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Examination of Overbed Tables: Healthcare Provider and User Preferences

Joe Manganelli, BArch; Anthony Threatt, MArch; Johnell O. Brooks, PhD; Linnea Smolentzov, MS; Mary Mossey, MS; Stan Healy, DHA; Ian Walker, PhD; and Keith Green, PhD

ABSTRACT

OBJECTIVE: This exploratory study examined the preferences of healthcare providers and patients with respect to overbed table features and functions, as well as how the devices tend to be used.

BACKGROUND: In order to improve the design of overbed tables, it is important to understand which features and functions of existing models are valued by healthcare providers and patients.

METHODS: A sample of overbed table models was presented to volunteers, who were asked to choose which models' implementation of specific features and functions they preferred. Structured interviews incorporating both forced choice and free response questions were administered to the volunteers—healthcare providers and patients at a rehabilitation hospital.

RESULTS: While the overbed tabletop and extendable tray are heavily used, all other features of the overbed table models are rarely used. Usability of the models exhibits the potential for improvement. Healthcare providers' and patients' feature preferences differ and occasionally conflict.

CONCLUSIONS: Existing overbed tables are valued primarily for the top surface. Other features and functions of the overbed table present opportunities for refinement of design, durability, and usability. There are strong patterns of agreement and disagreement in the preferences of healthcare providers and patients with respect to overbed table design, use, features, and functionality. There is potential to improve overbed table designs from both the perspectives of the staff and the patient.

KEYWORDS: Evidence-based design, hospital, human factors, patient-centered care, quality care, technology

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Introduction

This article describes an exploratory study of what overbed table features and functions are used and desired by patients and staff at a rehabilitation hospital. Structured interviews, aided with three models of overbed tables, were conducted in which patients and staff participants answered a mix of forced-choice and open-ended questions. This study is an incremental step in an overall research agenda to improve the usability and effectiveness of patient room furniture. We developed this study in response to our previous research on nightstands (Brooks et al., 2011; Brooks et al., 2012) and developing assistive furniture for hospital patient rooms and assisted-living patient rooms by incorporating Universal Design Principles (UDPs) and/or smart features.

We mention these strategies in particular because we believe that both of these approaches are fundamental to the future of assistive furniture and augmenting patient self-sufficiency. The purpose of incorporating UDPs is to make the environment safe, clean, understandable, and operable without training, and barrier free for all occupants, regardless of ability, in order to facilitate patient/occupant independence (Friedman, 2002; Iwarsson & Stahl 2003; Preiser & Ostroff 2001). Such strategies are often low-tech, such as using levers instead of knobs on doors. In contrast, smart technologies tend to be high-tech and function by actively extending user awareness, increasing control over systems, and enhancing the security, healthfulness, and safety of the environment. Smart technologies utilize sensing, inference, communication technologies, data storage and sorting, decision-making algorithms, and appliance controls (Cook et al., 2003; DeRuyter & Pelgrim, 2007; Intille, Larson & Munguia Tapia, 2003). An example of a high-tech, assistive technology is a sensor network dispersed throughout the interior environment which monitors people's biometrics and/or location in space, identifies activity, and offers automated assistance in response to what it perceives to be the user's needs (Demiris, Rantz, Skubic, Aud, & Tyrer, 2005; Miskelly, 2001; U.S. Department of Health and Human Resources, 2011).

Our focus on developing assistive and more usable patient room furniture is motivated by demographic shifts that are placing increasing pressure on healthcare resources, and hospital staff in particular. The world is on the verge of an aging population boom. Between 2010 and 2050, the percent of the population in the United States aged 65 years and over is expected to increase from just less than 13% to over 20%, and the number of individuals 85 years of age and older is expected to double (U.S. Census Bureau, 2008). Similar demographic shifts exist throughout the world (Mayhew, 2000; United Nations Department of Economic and Social Affairs, 2004). For instance, the population of those aged 65 years and older is expected to more than quadruple by 2050 in Africa, Asia, South America, and the Caribbean (United Nations Department of Economic and Social Affairs, 2004). The worldwide population of those aged 80 years and older is expected to increase by a multiplier of more than five by 2050, growing from 69 million people in 2000 to 368 million by 2050. Over the same time period, the median age of Americans, Europeans, and Asians will rise from approximately 38 years of age at present to 48 years of age (United Nations Department of Economic and Social Affairs, 2004). At the same time, populations globally are increasingly developing disabling chronic diseases, such as heart disease, cancer, diabetes, and obesity (World Health Organization, 2012). A consequence of these demographic shifts in the United States is that the cost of Medicare expenditures as a percentage of the U.S. gross domestic product (GDP) is projected to increase from 4% in 2007 to 12% by 2050 (U.S. Congressional Budget Office, 2007). In summary, the proportion of older adults worldwide will grow geometrically over the next 40 years, and many will find themselves hospitalized for non-communicable, chronic diseases which limit their functional independence unless

augmented by hospital staff or assistive furniture and devices. Hence, improvements to the usability and effectiveness of environments in which aging populations and people of limited physical capabilities receive care will be increasingly important to ensure their well being, to ease the burden of care on staff, and to control the cost of care.

The major challenges that the aging population faces are the loss of mobility and self-sufficiency. Often, seniors and people of limited physical capabilities feel their need for assistance makes them a burden on caregivers or hospital staff. As a result, they attempt activities of daily living that they are no longer capable of performing without assistance, often resulting in falls and other injuries which lead to more serious and long-term complications to maintaining independence. Given these current and future social conditions, elder care may become the "key work–family concern for the 21st century" (Craver, 2002; Smith, 2004). Consequently, society will need to focus on the needs and preferences of aging adults who must cope with diminishing mobility and a loss of independence (Coughlin, 1999).

Part of the solution will involve providing devices and technologies that help seniors and people of limited capabilities to maintain their independence and to reduce the burden of care on caregivers and patients' families.

Part of the solution will involve providing devices and technologies that help seniors and people of limited capabilities to maintain their independence and to reduce the burden of care on caregivers and patients' families. These technologies can place caregivers in the position of providing oversight and some assistance without requiring direct, constant intervention.

We initially targeted the patient room nightstand as a candidate for redesign as a smart and more usable piece of assistive patient room furniture that can serve an immediate, critical need in institutional settings and which has the potential to be deployed in domestic settings as well. We conducted two studies on the uses of the nightstand in assisted living and hospital facilities (Brooks et. al., 2011; Smolentzov et. al., 2009). User and staff feedback from the first set of studies suggested that the functionality of the nightstand could be improved if it were mobile and had an extendable surface, like a retractable tray. In response, we developed full-scale, medium-fidelity smart, mobile nightstand prototypes through an iterative and participatory design process with subject matter experts at a rehabilitation hospital. We then evaluated the smart, mobile nightstand prototypes using structured interviews with patients and staff (Brooks et al., 2012). The results revealed that caregivers and users did not desire or prefer a mobile nightstand with a tray but rather desired an overbed table with more onboard storage. Our preliminary review found no existing literature on overbed table usage in either domestic or institutional settings, nor were there any published design guidelines. In response, our first step was an exploratory study to determine what existing overbed table features and functions patients and staff use and to ask for suggestions about how to improve the usability and effectiveness of overbed tables. For the current research, we developed and administered a survey through structured interviews in which participants visually inspected three demonstration models of overbed tables: an entry-level model, a mid-range model, and a premium model. We also reviewed product manufacturer literature on 81 existing overbed table models from 22 manufacturers and compared those to our selected models. In this comparison, we excluded consumer models because institutional models

Table 1. Review of Specifications for Institution-Grade Overbed Tables (OBTs)

TYPE OF OBT [*n*]	ENTRY LEVEL [11]	MID-RANGE [26]	MID-RANGE BARIATRIC [2]	PREMIUM [16]
SIZE (inches)				
Avg W x L	16W x 31L	17W x 31L	18Wx 40L	18W x 33L
sdW	1	1	0	1
sdL	1	1	0	2
[*n*]	[11]	[23]	[2]	[13]
EXTENDABLE TRAY SIZE (inches)				
Avg W x L	14.5W x 26L	14W x 22L	N/A	16W x 23L
sdW	0	1		2
sdL	0	6		5
[*n*]	[1]	[2]		[4]
TABLE TOP STRUCTURAL MATERIAL	Particle Board	Particle Board or Molded Urethane	Particle Board	Particle Board or Molded Urethane
[*n*]	[10]	[23]	[2]	[14]
WEIGHT (pounds)				
Range	26–59	28–59	70–75	55–75
Avg	41	44	73	64
sd	13	13	3	8
[*n*]	[8]	[13]	[2]	[5]
LOAD CAPACITY (pounds)				
Range	50–100	25–100	500	75–100
Avg	71	73	500	96
sd	27	29	0	9
[*n*]	[7]	[16]	[2]	[7]
FRAME MATERIAL	Steel	Steel or Aluminum	Steel	Steel or Aluminum
[*n*]	[11]	[26]	[2]	[14]
RAISING/LOWERING MECHANISM	Racheting, Mechanical or Gas Spring	Mechanical Spring or Gas Spring	Racheting	Gas Spring
[*n*]	[9]	[15]	[2]	[9]
COLUMN TRAVEL (inches)				
Min	27	29	31	29
sdMin	3	1	0	1
Max	40	44	46	44
SdMax	5	2	0	2
[*n*]	[11]	[23]	[2]	[11]
FRAME FINISH	Powder Coating or Chrome-Plated	Powder Coating, Chrome Plating, or Anodized Aluminum	Powder Coating	Powder Coating, Chrome Plating, or Anodized Aluminum
[*n*]	[11]	[26]	[2]	[16]
TABLE TOP & TRAY SURFACE FINISHES	Laminate or Thermofoil	Laminate, Thermofoil, or Molded Urethane	Laminate	Laminate, Thermofoil, or Molded Urethane
[*n*]	[11]	[26]	[2]	[16]
SURFACE SHAPE VARIETY				
Y/N	N	Y/N/Optional	N	Y/N/Optional
Optional		**		**
[*n*]	[11]	[26]	[2]	[16]
LIP AROUND EDGE OF SURFACE				
Y/N	Y/N	Y/N	N	Y/N
Optional	*	**		***
[*n*]	[11]	[23]	[2]	[16]
STORAGE SHELVES/COMPARTMENTS				
Y/N	Y/N	Y/N/Optional	N	Y/N/Optional
Optional	*	**		***
[*n*]	[11]	[26]	[2]	[16]
VANITY/MIRROR				
Y/N	Y/N	Y/N/Optional	N	Y/N/Optional
Optional	*	**		***
[*n*]	[11]	[26]	[2]	[16]
CUP HOLDERS				
Y/N	N	Y/N	N	Y/N
Optional		*		**
[*n*]	[11]	[24]	[2]	[16]
TISSUE DISPENSER, HANDLES, OTHER				
Y/N	N	Y/N	N	Y/N
Optional		*		*
[*n*]	[11]	[26]	[2]	[16]

NOTES:

* Less than one-third of models offer these features as standard (or optional, if noted as such).

** Between one-third and two-thirds of models offer these features either as standard (or optional, if noted as such).

*** More than two-thirds of models offer these features as standard (or optional, if noted as such).

Table 2. Demonstration Tables

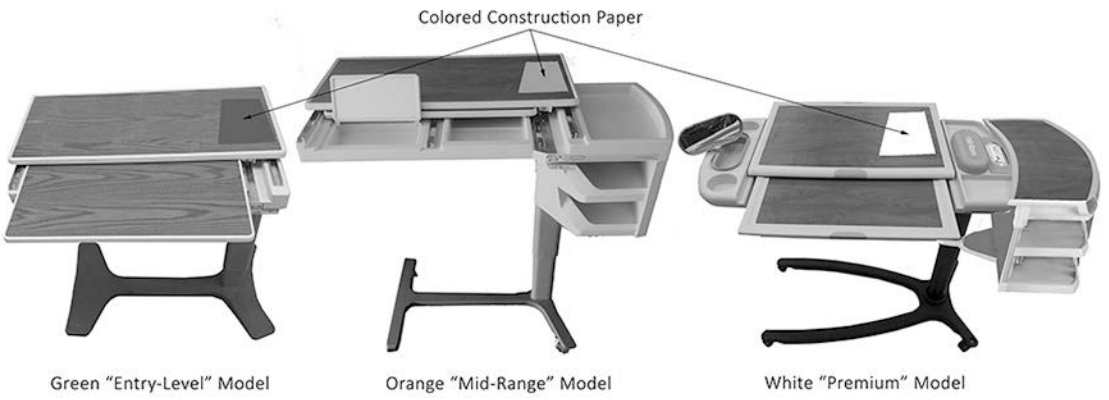
TYPE OF OBT	HILL-ROM 220 PATIENT MATE JR.	HILL-ROM 230 PATIENT MATE	HILL-ROM 636 ART OF CARE
Size (inches) W x L	15W x 36L	15W x 44L	18.75W x 50.25L
Extendable tray size (inches) W x L	14.5W x 26L	14.5W x 26L	18.5W x 26L
Table top structural material	Particle Board	Particle Board	Particle Board
Weight (pounds)	58	69	58
Load capacity (pounds)	100	100	100
Frame material	Steel	Steel	Steel
Raising/lowering mechanism	Gas Spring	Gas Spring	Gas Spring
Column travel (inches) Min–Max	30–46	30–46	29.25–46.5
Frame finish	Powder Coating	Powder Coating	Powder Coating
Table top & tray surface finishes	Laminate	Laminate	Laminate
Surface shape variety (Y/N)	N	N	Y
Lip around edge of surface (Y/N)	Y	Y	Y
Storage shelves/compartments (Y/N)	N	Y	Y
Vanity compartment/mirror (Y/N)	Y	Y	Y
Cup holders (Y/N/Optional)	N	N	Y
Tissue dispenser, handles, other (Y/N)	N	N	Y

NOTE:
During forced-choice questions about design feature preferences, color coding was used to differentiate between the models: Green = Entry level: Patient Mate, Jr. #220 (lighter, smallest, fewest features); Orange = Mid-Level: Patient Mate #230 (heavier, larger, additional storage and surface area); Green/Orange = Patient Mate, Jr./Patient Mate (same materials, finishes); White = Art of Care #636 Dual Surface (largest, unique design, most storage, most features).

tend to be larger, have higher load capacities, are made with more durable materials, finishes, and mechanisms, have larger table tops, and offer a wider range of features, functions, and styles. This procedure reduced the number of existing products reviewed to 55. Through this process, we confirmed that the overbed tables are classifiable in three product tiers and that our demonstration models were representative of the product tiers. The three product tiers we found are summarized in Table 1.

Entry-level models are generally smaller and lighter, with slightly lower load capacities on average; comprised of a few basic institutional-grade shapes, materials, finishes and mechanisms; and offer very few options. Mid-range models are generally larger and heavier, with slightly higher load capacities on average; and offer a greater selection of shapes, materials, finishes, mechanisms, and feature options. Premium models are generally the largest and heaviest, with much higher load capacities on average; offer the widest selection of shapes, materials, finishes, mechanisms, and features; and include as standard many of the features that are optional or unavailable on the mid-range models and completely unavailable on entry-level models, such as storage units mounted to the support column, unique or refined aesthetics, cup holders, tissue holders, and more refined opening, closing, raising, and lowering mechanisms. The three demonstration models we chose are summarized in Table 2, above, and Figure 1, below. Our entry-level model is smaller, lighter, and has the fewest features of the three. Our mid-range model is larger, heavier, and has some additional features, including storage. Our premium model is the largest, with distinct aesthetics, the most storage, and many premium features.

Figure 1. Three overbed table models used for the study: an entry-level model, a mid-range model, and a premium model.



Method

The method used for the current study evolved from two previous studies by Brooks et al. (2011, 2012), as described above. The study presented here was designed to identify user preferences and suggestions for what overbed table features and functions are used by patients and staff. Interview questions for this current study were exploratory, forced-choice and open-ended questions, modeled after the Brooks et al. studies.

Participants

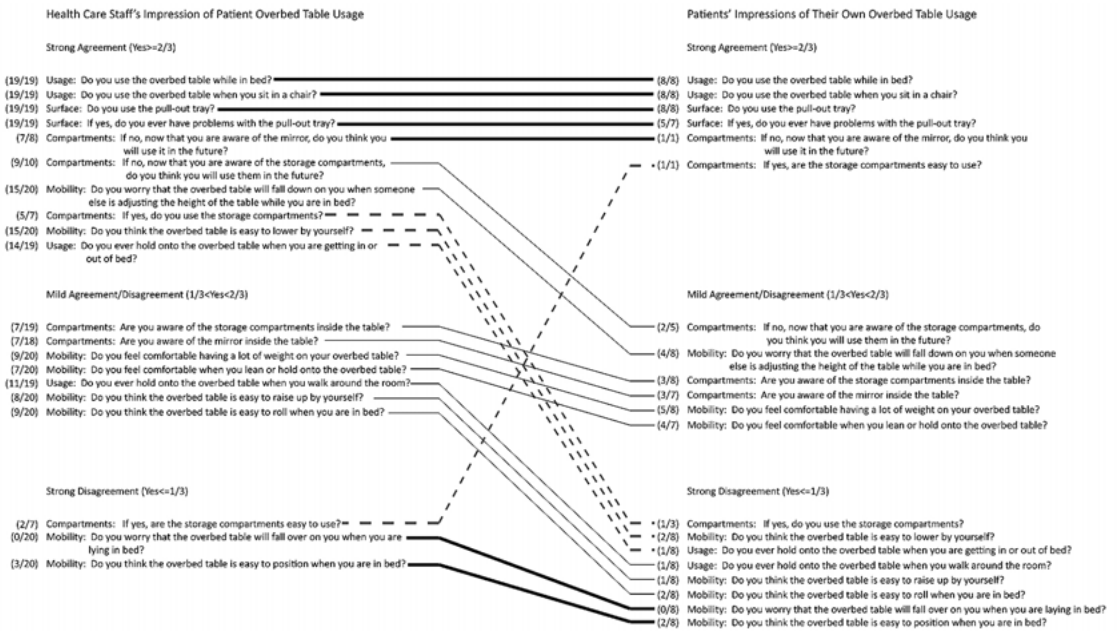
Volunteers for this study consisted of patients and hospital staff at a rehabilitation hospital. Eight patient volunteers and 21 staff volunteers participated in the study. Staff included doctors, nurses, occupational therapists, physical therapists, housekeeping, and general staff. In the interest of protecting the privacy of this small, exploratory sample population, and based on the conditions of the hospital's institutional review board (IRB) approval of the study design, demographic data are not presented here.

Procedure

Approval from the appropriate IRBs was obtained prior to data collection. Researchers told the volunteers the purpose of the study was to investigate which types of overbed table solutions best addressed a particular feature or function in order to better understand how to design overbed tables. Prior to beginning each interview session, informed consent was obtained and background information was recorded.

Data collection for this study occurred through structured interviews including demonstration of and volunteer interaction with three types of overbed tables as follows: Hill-Rom PatientMate Jr. #220 overbed table, referred to as the "entry-level" model; Hill-Rom PatientMate #230 overbed table with storage compartment, referred to as the "mid-range" model; and the Hill-Rom Art of Care #636 overbed table, referred to as the "premium" overbed table model (see Figure 1). For identification during the interviews, the entry-level model was marked with a sheet of green construction paper on the table top, the mid-range model was marked with orange paper, and the premium model was marked with a white sheet of paper.

Figure 2. Forced-choice answers to usage and mobility questions.



There were four main sections to the interview process. First, participants were asked forced-choice questions (Yes/No) about usage tendencies and the mobility of overbed tables in general (see Table 3 and Figure 2). Next, the participants offered size preferences for the top surface, extendable tray, and cup holders of the overbed tables (see Table 4). Then participants compared various features and functions of the three demonstration models and picked which of the three overbed tables best implemented a particular feature or function (see Table 5). Last, participants answered open-ended questions about various aspects of overbed table use and design (see Figures 3, 4, 5, and 6, below).

Researchers interviewed patients one-on-one; researchers interviewed hospital staff in groups ranging from 2 to 6, though each volunteer was assigned a research staff note-taker who recorded individual responses. In addition, one researcher performed the role of the facilitator, demonstrating the features of the overbed tables, reading the script, and asking the interview questions. The interview methods differed for patients and staff because access to patients and staff was dependent on their schedules. For each interview question, the facilitator would first demonstrate or point out how each of the three overbed tables offered a particular feature or function, followed by a question about that feature or function. For instance, the facilitator would slide the tray open, reveal the compartments inside, gesture toward the volunteer, and then ask, "Are you aware of the storage compartments inside the table?" If the response was yes, then the facilitator asked, "Do you use the storage compartments?" The volunteer was asked to respond only in the format requested by the facilitator (Y/N, pick one, or open-ended). If a volunteer wanted to provide a statement when a Y/N or pick one response was appropriate, the matter was directed to the facilitator, who repeated the question and demonstration, and reminded the volunteer of the appropriate for-

mat for the response. Neither the facilitator nor the note takers answered questions or conversed with participants. In order to best understand some features and functions, volunteers were encouraged to approach the overbed tables and interact with them directly. For instance, to assess which tray type the volunteers preferred opening, they were invited to get up and open the tray on each model.

Results

For convenience, the results of this study are presented in sections according to the major overbed table features and functions categories investigated: Usage, Mobility, Size, Design Preference, and Content Analysis of Likes/Dislikes/etc. The breakdown of interview questions per category is as follows: Forced-choice interview questions (yes/no answers) addressed categories which included general usage (4 questions), surface usage (2 questions), compartments usage (8 questions), and mobility (8 questions). In addition, there were forced choice (pick one) questions about size (6 questions) and about design preference (13 questions). There were also open-ended questions about use of the overbed tables in general (4 questions), about the value of adding lighting to the overbed tables (4 questions), and about frustrations with the overbed table (asked of hospital staff only, 3 questions). These were analyzed using content analysis as per Figures 3, 4, 5, and 6, below.

Three types of analysis were conducted as follows: frequency analysis with cut scores on the Usage, Mobility, and Design Preference categories (forced choice responses), as per Tables 3 and 5 and Figure 2; mean values analysis on the Size preferences, as per Table 4; and content analysis of the Likes/Dislikes/etc., responses to the open-ended questions, as per Figures 3, 4, 5, and 6. With respect to frequency analysis, three categories were created: (1) questions for which the volunteers answered in the affirmative two-thirds of the time or more were considered *strong positive agreement*; (2) questions for which the volunteers answered in the affirmative less than two-thirds of the time but more than one-third of the time were considered having *weak agreement/disagreement*; and (3) questions for which the volunteers answered in the affirmative one-third of the time or less were considered to have *strong negative agreement* with the question. Establishing cut scores at one-third and two-thirds agreement was determined during exploratory analysis within a small sample of subject matter experts because doing so separated responses into two categories which have a high likelihood of validity (less than one-third and greater than two-thirds), given that in these categories, response agreement or disagreement is significantly greater than chance; and a third category (greater than one-third but less than two-thirds) in which the responses are not significantly greater than chance, suggesting that we do not have enough data to draw any preliminary conclusions about these items. This method and justification of using cut scores is consistent with use of cut scores in general (Dwyer, 1996) and has been used and refined by our team in prior research (Brooks et al., 2012). In addition, we compared the frequencies of the hospital staff volunteers' responses to those of the patients as per Figure 2, above, noting the relationship of positive and negative agreement across the two groups.

With respect to content analysis, we used a computer program to count the occurrence of key words in the responses to open-ended questions. This type of content analysis identifies key themes of spoken or written content or responses in consumer research (Kassarjian, 1977). In order to convey the results of this content analysis, we used a computer program which scaled the size of the analyzed words proportionally with the number of times they appeared in the answers to the open-ended questions.

The number of responses to each question varied. In some instances, a volunteer did not answer because the question was only addressed to those who gave a particular answer to the previous question. For

instance, one question read, "If yes, do you use the storage compartments?" In a few other instances, a volunteer would not answer Yes/No as requested but responded with a statement. When this occurred, the facilitator would repeat the question and ask for a Yes/No answer. This usually resulted in the volunteer answering with a Yes/No answer. But sometimes the volunteer would still not answer Yes/No. When this occurred, we recorded the statement given but did not use it during analysis.

Usage

The data discussed in this section is summarized in Table 3, below. Table 3 lists percentages for both agreement and disagreement. In the interest of brevity and consistency, only the percentage for agreement is provided in the Results Section. For example, (13%) agreement indicates that the participants did not agree with the statement. Hospital staff members (n = 19) unanimously agreed that patients used the overbed tables while in bed and while sitting in a chair and strongly agreed (74%) that patients used the overbed table as an aid while getting out of bed, but only somewhat agreed (58%) that patients used overbed tables as support while walking. Patients (n = 8) unanimously agreed that they used the overbed tables while in bed and seated in a chair (100%) but strongly disagreed with the idea that they used the overbed tables to steady themselves while getting out of bed or walking (13%). Both hospital staff and patients unanimously agreed that they used the overbed tables' pull-out trays, and both groups also strongly agreed that operation of the pull-out tray is problematic (100% and 75%, respectively). Hospital staff members were relatively unaware of the interior compartments of overbed tables (37%), and patients were only slightly more aware of these features (38%). Of those hospital staff who were aware of the interior compartments, most believed that patients used them (71%), whereas only one-third of patients who were aware of the interior compartments actually used them (33%). For those hospital staffers who were aware of the interior compartments, they did not think that they are easy to use (17%). Conversely, the one patient who used the interior compartments believed that they were easy to use. Of those who were unaware of the interior compartments, the staff overwhelming agreed that they are likely to use or recommend use of the compartments in the future now that they know of them (92%), whereas a minority of those patients who were unaware of the compartments said they are likely to use them now that they know of them (40%). Similarly, most staff and patients, respectively, were unaware of the mirror within an interior vanity compartment (39% and 43%, respectively). Both the hospital staff and the patients who were unaware of the mirror said that they are very likely to use it now that they are aware of it (89% and 100%, respectively).

Mobility

Note: The data discussed in this section is summarized in Table 3, below. Table 3 lists percentages for both agreement and disagreement. In the interest of brevity and consistency, only the percentages for agreement are provided in the Results Section. For instance, (13%) agreement indicates that the majority of participants did not agree with the statement.

For both staff and patients, approximately half (47% and 63%, respectively) felt comfortable with substantial weight placed on the overbed table. Only about one-third of staff felt comfortable leaning or holding onto the overbed table (35%), whereas a little more than half of patients felt comfortable leaning or holding onto the overbed table (57%). None of the staff and none of the patients were concerned with the overbed table falling on the patient while the patient was in bed. However, three-quarters of staff and half of patients (75% and 50%, respectively) were concerned that the overbed table might fall on a patient in bed if someone else were adjusting it while positioned over the bed. Only half of staff and approximately one-eighth of patients

agreed that the overbed table top was easy to raise by oneself (50% and 13% respectively), and slightly more felt it was easy to lower by oneself (75% and 25%, respectively). Less than half of staff and only a quarter of patients agreed that the overbed table was easy to roll while in bed (45% and 25%, respectively). Similarly, just half of the staff and only a quarter of the patients agreed that it is easy to posi-

Table 3. Usage and Mobility—Forced-Choice Responses (Y/N)

QUESTION	NUMBER OF VOLUNTEERS RESPONDING		% YES		% NO	
	STAFF	PATIENTS	STAFF	PATIENTS	STAFF	PATIENTS
USAGE						
Do you use the overbed table while in bed?	19	8	100	100	0	0
Do you use the overbed table when you sit in a chair?	19	8	100	100	0	0
Do you ever hold onto the overbed table when you are getting in or out of bed?	19	8	74	13	26	87
Do you ever hold onto the overbed table when you walk around the room?	19	8	58	13	42	87
SURFACE						
Do you use the pull-out tray?	19	8	100	100	0	0
If yes, do you ever have problems with the pull-out tray?	19	7	100	71	0	29
COMPARTMENTS						
Are you aware of the storage compartments inside the table?	19	8	37	38	63	52
If yes, do you use the storage compartments?	7	3	71	33	29	67
If yes, are the storage compartments easy to use?	7	1	29	100	71	0
If no, now that you are aware of the storage compartments, do you think you will use them in the future?	10	5	90	40	10	60
Are you aware of the mirror inside the table?	18	7	39	43	61	57
If no, now that you are aware of the mirror, do you think you will use it in the future?	8	1	88	100	12	0
MOBILITY						
Do you feel comfortable having a lot of weight on your overbed table?	20	8	45	63	55	37
Do you feel comfortable when you lean or hold onto the overbed table?	20	7	35	57	65	43
Do you worry that the overbed table will fall over on you when you are lying in bed?	20	8	0	0	100	100
Do you worry that the overbed table will fall down on you when someone else is adjusting the height of the table while you are in bed?	20	8	75	50	25	50
Do you think the overbed table is easy to raise up by yourself?	20	8	40	13	60	87
Do you think the overbed table is easy to lower by yourself?	20	8	75	25	25	75
Do you think the overbed table is easy to roll when you are in bed?	20	8	45	25	55	75
Do you think the overbed table is easy to position when you are in bed?	20	8	15	25	85	75

tion the overbed table while in bed (50% and 25%, respectively).

Size

Note: The data discussed in this section is summarized in Table 4, below. For questions about preferred overbed table size (eight questions), we allowed the respondents to choose the existing sizes of one of the sample units or to use a 42-inch ruler to pick the size they felt was most appropriate for each dimension. For reference, the dimensions of the existing overbed table table tops are approximately 36 inches long by 15 inches wide for the entry-level and mid-level models and 36 inches long by 18.75 inches wide for the premium model. The existing slide-out trays are approximately 26 inches long by 14.5 inches wide and 26 inches long by 18.5 inches wide, respectively. Hospital staff and patients' preferences for table sizes varied widely, with the minimum recommended length being 18 inches and the maximum 42 inches, and the minimum suggested width being 12 inches and the maximum being 35 inches. However, the mean recommended sizes for the table top surface are fairly close to the dimensions of the tops of our test units, both for the length (M = 32.78", SD = 5.65"; M = 33.44", SD = 5.83", respectively) and the width (M = 19.55", SD = 4.75"; M = 17.75", SD = 4.65", respectively). Both staff and patients strongly agreed that an extendable tray is desirable (89% and 100%, respectively). However, suggestions for the length and width of the extendable tray varied widely (12"–36" [length]; 12"–35"[width]), but the mean length (M = 26.54", SD = 5.1"; M = 25.43", SD = 8.62") and mean width (M = 16.72", SD = 4.94"; M = 15.2", SD=3.0", respectively) are fairly close to the existing actual dimensions (L = 26.0", W = 14.5").

None of the staff and none of the patients were concerned with the overbed table falling on the patient while the patient was in bed.

Questions about number and sizes of cup holders were also asked. First, volunteers were asked to state the ideal number of cup holders without having any exposure to examples of cup holder sizes

Table 4. Table Top, Tray, and Cup Holder Size Preferences

QUESTION	NUMBER OF VOLUNTEERS RESPONDING		AVERAGE PREFERRED VALUE	
	STAFF	PATIENTS	STAFF	PATIENTS
What would be your ideal size (length) of the table's surface?	21	8	32.78" L x 19.55" W	33.44" L x 17.75" W
Comparing overbed table features: Do you want an extendable tray? (Y/N)	18	8	Yes (16/18)	Yes (8/8)
What would be your ideal size of the extendable tray?	19	8	26.54" L x 16.72" W	25.43" L x 15.20" W
What is your ideal number of cup holders?	19	8	1.8	1.75
Do you want the cup holder to be above the tray or recessed?	16	0	Recessed (15/16)	—
Which cup holder size do you prefer (pick from four sample sizes)?	20	8	3.1"	3.4"
Which alternative cup holder size do you prefer (pick from four sample sizes)?	17	8	3.77"	3.78"
Which cup holder size do you prefer (show with ruler)?	20	8	1.85"	2.35"
Which alternative cup holder size do you prefer (show with ruler)?	16	8	1.9"	2.38"

or the space required for any particular number of cup holders. Under these circumstances, volunteers from both groups had very similar preferences for number of cup holders (M = 1.79, SD = 0.42; M = 1.75, SD = 0.71, respectively). In addition, hospital staff members were asked whether recessed or above-surface cup holders were preferable. Staff indicated a strong preference for recessed cup holders (94%). Researchers asked volunteers to provide one to four suggestions for cup holder size, the premise being that there would be at least one but likely no more than four different, useful sizes of cup holders on the overbed table. This question was asked twice. The first time, staff and patients were asked to select (point to) one of five circular holes cut out of a cardboard sheet that represents the ideal size for a cup holder. The five circular holes had the following diameters: 2.0 inches, 2.75 inches, 3.5 inches, 4.25 inches, and 5.0 inches. The mean preferences for cup holders' sizes were very similar (M = 3.1", SD = 3.5; M = 3.4", SD=0.756). The second time researchers asked about preferred cup holder size, staff and patients were asked to indicate with forefinger and thumb the ideal diameter for the cup holder without relying on a reference shape. A research assistant then took a ruler and measured the distance between forefinger and thumb indicated by each volunteer. Asking the question in this way, without providing a prop, resulted in the staff preferring a mean cup holder diameter of M = 1.85" (SD = 1.06), whereas the patients suggested a mean cup holder diameter of M = 2.35" (SD = 2.02). Next, staff and patients were asked if alternative cup holder sizes should be considered. For the question about an alternative cup holder size, the volunteers again selected the circle in a template (by pointing) to indicate their preferred cup holder size. The staff indicated that the cup holder diameter should be M = 3.77" (SD = 0.702), and the patients indicated that the cup holder diameter should be M = 3.78" (SD = 0.756). These values are consistent with the values selected for the primary cup holder size. The preferred diameters for the second cup holder size indicated with forefinger and thumb (M = 1.9", SD = 1.24"; M = 2.38", SD = 2.0") were consistent with the results indicated by forefinger and thumb for the primary cup holder size query. In summary, the hospital staff and patients prefer two cup holders, but the preferred diameter is unclear.

Volunteers from both groups had very similar preferences for number of cup holders.

Design Preference

Note: The data discussed in this section is summarized in Table 5, below. Researchers asked volunteers 13 questions to compare the three standard overbed table product classes presented to them and determine which design best incorporated specific features and functions. For the comparison, volunteers were allowed to approach the overbed tables and interact with them. When both the entry-level overbed table (marked with green construction paper) and the mid-range overbed table (marked with orange construction paper) had identical features, the information was recorded as *green/orange,* and later translated to *entry-level/mid-range.*

When comparing how to open the extendable tray, the entry-level/mid-range units have a lever-release-locking mechanism, whereas the premium unit's mechanism does not require the user to unlock the mechanism via a lever release. The benefit of the lever-release-locking mechanism is that once the tray is locked in a position, it will stay firmly fixed in that position until the lever is released. The problem with the lever-release-locking mechanism as implemented on the entry-level and mid-range units is that the lever-release can be difficult for some users to operate, and once released, the tray has a tendency to slide very rapidly until the lock sets again which can cause shaking and spilling of

Table 5. Overbed Table Feature and Function Implementation Preferences

QUESTION	NUMBER OF VOLUNTEERS RESPONDING		% PREMIUM		% ENTRY-LEVEL/ MID-RANGE		% MID-RANGE		% ENTRY-LEVEL	
	STAFF	PATIENTS	STAFF	PATIENTS	STAFF	PATIENTS	STAFF	PATIENTS	STAFF	PATIENTS
How to open tray?	21	8	86	50	14	50	0	0	0	0
How to close tray?	21	8	76	37	24	63	0	0	0	0
How to raise table?	21	8	81	75	19	25	0	0	0	0
How to lower table?	21	8	76	63	19	37	0	0	5	0
How it rolls?	21	8	91	75	9	25	0	0	0	0
Which side shelves opening?	21	8	62	50	0	0	38	50	0	0
Which top of side-shelves / compartments?	21	8	14	37	0	0	81	63	5	0
Which bottom 2 shelves?	21	8	52	63	0	0	48	37	0	0
Which mirror?	21	7	81	71	19	29	0	0	0	0
Do you like how the mirror rotates on white? (Y/N)	4	3	75 (Yes)	100 (Yes)	0	0	0	0	0	0
Which lip design do you prefer?	21	8	95	50	0	0	0	0	5	50

items on the top. The rapid action also increases the feeling that one's fingers might get pinched while operating the unit as one shifts fingers from operating the lever to control the slide of the tray. Conversely, the benefit of the non-locking design is that operation is smooth and steady. The problem with this latter mechanism is that there is no actual bolt or lever securing the tray in place, so that bumping the tray too hard can unexpectedly make it slide a little, causing items on it to topple. For staff, 86% preferred the premium unit's mechanism, whereas for the patients, preference was split equally—50% for the premium mechanism, 50% for the entry-level/mid-range mechanism. With respect to closing the extendable tray, staff strongly preferred the premium unit's mechanism (76%), whereas the patients had a slight preference for the entry-level/mid-range mechanism (63%). With respect to how to raise the table top, both the staff and the patients strongly preferred the premium unit's mechanism (81% and 75%, respectively). But with respect to how to lower the table top, while the staff had a strong preference for the premium unit's mechanism (76%), the patients had a mild preference for the premium unit's mechanism (63%). For both raising and lowering the unit table tops, the premium unit's travel was more controlled, with a reassuring level of consistent resistance which moderated the rate of travel. Conversely, the entry-level/mid-level unit's travel was not moderated as much, which resulted in the tops dropping with gravity as soon as the lever was released.

Both groups exhibit a strong preference for how the premium unit rolls (91% and 75%, respectively). With respect to the side shelving on the premium and mid-range units, staff had a mild preference for the premium unit's shelves over those of the mid-range unit (62%), whereas the patients were evenly split on which shelving was better. When specifically considering the top shelf attached to the premium and mid-range units, the staff strongly preferred the mid-range unit's top shelf (81%), and the patients exhibited a mild preference for the mid-range unit's top shelf (63%). (The premium unit's top shelf is just a flat plane with a minimum lip, less than an eighth of an inch, around the edge, whereas the mid-range unit's top shelf lip is about an inch and

a quarter deep.) With respect to the bottom shelves of the mid-range and premium units, the staff were split pretty evenly, with 52% preferring the premium unit's bottom shelves, while the patients also exhibited a mild preference (63%) for the premium unit's bottom shelves. Each unit also has a mirror. The entry-level and mid-range units' mirrors are identical, whereas the premium unit's mirror is a fundamentally different design. The entry-level/mid-range units' mirrors are real glass and foil mirrors that are integrated, flip-top devices located in a vanity compartment that slides out from under the extendable tray, whereas the premium unit's mirror is a flip-up-and-rotate plastic and foil unit mounted on the underside of the lid of a storage box that sits in a recessed depression on the top of the table top. The staff strongly preferred the premium unit's mirror design (81%), as did the patients (75%). The lip around the surfaces of the premium unit was slightly more pronounced, and the staff overwhelmingly preferred it (95%), whereas the patients exhibited no preference (50%).

The content analysis suggests that both staff and patients value the mobility and convenience of the overbed tables and mostly use the overbed tables during meals.

Content Analysis of Likes and Dislikes

Last, the participants answered 11 open-ended questions about likes and dislikes of existing designs, incorporation of lighting into the overbed tables, unsanitary conditions associated with overbed tables, and suggestions for improving the design of overbed tables. We used content analysis to investigate the frequency of certain key words in the responses. Though one content analysis was conducted for each question, the results of five content analyses stand out as particularly meaningful: existing feature/function likes; existing feature/function dislikes; additional features/functions desired; specific frustrations; and suggested changes. (See Figures 3, 4, 5, and 6.) The content analysis suggests that both staff and patients value the mobility and convenience of the overbed tables and mostly use the overbed tables during meals. Conversely, both patients and staff identify several deficiencies of these overbed tables, including the usability of the compartments, the extending mechanisms, and the difficulty of operating the devices. Cup holders seem to be the primary feature that both staff and patients would like added to the overbed tables. For staff, frustrations when positioning overbed tables include navigating under the bed, over cords on the floor, and the general user-experience of moving the overbed table around the room. Suggested changes include easier operation and making the overbed table as small as possible. However, the comments about making the overbed tables smaller may contradict results from the table sizes questions as illustrated in Figure 3, wherein staff requested modestly larger top and extendable tray surfaces. Further study is needed on this topic.

Limitations

This study has small volunteer populations, especially the patient population, for which it was challenging to obtain volunteers. While the selected overbed table features and functions are representative of entry-level, mid-range, and premium institutional overbed tables, the models used are from the same manufacturer. Furthermore, data on preferred cup holder size was obtained by having participants suggest cup holder sizes. We did not inventory cup sizes of standard hospital-grade juice, water, and other cups. This matter is addressed further in "Future Research," below.

Discussion

The results yield five primary observations about hospital staff and patient preferences with respect to overbed tables. The first observation is that existing overbed tables serve essential roles. There is overwhelming agreement that patients use overbed tables during meal time, while grooming, while maintaining oral and facial hygiene, while applying makeup, and as a place to set out and store personal artifacts. Fulfilling these roles is critical to the quality of the patient's daily life and in re-establishing functional independence; thus, overbed tables are essential components of patient rooms, even if all they provide is a movable, flat, horizontal surface. In addition, staff and patients unanimously agreed that overbed tables are used by patients for these purposes both while in bed and while sitting in chairs.

Figure 3. Content analysis: staff and patient likes.

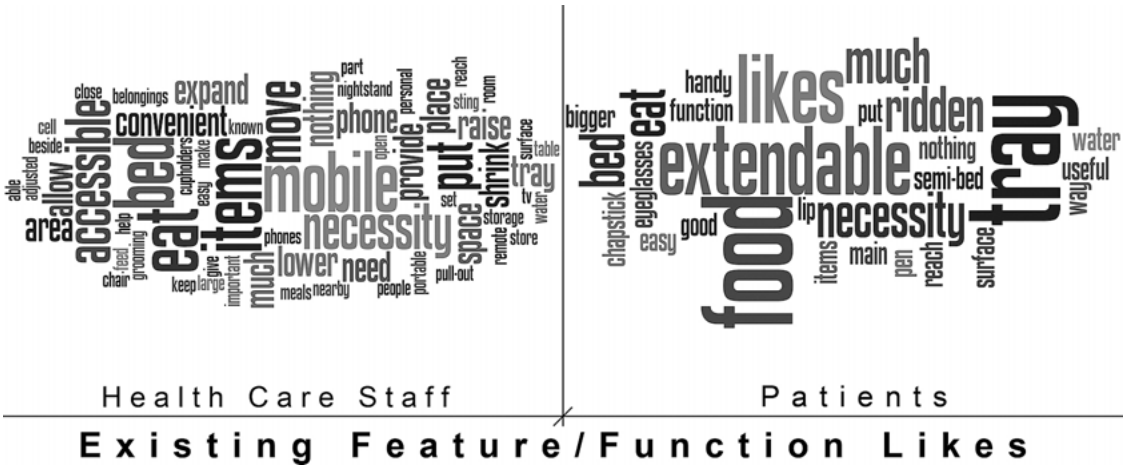
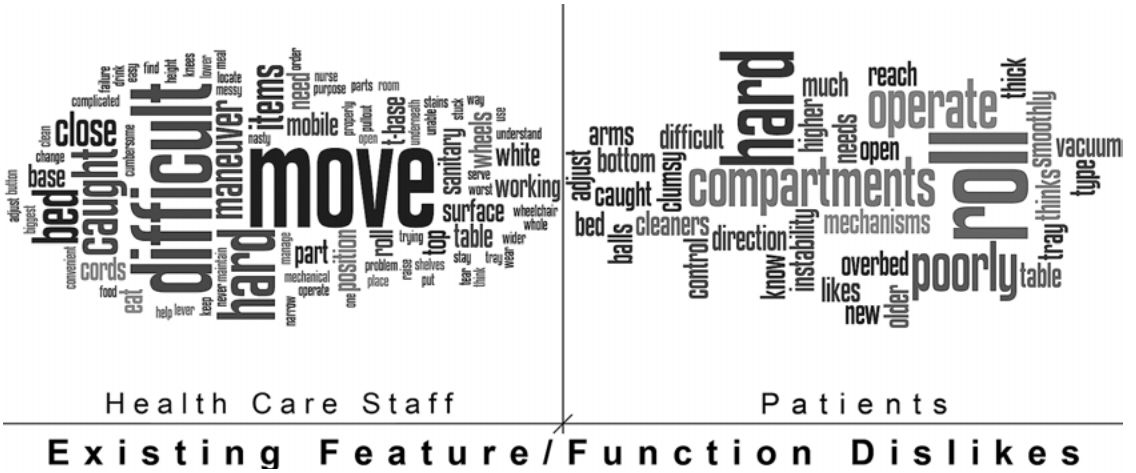


Figure 4. Content analysis: staff and patient dislikes.



The second observation is that existing overbed tables are difficult to operate and to move about in the patient room. Patients and some hospital staff do not fully understand all features and functions of overbed tables because some of the features and functions are not intuitive and not easy to operate. Patients and staff also note that enhancements with the operation of the extendable tray, the raising and lowering of the table top, the rolling of the device, the addition of cup holders, and the legibility of the overall system ("legibility": features and functions are identifiable and operable without training) would all contribute to the overbed tables being more user-friendly than they are at present. As a result, though the overbed tables already receive extensive use, that use is for their role as mobile table tops primarily. In summary, under-utilized

Figure 5. Content analysis: staff and patients wants.

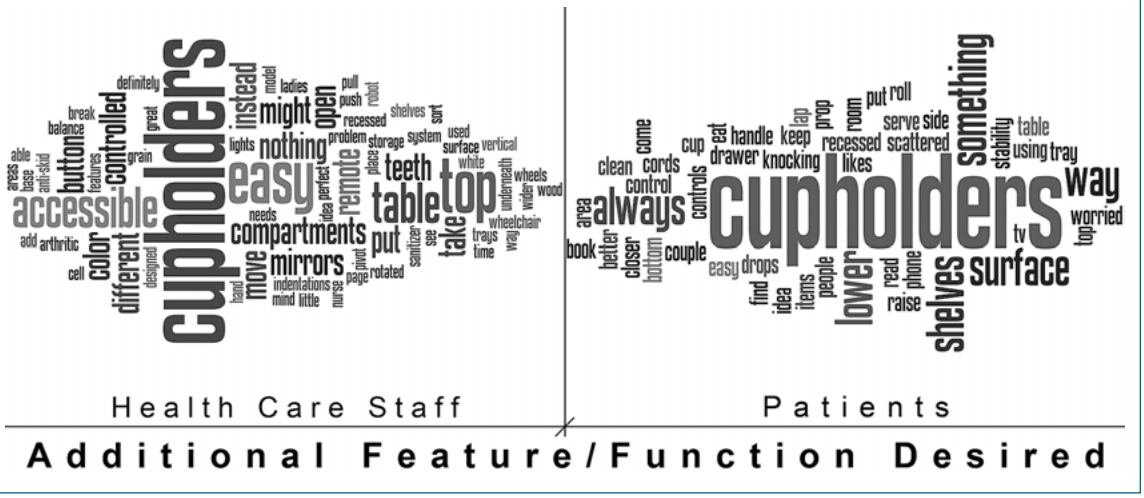


Figure 6. Content analysis: staff frustrations.

features and functions would greatly benefit from increased usability.

The third observation is that the overbed tables' opportunities for improvements are product design issues related to the selection, refinement, and articulation of components; the feel and operation of mechanical slides and locks; the need to make features like cup holders standard; and the need for all of the overbed table's features and functions to be intuitively obvious and usable without training. This last point is critical. No feature or function should require training to identify or use. Such a requirement places undue burden on the patients, staff, organization, and family or friends visiting the patient. In summary, these are incremental, evolutionary design challenges that do not require complex or fundamentally new features, functions, technologies, or design. Redesign of overbed table features and functions using universal design principles and usability analysis could greatly improve the usefulness of overbed tables.

There is overwhelming agreement that patients use overbed tables during meal time, while grooming, while maintaining oral and facial hygiene, while applying makeup, and as a place to set out and store personal artifacts.

The fourth observation is that the hospital staff's understanding of how patients use overbed tables versus how patients feel about using overbed tables versus how patients report using overbed tables do not map consistently onto each other. Future research observing how patients actually use overbed tables is essential. For now, this exploratory research identified several areas of focus for such an observational study. As per Figure 2, there is a subset of the responses that exhibited strong positive ($x> = ⅔$) or negative ($x< = ⅓$) agreement between hospital staff and patients with respect to each question. This was true for 7 of the 20 responses mapped. For four of these seven strong agreement items, staff and patients agreed unanimously that (a) the overbed table is used both while in bed and in a chair (19/19, 8/8); (b) the pull-out extendable tray is used (19/19, 8/8); and (c) there is no concern that the overbed table will fall on the patient while the patient is in bed (0/20, 0/8). In addition, staff and patients strongly agreed that (a) operating the pull-out extendable tray is problematic (19/19, 5/7); (b) the user is likely to use the mirror once they become aware of it (7/8, 1/1); and (c) it is not easy to position the overbed table while in bed (3/20, 2/8). In summary, the unanimous or near-unanimous consensus of these responses indicates that the overbed table is used both while in bed and in chairs, that the extendable tray is heavily used but its usability should be improved, that overbed tables feel stable to staff and patients, that a mirror is a desirable feature, and that positioning the overbed table while in bed should be improved.

Though the overbed tables already receive extensive use, that use is for their role as mobile table tops primarily.

For another 4 of the 20 mapped responses, both the hospital staff and the patients exhibited mild agreement/disagreement to the questions. Awareness of the overbed table's internal compartments (7/19, 3/8) and mirror (7/18, 3/7) were mixed. Users' responses to feeling comfortable with a lot of weight on the overbed table were mixed (9/20, 5/8). Users' responses to feeling comfortable leaning on overbed tables for support were also mixed (7/20, 4/7). In summary, given the mixed responses to these questions, further research is necessary. Why are some patients

and staff aware of the internal compartments and mirrors but not others? What amount of weight on the overbed table is comfortable for users? Does location of the weight factor into the users' feelings of comfort or discomfort? Under what circumstances and in what positions do users lean on the overbed table? How can this be avoided?

For the remaining 9 of 20 responses, the hospital staff's impressions of how the patients use the overbed tables, whether or not they use certain features and functions, what is important to the patients, and what concerns the patients about using overbed tables differed either somewhat or significantly from patients' self-reported preferences and/or behaviors. Staff strongly agreed that patients will use the storage compartments if they are aware of them, whereas patients disagreed mildly (9/10 and 2/5, respectively). Staff strongly agreed that a user would be concerned that the overbed table might fall if or when someone else adjusts the height, whereas patients had a mixed response (15/20 and 4/8, respectively). A slight majority of staff believed that patients hold onto the overbed table for support while walking, whereas only one patient agreed (11/19 and 1/8, respectively). Eight of 20 staff thought the overbed table was easy for a patient to raise, whereas just 1 of 8 patients agreed. Similarly, 9 of 20 staff thought the overbed table was easy for a user to roll, whereas only 2 of 8 patients agreed. There were also strong disagreements between staff impressions of user behavior and patients' impressions. Whereas 5 of 7 of the staff who were already aware of the overbed table's internal compartments believed that users used them, only 3 of 8 patients were aware of the compartments and only 1 of the 3 actually used them. Similarly, whereas 15 of 20 staff believed the overbed table top was easy to lower, only 2 of 8 patients agreed. And whereas 14 of 19 staff believed users hold onto the overbed table while getting out of bed, only 1 of 8 patients agreed. In summary, the results of these interviews suggest opportunities for future research. Do hospital staff members know that patients are often more capable of manipulating or controlling their overbed tables than the patients themselves feel or express? How should ease of use be defined with respect to raising and lowering the overbed table top? What are the determining factors for whether or not a user will utilize the compartments? Do patients use the overbed table to steady themselves while getting out of bed?

These are incremental, evolutionary design challenges that do not require complex or fundamentally new features, functions, technologies, or design. Redesign of overbed table features and functions using universal design principles and usability analysis could greatly improve the usefulness of overbed tables.

The fifth observation is that the results, as expressed in Figure 2, lend themselves to design guidelines for improving overbed tables. Those items for which there is strong agreement across groups (thick, solid lines) tell us that existing overbed tables like the ones used in this study are used both in bed and in a chair, are considered stable, require an extendable tray that is easy to use and durable since it will receive heavy use, and must be easy to position while in bed. Those items that are connected by thin lines should be considered with caution. It may be that items for which there is mild agreement or disagreement are not significant features or functions for hospital staff or patients. Conversely, the benefits of using these features and functions may be significant but they remain underutilized because they are unclear to the users or difficult to use. If the latter is true, then improving the intuitiveness and usability of these features and functions may

enhance patient independence and quality of care. For those items where staff and patients responded strongly but in opposite ways, the questions should be revisited, and if the results remain the same, then further research will be required to resolve the discrepancies.

Table 6. Summary of Key Findings from This Exploratory Study

KEY FINDINGS
♦ The primary use of an overbed table is as a mobile table top supporting dining and grooming, as well as a place to lay personal artifacts.
♦ While the overbed table serves a critical need, many of its features and functions are not used. Patients and staff rarely use features and functions not directly related to dining, grooming, and laying out personal artifacts. Improved legibility and ease-of-use of secondary functions may increase their usage.
♦ On average, both patients and staff prefer a slightly larger overbed table top and extendable tray. However, there was a lot of variability in the responses, and existing table top and extendable tray sizes are very close to the desired sizes of both patients and staff.
♦ Both patients and staff prefer two cup holders.

Future Research

Following from the observations above, this study suggests several areas of future research, mostly related to patient safety and overbed table usability, including:

- Test the findings of this exploratory user preferences study by repeating at other hospitals and/or with other overbed table demonstration models.
- Inventory actual and acceptable weight loads for overbed tables and compare to industry standard design loads.
- Inventory standard cup sizes used in institutional care settings and average number of cups in use on an overbed table, and analyze the anthropometric opportunities and challenges of cup holder placement and design in overbed tables.
- Inventory existing locking mechanisms and other potential locking mechanisms and study the anthropometry of using each in real contexts in order to develop guidelines for improving the design and functionality of locking/unlocking (a) the overbed table wheels; (b) the raising/lowering mechanism; (c) the extendable tray sliding/locking mechanisms.
- Conduct an observational study in order to (a) determine whether patients lean on the overbed tables while getting into or out of bed; (b) assess possible fall hazards and if design improvements can eliminate the possibility that anyone lean on the overbed table.
- Conduct survey research in which teams of designers and staff evaluate overbed tables using Malone & Dellinger's Evidence-Based Design Furniture Checklist to compare results to ours reported here (Malone, 2010).

Conclusions

In summary, an overbed table is an essential component of a patient's activities of daily living while staying in a hospital patient room. The primary use of an overbed table is as a mobile table top supporting dining and grooming, as well as a place to lay out personal artifacts. While overbed tables serve critical needs, many of their features and functions are underutilized. However, improvements that allow for a better understanding and ease-of-use of those features and functions would be beneficial to patients and caregivers and increase patient independence.

This research represents a first, exploratory foray into understanding how users utilize overbed

tables. It validates certain features and functions of existing overbed tables, while identifying opportunities for design improvement and future research. Based on this and prior research, we have some understanding of what features and functions staff and patients prefer. Our next step is to assess *how* and *why* patients and staff use overbed tables. *What are the use cases, scenarios, and tasks?* Assessing this information may shed light on why patients and staff prefer the features and functions noted in this study.

Implications for Practice

- The primary use of an overbed table is as a mobile table top supporting dining and grooming, as well as a place to lay personal artifacts.
- While the overbed table serves a critical need, many of its features and functions are not used. Patients and staff rarely use those features and functions that are not directly related to dining, grooming, and/or laying out personal artifacts. Improved legibility and ease-of-use may increase their usage.
- On average both patients and staff prefer a slightly larger overbed table top and extendable tray. However, there was much variability in the responses, and existing table top and extendable tray sizes are very close to the sizes desired by both patients and staff.
- Both patients and staff prefer two cup holders.

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