
Gell, N.M., Rosenberg, D.E., Demiris, G., LaCroix, A.Z., & Patel, K.V. (2015). Patterns of technology use among older adults with and without disabilities. *The Gerontologist, 55*, 412-421. doi:10.1093/geront/gnt166
Happ, M.B., Roesch, T.K., & Garrett, K. (2004). Electronic voice-output communication aids for temporarily nonspeaking patients in a medical intensive care unit: A feasibility study. *Heart & Lung, 33,* 92-101. doi:10.1016/j.hrtlng.2003.12.005
Happ, M.B., Roesch, T.K., & Kagan, S.H. (2005). Patient communication following head and neck cancer surgery: A pilot study using electronic speech-generating devices. *Oncology Nursing Forum, 32*, 1179-1187.
Happ, M.B., Walaszek, L., Von Visger, T., Weber, M., Vermillion, B., Chipps, E.,… Patak, L. (2014). 603: Usability and acceptability testing of an iPad communication application in the intensive care unit. *Critical Care Medicine, 42*, A1505. doi:10.1097/01.ccm.0000458100.13793.0c
Healthcare Cost and Utilization Project. (2006). *HCUP facts and figures: Statistics on hospital-based care in the United States*. Rockville, MD: Agency for Healthcare Research and Quality.
Kowitlawakul, Y. (2011). The technology acceptance model: Predicting nurses' intention to use telemedicine technology (eICU). *Computers, Informatics, Nursing, 29*, 411-418. doi:10.1097/NCN.0b013e3181f9dd4a
Leathart, A.J. (1994). Communication and socialisation (1): An exploratory study and explanation for nurse-patient communication in an ITU. *Intensive & Critical Care Nursing, 10*, 93-104.
Menzel, L.K. (1998). Factors related to the emotional responses of intubated patients to being unable to speak. *Heart & Lung, 27*, 245-252.
Nasreddine, Z.S., Phillips, N.A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I.,...Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society, 53*, 695-699. doi:10.1111/j.1532-5415.2005.53221.x
Nielsen, J. (1993). *Usability engineering*. Boston, MA: AP Professionals.
Nielsen, J. (1994). Estimating the number of subjects needed for a thinking aloud test. *International Journal of Human-Computer Studies, 41*, 385-397. doi:10.1006/ijhc.1994.1065
Nilsen, M.L., Sereika, S.M., Hoffman, L.A., Barnato, A., Donovan, H., & Happ, M.B. (2014). Nurse and patient interaction behaviors' effects on nursing care quality for mechanically ventilated older adults in the ICU. *Research in Gerontological Nursing, 7*, 113-125. doi:10.3928/19404921-20140127-02.
Page, T. (2014). Touchscreen mobile devices and older adults: A usability study. *International Journal of Human Factors and Ergonomics, 3*, 65-85. doi:10.1504/IJHFE.2014.062550
Patak, L., Gawlinski, A., Fung, N.I., Doering, L., & Berg, J. (2004). Patients' reports of health care practitioner interventions that are related to communication during mechanical ventilation. *Heart & Lung, 33*, 308-320.
Pew Research Center. (2014, April 3). *Older adults and technology use*. Retrieved from http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/
Pew Research Center. (2015, April 1). *U.S. smartphone use in 2015*. Retrieved from http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015
Pew Research Center. (2017, May 17). *Technology use among seniors*. Retrieved from http://www.pewinternet.org/2017/05/17/technology-use-among-seniors
Pew Research Center. (2018, February 5). *Mobile fact sheet.* Retrieved from http://www.pewinternet.org/fact-sheet/mobile
Poelmans, S., Wessa, P., Milis, K., Bloemen, E., & Doom, C. (2008). *Usability and acceptance of e-learning in statistics education, based on the compendium platform*. Paper presented at the Proceedings of the International Conference of Education, Research and Innovation, Madrid, Spain.
Rodriguez, C., & Rowe, M. (2010). Use of a speech-generating device for hospitalized postoperative patients with head and neck cancer experiencing speechlessness. *Oncology Nursing Forum, 37*, 199-205. doi:10.1188/10.ONF.199-205
Rodriguez, C.S., & Blischak, D.M. (2010). Communication needs of nonspeaking hospitalized postoperative patients with head and neck cancer. *Applied Nursing Research, 23*, 110-115. doi:10.1016/j.apnr.2008.04.001
Rodriguez, C.S., Rowe, M., Koeppel, B., Thomas, L., Troche, M.S., & Paguio, G. (2012). Development of a communication intervention to assist hospitalized suddenly speechless patients. *Technology and Health Care, 20*, 489-500. doi:10.3233/THC-2012-0695
Rodriguez, C.S., & VanCott, M.L. (2005). Speech impairment in the postoperative head and neck cancer patient: Nurses' and patients' perceptions. *Qualitative Health Research, 15,* 897-911. doi:10.1177/1049732305278903
Steinhubl, S.R., Muse, E.D., & Topol, E.J. (2013). Can mobile health technologies transform health care? *JAMA*, *310*, 2395-2396. doi:10.1001/jama.2013.281078
Stovsky, B., Rudy, E., & Dragonette, P. (1988). Comparison of two types of communication methods used after cardiac surgery with patients with endotracheal tubes. *Heart & Lung, 17*, 281-289.
Weiss, A.J., & Elixhauser, A. (2014, October). *Statistical brief #180: Overview of hospital stays in the United States, 2012.* Retrieved from http://www.hcup-us.ahrq.gov/reports/statbriefs/sb180-Hospitalizations-United-States-2012.pdf
Ziefle, M., Himmel, S., & Holzinger, A. (2013). How usage context shapes evaluation and adoption in different technologies. In F. Rebelo, & M.M. Soares (Eds.), *Advances in usability evaluation part II* (pp. 211-220). London, UK: Taylor & Francis.

ABOUT THE AUTHORS

Dr. Nilsen is Assistant Professor, Dr. Morrison is Graduate Student Researcher, and Dr. DeVito Dabbs is Professor, Department of Acute and Tertiary Care; Dr. Lingler is Associate Professor and Dr. Sereika is Professor, Department of Health and Community Systems, University of Pittsburgh School of Nursing; Dr. Myers is Professor, Human-Computer Interaction Institute, Carnegie Mellon University School of Computer Science; Dr. Johnson is Professor and Chairman and Dr. Nilsen is also Assistant Professor, Department of Otolaryngology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania; and Dr. Happ is Associate Dean of Research, Center of Excellence in Critical and Complex Care, The Ohio State University College of Nursing, Columbus, Ohio.

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Address correspondence to Marci Lee Nilsen, PhD, RN, CHPN®, Assistant Professor, Department of Otolaryngology, University of Pittsburgh School of Medicine, and Department of Acute and Tertiary Care, University of Pittsburgh School of Nursing, 318A Victoria Building, 3500 Victoria Street, Pittsburgh, PA 15261; e-mail: mlf981@pitt.edu.

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