TOWARDS MORE ELDER FRIENDLY HOSPITALS: Final Report – Studies 3b and 3c

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Abstract

Deconditioning and loss of functional status occurs at high rates among elderly persons admitted to hospitals, independent of their medical condition. Design of the physical environment is one of several explanations as to why this may occur. The two pilot studies described in this report tested selected environmental modifications designed to overcome some of the physical barriers to safe independent transfer, mobility, and toileting identified in Studies 1 and 2 of the *Towards More Elder Friendly Acute Hospitals Research Project.* One pilot study (Study 3b) took place in two originally identical bedrooms at Burnaby Hospital, a community hospital located in Burnaby, British Columbia. The second (Study 3c) took place in two adjacent bathrooms. In both Studies 3b and 3c, one room remained "as is " and the other was modified; 36 community-dwelling volunteers aged 75+ performed a series of tasks in both the original and the modified bedrooms and the two toilet areas. Order of exposure to the "typical" and modified rooms was counterbalanced. Three types of data were collected: subjective, physiological and video. The environment modifications of interest were rated by participants for ease of use, for helpfulness, and/or for appeal and they were asked to respond to questions such as "what did you like most/least about the rooms and why"? Heart rate was measured as participants rested in each bedroom and postural sway was recorded as they transferred from the bedroom to the bathroom and while they pretended to use the toilet and "freshen up" at the sink. To document gross movement, gestures, coping actions and facial expressions, high resolution webcams were mounted in the bedrooms and bathrooms and a camcorder followed the participants throughout the study. A number of lessons were learned from the study about relatively inexpensive design features that if implemented in new construction and retrofitting, have the potential to increase the elder friendliness of FH hospitals (e.g. movement activated lighting at the entrance to the bathroom). A number of useful lessons were also learned concerning equipment and procedures for remote monitoring of physiological functioning and stress. The report ends with a series of recommendations that include recognizing the diversity of the frail elder population of British Columbia and designing physical space in hospitals to meet the needs of patients with multiple chronic physical and/or cognitive impairments.

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Acknowledgements

The studies described in this report (3b and 3c), and the broader project of which they are a part, were funded by a grant awarded to Dr. Gloria Gutman, in Spring 2005 by Fraser Health. At the outset, we wish to acknowledge the leadership of Kathleen Friesen, Director of Geriatric Programs and Services, Fraser Health and Dr. Belinda Parke, former Regional Clinical Nurse Specialist – Older Adults, in drawing the attention of Fraser Health to the concept of elder-friendliness in the design of the physical environment of acute hospitals and the potential of physical design elements to impact positively or negatively on health outcomes of frail elders. It was their initiative that led to the availability of funding for the five studies (1, 2, 3a, 3b, 3c) that comprise the set known as the *Towards More Elder Friendly Acute Hospitals Project*. Throughout Study 3, Kathleen has served as the official representative of Fraser Health on the research team and she has chaired the Advisory Committee.

Thanks go as well to the individuals who comprised the Advisory Committee. These included Kelly Duke, Anne Earthy, Dr. Peter O'Connor, Irene Sheppard and Belinda Parke - all from the Fraser Health Geriatric Clinical Services Planning and Delivery Team's Elder-friendly Hospitals Subcommittee, and Bonnie McCoy and Holly Kennedy-Symonds from Burnaby Hospital. This group provided valuable advice during the various stages of the research described in this report.

In the original proposal for Study 3, "typical" and modified patient rooms and bathrooms were to have been mocked up at the SFU-BCIT Living Laboratory, located in downtown Vancouver. It became clear early on however, that it would not be feasible to move "real" hospital furniture into that location, due to constraints posed by the freight elevator. We wish to thank Arden Krystal, Executive Director of Burnaby Hospital, for giving us access to space at Burnaby Hospital to conduct the study. All around, Burnaby Hospital was a superior setting for the study, providing ecological validity as well as the added value of having emergency facilities and staff close by in the event of illness or an accident.

Another change from the original proposal for this study, was that 10 care providers were to have participated in a focus group and provided feedback on the modifications undertaken after having watched video clips of the seniors during their testing. Instead, in the process of designing the modifications and finalizing the protocol, tours of the study site were conducted and during these, advice was solicited. Tour participants included Burnaby Hospital occupational therapists and physiotherapists, Marcia Carr (Clinical Nurse Specialist), Cathy Sendecki (Geriatric Emergency Clinician), members of the project's Advisory Committee, the Hip Collaborative and Susan Chunick (FH Director of Research). Their comments are gratefully acknowledged.

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Introduction

An estimated 25% to 60% of adults aged 65 and older experience a loss of independence while in the hospital, independent of the condition they are being treated for (Palmer, 1998). As indicated in the literature review that follows, this is thought to occur for a number of reasons, one of which relates to the design of the physical environment of hospitals.

The two studies described in this report are part of a larger research project, designed by Dr. Gloria Gutman, Gerontology Research Centre Simon Fraser University, for the Elder-friendly Health Environmental Committee of the Fraser Health Acute Geriatric Clinical Services Planning and Delivery Team. The goal of the project was to improve the elder friendliness of the physical environment of acute care hospitals in Fraser Health (FH). [1] In Study 1 (Gutman, Love, Parke & Friesen, 2006), descriptive data concerning the physical environment were collected from nine of the sixteen Acute Care for Elders (ACE) units in operation in the United States in Fall, 2006 . ACE units, a care model developed by SUMMA Health in Akron, Ohio, have five defining characteristics one of which is a "prepared environment." The stated goal of the prepared environment of ACE units is to encourage independence and self-care to the extent that older adult patients are able. The SUMMA Health ACE unit, the only one to have been the subject of randomized controlled trials (Counsell, Holder, Liebenauer, Palmer, Fortinsky, Kresevic, et al. 2000) was used as the "Gold Standard" for the environmental design modifications implemented in the study described in the present report. Study 2 (Gutman, Sarte, Parke & Friesen, 2005) involved site visits and focus groups conducted at six of the 12 hospitals in FH. One purpose of study 2 was to determine the characteristics of "typical" FH patient rooms and toileting facilities in medical and surgical units. A second purpose was to determine staffs' views of design features of the patient areas that were and were not elder-friendly. The purpose of Study 3a, the first of the intervention studies that are the "meat" of the project, was to assess whether modifications to the physical environment of the patient bedroom could improve

[1] For purposes of this project "elder friendly" was defined as "elder-friendly" was defined as having environmental design features that are considerate of the special safety, physical, social, and psychological needs of older adults.

older adult patients' learning/retention of post-discharge instructions. Post-discharge instructions were one of three topics identified by the project's Advisory Committee as of special interest. The other two were safe self-transfer and self-toileting. Study 3b reported here, focused on the former. It took place in the same research area as Study 3a – two four-bed patient rooms in Burnaby Hospital, a community hospital in Burnaby, British Columbia. Study 3c also the subject of this report, took place in two adjacent toileting areas.

Love (2007) provides a detailed description of the modifications made to one of the patient rooms to reduce visual and auditory distraction and the impact these changes had on learning/retention of post-discharge instructions. Study 3b tests the impact of other changes made to the patient room modified in Study 3a. Study 3c focuses on modifications made to the toileting area to make it safer and more user friendly to older patients attempting to self-toilet.

In designing studies 3b and 3c the approach taken was to attempt to modify environmental barriers to safe self-transfer and self-toileting identified in Studies 1 and 2 and by the project's Advisory Committee. This information was supplemented with the authors' knowledge of the environment and aging literature. The bulk of this literature deals with design recommendations for private homes and care facilities. Still, it was thought that some principles were equally applicable to the acute hospital setting (e.g. the need to maximize colour contrast in order to compensate for changes in the lens of the eye that take place with aging and that interfere with colour and figure-ground perception).

Literature Review

Extent and Scope of the Problem

The 2006 Census of Canada indicates that persons aged 65 and over comprise 14.6% of the population of British Columbia. However, older adults make up approximately one-third of hospital cases in the province and account for 55% of inpatient hospital days (Wister, Gutman, Adams & Chou, 2006). In Spain, where 19.6% of the population is aged 65+, over one-third of older adults leave hospital with new impairment in functional status (El Pais, 2006). In the United States, 60% of acute care beds are filled by older adults (Kresevic et al., 1998); 25%-60% of people age 65+ experience a decline in functional status between admission and discharge, independent of diagnosis (Gillick, Serrell & Gillick, 1982; Hirsch, Sommers, Olsen, et al. 1990; Inouye, Wagner, Acampora . et al. 1993; Palmer, 1995; Warshaw, Moore, Friedman , et al. 1982). The Harvard Malpractice Study (Brennan, Leape, Laird, Hebert, Localio, Lawthers, Newhouse, Weiler & Hiatt, 1991) showed that rates of adverse events in hospitals, which include fall-related injuries, increased monotonically with age. Older adults had more than double the risk of persons aged 16-44.

Reasons for Deconditioning and Functional Decline in Hospitals

There is a considerable literature on deconditioning in elderly hospital patients, the term given to the physiological and psychological changes that have been observed to take place after as few as two days post-admission . As Lazarus, Murphy, Coletta, McQuade and Culpepper (1991) note, “Physical activity has been recognized as an important aspect of patient care for nearly 50 years. Yet, deconditioning and functional decline of elderly hospital patients continue to be reported” (p.2452).

There are a number of possible reasons for the high rates of deconditioning and loss of function that occur among older persons admitted to acute hospitals. The beliefs and attitudes of older persons themselves constitute one set of factors. Some older people believe that bed rest is the appropriate way to treat their conditions and resist attempts to get them out of bed. Others attempt to maintain independence in such activities as toileting but are discouraged from doing so by difficulty experienced in getting out of bed, by a trip or fall in the process of transferring from bed to bathroom or when getting on or off the toilet. Subsequently, fear of falling may become a reason for remaining sedentary. As Palmer (1995) notes, however, "although elderly hospitalized patient often want to stay in bed, prolonged or sustained bed rest has deleterious physiological effects" (p, 121). These include cardiac and other muscle deconditioning, increased risk of skin breakdown, accelerated bone loss, incontinence and constipation. Psychological sequella such as depression may also be manifest. Kortebein, Ferrando, Lombeida, Wolfe and Evans (2007) showed that even in healthy older adults, 10 days of voluntary bed rest led to decreases in muscle mass and strength and other physiological changes. The evidence linking immobility and deconditioning in other words, is incontrovertible.

Another set of factors that contribute to deconditioning relate to the culture of hospitals, which tend to foster passivity and dependency. As well, some staff are known to discourage older patients from attempting independent transfer and toileting out of fear of litigation in the event of a fall-related injury.

Inouye et al. (1993) draw attention to iatrogenic complications, which tend to occur at a considerably higher rate in older than in younger persons. The most common of these include adverse drug reactions, complications of diagnostic and therapeutic procedures, nosocomial infections, fluid and electrolyte disturbances, and falls.

Palmer (1995) identifies four factors that he considers to be particularly important: Iatrogenic illness, bed rest and immobility, under-nutrition, and of particular interest to the present report, the physical environment. In discussing the physical environment he notes that:

> The typical American hospital is structured to meet the needs of physicians and care-givers, not the patients. For older patients, the hospital can be a hostile environment. Raised beds make getting up and laying down difficult and risky. Cold, shiny floors look wet and make getting out of bed uncomfortable and frightening. Cluttered hallway corridors discourage independent ambulation and contribute to the risk of falling. Sterile-appearing walls and corridors fail to provide the orienting clues that permit independent way-finding. The

> many disturbing, unfamiliar, and often unanticipated routines and procedures may clash with the patient's usual or desired routines. These factors may foster functional dependence, accelerate functional decline, and induce delirium (p. 121-122).

Cochran (2005), like Palmer, stresses the importance of "keeping older adults walking" and performing activities of daily of daily living as a means of preventing deconditioning. She too mentions several modifications to the physical environment as aids in achieving the goal of keeping patients mobile – specifically, installing cushioned flooring and placing handrails in the hallway. Creditor (1993) also notes that the "cascade to dependency" can be avoided by deemphasizing bed rest and modifying the physical environment. He draws special attention to "removing the hazard of the high hospital bed with rails". Gillis and MacDonald (2005) suggest that nurses advocate for continual walking paths within hospital units so that patients can maintain mobility and staff can monitor distance walked. They also recommend replacement of high hospital beds with "modified geriatric beds", installation of non-slip floor surfaces such as cork or rubber, as well as "proper lighting", the use of night lights in patient areas, and ease of access to room lights all of which, they contend, will assist older patients in becoming familiar with their new environment and will promote functional mobility.

Environmental Barriers to Safe Independent Transfer: Findings from Studies 1 and 2

Table 1 shows the responses of ACE Unit staff and of FH staff when asked, in Studies 1 and 2, to identify environmental barriers to safe independent transfer. As can be seen, in large measure they echo the comments about high beds, hard-surface floors, poor lighting and clutter referred to in the deconditioning literature. Table 2 shows perceived barriers to safe self-toileting. As will be seen in the discussion below of empirical studies of selected hospital design elements, some of the ACE Unit and FH staff's comments are reflective of the falls literature which also draws attention to fixtures of inappropriate height, doors that are difficult to open and lack of direct access from the bedroom to the toilet area.

Table 1: Perceived Barriers to Safe Patient Self-Transfer (Source: Studies 1 & 2)

Design Element	Concern
Bed	Does not go low enough Controls are difficult for patients to use
Over- bed tray	Used for support or as a walker – need brakes! Drawers problematic Wheels get stuck under bed Height adjustment and/or repositioning often difficult Design of tray top poor
Chairs	Too low, lack arms, do not provide back support Non-removable or adjustable arms (impedes wheelchair transfer)
Lighting	Controls out of patient's reach Night visibility poor Ceiling lights disturbing to other patients in multi-bed rooms; shine in patient eyes
Flooring	Hard surface flooring: glare, slippery when wet Carpet: issues include maintenance and durability Pattern a problem with both hard surface floors and carpets
Clutter	A hazard for patients both in the bedroom and when walking in hallways

Table 2: Perceived Barriers to Safe Patient Self-Toileting (Source: Studies 1 & 2)

Design Element	Concern
Bathroom Doorway & Door	Narrow, heavy, difficult to open
Toilet	Too low
Sink area	Lack of counter space for personal toiletries and towels
Lighting	Insufficient over sink, toilet Poor, especially at night
Grab bars	Poorly placed to assist in self-toileting
Toilet paper holder	Difficult to reach
Access	Too far; hard to reach due to clutter; direct visual/physical access often lacking
Size	En-suites not large enough to accommodate a wheelchair or person using walker.

Empirical Studies of Environmental Modifications

There are very few empirical studies reported in the hospital design literature testing the efficacy or the cost-effectiveness of the various environmental modifications that have been suggested as ways of enhancing older patients' mobility and increasing their independence and safety in transferring and toileting. The long term care literature is only slightly less limited.

Flooring

Willmott (1986) tested the clinical observation that reflective flooring adversely affects walking in elderly hospital patients in a study comparing their gait on carpeted and reflective vinyl floors. Mean gait speed and step length were found to be significantly greater on carpet than on vinyl. Willmott reports that among the 58 participants (average age 76.05 years), "some … expressed fear of walking on vinyl, but were confident on carpet. No patient expressed difficulty in walking on carpet" (p.120)

Simpson, Lamb, Roberts, Gardner and Grimley Evans (2004) measured the mechanical properties of floors and the number and location of falls and hip fractures in a two year prospective study carried out in 34 residential care homes for older persons in the UK. Four flooring types were examined in the study: wood sub-floors with no carpet, wood sub-floors with carpet, concrete sub-floors with no carpet, and concrete sub-floors with carpet. A total of 6,641 falls and 222 fractures were recorded. As shown in Table 3, the vast majority of falls occurred on carpeted floors, reflecting the greater amount of time that residents spent walking and standing in corridors, lounges and dining rooms compared with uncarpeted bathing, toileting and other utility areas where uncarpeted floors were typically found. But wood carpeted floors were found to be associated with the lowest number of fractures per 100 falls.

Table 3 Fractures per 100 Falls by Floor Type (Source: Simpson, Lamb, Roberts, et al. 2005)

	N (falls)	N (fractures)	Fractures per 100 falls	RR (95% CI)
Wood-carpeted	2812	65	2.31	1
Wood-uncarpeted	266	11	4.14	1.8 (0.96,3.35)
Concrete-carpeted	3071	134	4.36	1.9 (1.41.2.53)
Concrete-uncarpeted	492	12	2.44	1.1 (0.57.1.94)

Based on the data in Table 3, the authors estimate that the risk of breaking a hip would have been reduced by 80% if carpets had been laid on uncarpeted wooden floors. However, since there were relatively few such floors in the sample, the number of falls that would have been prevented would have been only 5 (2.3% of the 222 fractures). On the other hand, substituting carpeted wood floors for carpeted concrete floors would have prevented 63 fractures (28% of the total). They were surprised at the relatively low number of fractures in falls that occurred on uncarpeted concrete floors. Data from a transducer that, when dropped on the floor, simulated the peak impact force during a fall by a person of average height and weight, showed that impact force was greatest on this type of floor. Simpson et al. suggest that perhaps falls that take place in bath and toilet areas are different from those that occur elsewhere and/or that in the "crowded environment" of bath rooms and toilet areas, falls were broken by residents seizing handrails or that they were stopped from hitting the floor by the fixtures. This interpretation, in turn, suggests that in studying the relationship between falls and type of flooring and floor covering, a holistic approach needs to be taken that considers the type of behavior that is occurring (e.g. walking, standing, sitting down or getting up from a toilet), the characteristics of the individuals performing the behavior (e.g. frail elders) and the design elements in the proximate environment (i.e. what furnishings or fixtures are available to break the fall).

It is also important to take into consideration the time of day when falls most commonly occur. In a retrospective review of patient falls in a 248-bed acute care community hospital, Alcee (2000) found that the majority took place during the night shift (8 pm to 8am). Two other findings from Alcee's study are of relevance to the *Towards More Elder Friendly Hospitals Project*: first, the greatest number of falls occurred on the medical/oncology unit followed by the medical/orthopedic unit both of which are likely to serve high proportions of older patient; second, 30% of the patients who fell were attempting to use the bathroom.

Two other studies report rates of bathroom falls similar to those found by Alcee. Brandis (1999), in a retrospective audit of hospital inpatient falls, found that 51.8% occurred in the bedroom, 24.4% in bathroom areas, 6.3% in halls and 2.2% in other departments. While transfers to and from bed were reported in 42.2% of the falls, 30% involved activities related to toileting. In their retrospective study of patient incident reports in a 152 private room acute care specialty hospital without pediatric or obstetrical care, Morgan, Mathison, Rice and Clemmer (1985) found that 65% of falls occurred in the patient bedroom, one-third near the bed; 29% occurred in the private bathroom attached to each room, two-thirds near the toilet. It is informative to note that of the 162 falls that took place in the patient bedrooms over the 22 months of the study, 57 (34%) occurred on the way to or from the bathroom. Combined with the 72 that occurred in the bathroom, over half (52%) of the total number of falls were bathroom-related. Morgan et al. (1985) draw attention to the greater risk of falls among men aged 65+ than among women of comparable age and, like Alcee (2000) to the greater risk per bathroom trip during the night. With respect to prevention, they advise that bedside rails and restraints be used only for confused, restless, or sedated patients. They also recommend lower bed heights to eliminate the need for footstools and to decrease fall distance. Additionally, they suggest that the bed-bath environment be modified "to provide minimal distances, secure handholds, and 'forgiving' surfaces" (p.777). Design problems in the bedroom and bathroom identified by Brandis (1999) included slippery floors, inappropriate door openings, poor placement of handrails and incorrect furniture and toilet heights.

Lighting and Bed and Light Controls

No empirical studies were found of older adult hospital patients' performance of activities of daily living under different lighting conditions nor of their preferences or ability to manipulate bed or light controls. Shumaker and Reizenstein (1982) note that poor lighting can cause patient discomfort either because it is insufficient or because it is too bright or glaring. Problems can result from the types of lighting fixtures and bulbs that are selected and from their less than optional placement on walls, ceiling or furniture. Ulrich (2000) draws attention to the plight of bedridden patients who are forced to stare at glaring ceiling lights. Shumaker and Reizenstein (1982) highlight the frustration and blow that is dealt to a patient's self-image by their inability to reach light switches located on a headwall behind their bed and need to rely on a nurse to turn a light on or off . Sleep disturbance, increased risk of falls, and confusion are other potential results of poor lighting and/or lack of patient control of room illumination.

Theoretical Framework

The theory guiding the research described in this report emanated from two sources: the Environment and Aging literature and the Health Facilities Design literature.

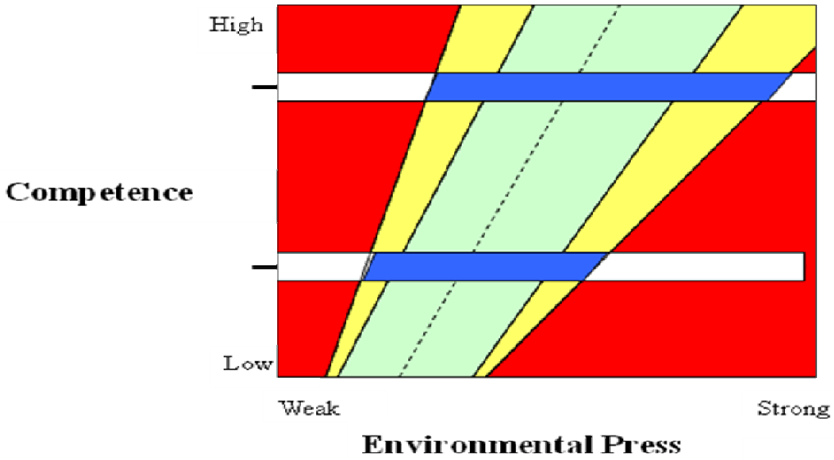
Environmental Press Model

From the Gerontological perspective, the main theoretical concepts framing the research were Lawton and Simon's (1968) Environmental Docility Hypothesis and Lawton and Nahemow's (1973) Ecological Model. Both consider behavior to be a function of the person, the environment, and the interaction between the two as expressed in the equation $B= f(P, E)$ formulated by Lewin (1951). The essence of these concepts is that as competency declines, the individual is less able to cope with "environmental press" and more impacted by his/her environment. Competency is defined as the aggregate of the individual's health, physical capabilities, sensorimotor functioning, cognitive ability and ego strength. Press refers to the "demand character" of the context in which a person behaves. The ecological model posits that the outcome, when a person of a given competence level is in an environment of a particular press level , is on a continuum ranging from positive to negative and apparent in both behaviour and affect (Lawton, 1980).

As Love (2007) notes, press, like competence, can vary over time. She illustrates this with the example of an open window near a bed-ridden hospital patient. While initially it may have positive press (as it provides fresh air to a stuffy room) later the press can become negative if the room becomes too cold and the person cannot get up to close it. As can be seen in Figure 1, the competency axis ranges from low to high and the press axis from weak to strong. The central line, labeled "Adaptation level" represents the theoretical mean of adaptation for all people at that competence level around which, a normal curve would cluster. With moderate increases or decreases in press, behaviour and affect will remain positive. However, as press continues to increase/decrease it will reach a point where positive affect and behaviour become threatened. If press surpasses competence or if it fails to provide sufficient challenge or opportunity for social interaction, negative behaviour and affect will occur (Holliday & Gutman, 1999; Lawton & Nahemow, 1973). For example, stairs may present too strong a challenge (press) to a person recovering from hip fracture surgery (decrease in competency). Conversely, insufficient press (e.g. prescribed bed rest when not strictly needed) can result in loss of mobility, boredom and/or sensory deprivation.

According to the model, persons at a low level of competence can demonstrate positive behaviour and affect if the environment is of sufficiently low press, but their range of tolerable press is smaller than that of persons at a higher level of competence who can respond to a wider range of press without negative impact (Lawton & Nahemow, 1973). The model also illustrates that for all levels of competence, there is a point beyond which, behaviour and affect deteriorate.

Figure 1: Press Competency Model.



Adapted from “Ecology and the aging process” by M. P. Lawton and L. Nahemow (1973). In C. Eisdorfer and M.P. Lawton (Eds.) *Psychology of adult development and aging* (pp. 619-674). Washington, D.C.: American Psychological Assn

While the majority of older people are not "incompetent", the prevalence of disease (particularly chronic disease) increases with age. Normal aging is also accompanied by changes in the sensory, motor and neural systems; deficits in vision and hearing are common; mobility, agility and balance are also affected. Any or all of these factors make it more difficult to cope with environmental press. In the case of a medical or surgical patient the condition that led to hospital admission further reduces competency.

Theory of Supportive Design

This theory was developed by Roger Ulrich who has been a leader in drawing attention to the need for hospital designers to place more emphasis on creating surroundings that will calm patients or strengthen their ability to cope with the stress associated with illness and hospitalization. He argues that healthcare facility designers have traditionally emphasized functional efficiency, provision of “effective platforms” for medical treatment and technology, and cost containment, and largely ignored patients’ psychological and social needs.

> The key factor motivating awareness of facility design has been mounting scientific evidence that environmental characteristics influence patient health outcomes. Many studies have shown that well-designed environments can, for instance, reduce anxiety, lower blood pressure, and lessen pain. Conversely, research has linked poor design or ‘psychosocially unsupportive surroundings’ to negative effects such as higher occurrence of delirium, elevated depression, greater need for pain drugs, and in certain situations longer hospital stays (Ulrich, 2000, p.1).

Among aspects of the physical environment of hospitals that have been found to affect patient outcome are: noise, music, windows or lack thereof (e.g. sunny rooms and rooms with a pleasant view have been shown to promote healing), number of beds in a room, flooring material and furniture arrangement (see Ulrich, Quan, Zimring, Joseph, & Choudhary, 2004 for a detailed review of findings). According to the Theory of Supportive Design, the potential for these design elements to promote improved health lies in their ability to facilitate stress coping and restoration.

> *Supportive* healthcare design begins by eliminating environmental characteristics (loud noise, for instance) that are stressful or can have direct negative impacts on outcomes. Additionally, supportive design goes a significant step further by including design features in the environment that research indicates can calm patients, reduce stress, and strengthen coping resources and healthful processes (Ulrich, 2000, p.2).

The latter is accomplished by fostering the patient’s sense of control and access to privacy, access to social support and access to nature and other positive distractions. Ulrich considers stress to be an important medical concern both because it is a significant health outcome in and of itself and because it directly and negatively affects other outcomes.

Research Question and Purpose

The studies report here, like Study 3a reported by Love (2007), are novel in that they attempted to determine, from the verbalizations and behaviors of seniors brought into an actual hospital setting, whether modifications to selected elements of the physical environment could remove barriers and foster and facilitate safe self-transfer and self-toileting. The design elements selected for study in the case of the bedroom included the lighting, bed and light controls, and flooring. In the bathroom, the focus was on improving the lighting and the perceptibility of fixtures, testing two different toilet arm-support systems, and determining the efficacy of a pull down shelf on which patients could place objects used in personal hygiene and grooming.

Hypotheses

No formal hypotheses were proposed. The underlying supposition of study 3b, however, was that participants would prefer a modified bedroom over a "typical" FH hospital bedroom because in it, they would have greater control over the proximate environment – specifically, the bed and the illumination surrounding it. We also expected that there would be fewer instances of loss of balance in the modified bedroom as a function of the greater control users had over the height of the bed they were exiting, the generally brighter illumination, and the flooring material used. Similarly, a preference for and less postural sway and few instances of loss of balance were expected in the modified bathroom as a function of the changes introduced. Given the link between control and stress, it was further anticipated that participants would experience less stress in a modified as compared with a "typical" hospital bedroom and toilet area and that this would be reflected in a lower heart rate.

Method

Overview of the Research Design

This study was conducted in two four-bed hospital bedrooms and two bathrooms in an unused area on the seventh floor of Burnaby Hospital, a community hospital in Burnaby, British Columbia. For the study, one bedroom and one bathroom were left in their original state. The second bedroom and bathroom were modified to reduce visual and auditory distraction; to facilitate safe, independent transfer; to generally be more Elder Friendly (e.g. brighter lighting; greater colour contrast); and to be more aesthetically pleasing than the “typical” patient bedrooms and bathrooms in FH (e.g. co-ordinated colour scheme, more “home-like” décor).

First in the bedrooms and then in the bathrooms, older adult volunteers played the role of a patient. In this role they: operated the bed and light controls; transferred into and out of a hospital bed; got up from a chair and walked (with a walker) into the bathroom, simulated the movements related to using the toilet (sitting down/getting up, reaching for toilet paper) and then pretended to “freshen-up” at the sink. Participants rated the ease or difficulty of each task and were given the opportunity to provide feedback on the environmental design modifications that had been undertaken or suggest others. A video camera and webcams recorded performance while other non-invasive technology recorded postural pitch and sway.

Table 4 summarizes the research design. As can be seen, half of the participants started in the “typical” patient room and half in the modified room. Assignment to Group 1 (“Typical” bedroom first) or Group 2 (Modified bedroom first) was done on an alternating basis at the time the potential participants first contacted the research office and was assigned an ID number. The order of exposure to the bathrooms was the same as the order of exposure to the bedrooms (i.e. Group 1 was exposed to the “typical” bathroom first and the modified bathroom second).

Table 4: Overview of the Research Design

	Study 3b: Facilitating safe independent transfer		Study 3c: Facilitating safe independent toileting	
	Order of exposure to patient rooms		Order of exposure to bathrooms	
	1st	2nd	1st	2nd
Gp.1 – odd number ID (n=18)	"Typical"	Modified	"Typical"	Modified
Gp.2 – even number ID (n=18)	Modified	"Typical"	Modified	"Typical"

Study Participants

Recruitment and Screening

A total of 36 older adults participated in this exploratory study. They were recruited by a variety of means. These included "piggy-backing" on a mail-out of donation receipts to the Burnaby Hospital Foundation and posting notices on bulletin boards for the Burnaby Hospital Auxiliary and volunteers and placing an advertisement (Saturday, January 6th) in two local newspapers - the *Burnaby NOW* and *New West Record* . E-mail lists maintained by the Department of Gerontology, Gerontology Research Center and Retirees Association at Simon Fraser University were also used to send recruitment notices and information. Additionally, friends and associates of the researchers (e.g. the Director of the SFU Senior Citizens' Program) were asked to recruit from among people they knew who fit the criteria.

All recruiting materials (see Appendix 1) included a general description of the study, described the eligibility criteria and indicated that as an incentive to participate, the older adult volunteers would be paid a $50 honorarium, served refreshments and would be reimbursed up to $10 for transportation or parking costs.

Potential participants were telephoned within a week of contacting the research office and asked a series of questions (See Appendix 2) in order to confirm that they met the eligibility criteria described in the recruiting materials as well as to obtain information on the socio-demographic, health and functional status of those who became study participants. The eligibility criteria were: age 75 or over, living in their own house or apartment, fluent in English, able to hear normal speech with minimum difficulty (with a hearing aid if used), able to read letters the size of newspaper print (with glasses if used), had not had a hip fracture or been told by the doctor that they had Congestive Heart Failure (CHF), a movement disorder (e.g. Parkinsons), or cognitive impairment (e.g. Alzheimer's or other dementia), had not been the caregiver for a person recovering from a hip fracture or suffering from CHF and, had not been primarily employed as a health care professional prior to retirement. English fluency, ability to hear normal speech and to read with minimal difficulty, and absence of cognitive impairment were to minimize barriers to comprehension of instructions and maximize feedback. Excluding persons diagnosed with, or having been the caregiver for someone with either CHF or hip fracture surgery and persons who had been primarily employed in healthcare was to avoid the influence of prior learning. Because the protocol required independent transfer from chair to bed, and movement within and between two patient rooms and two bathrooms, persons with movement disorders such as Parkinson's were excluded for their own safety.

While compliance with criteria was based mainly on self-report, potential study participants were administered Form 2 of the Hopkins Verbal Learning Test (HVLT-R) (Brandt & Benedict, 2001). Scores on this test served both as a screen for memory impairment and for later use as an independent variable, among those who were found eligible and actually participated in the study.

Before ending the telephone conversation, an appointment was made with the eligible volunteer to come to Burnaby Hospital to participate in the study and transportation/parking options were discussed.

Table 5 shows the recruitment source of the 36 individuals who took part in the study. As can be seen, most were recruited by the ad placed in the two local newspapers (see Appendix 1 for a copy of the ad).

Table 5: Study 3b & 3c Participants, by Recruitment Source

Source (n=36)	
Newspaper Ad	25
E-mail	7
Carried over from Study 3a recruitment	2
Burnaby Hospital Auxiliary	1
Friends/Associates	1

In total, 41 potential candidates were screened in order to reach the target sample size of 36. Reasons for ineligibility among the five who did not fulfill the study criteria were as follows: 3- poor eyesight; 1- under age 75; 1- was a nurse before retirement. Thirteen additional older adults who had expressed an interest in participating were placed on a list of alternates for this project (in case some dropped out, which none did).

Participant Profile

Question categories and response alternatives in the Participant Profile (see Appendix 2) were modeled on the Minimum Data Set-Home Care (1995). This tool has well established reliability and validity (Hirdes, et al. 2004; Hirdes & Carpenter, 1997; Landi, Tua, Onder, et al. 2000). The questions began with personal characteristics (sex, marital status, education) and support received (daily help in the home? Y/N). Candidates were next asked about their physical functioning. Questions included whether they had difficulty getting around their home safely because of vision problems, had difficulty completing activities of daily living (meal preparation, ordinary housework, managing finances, managing medications, using the telephone, shopping and transportation), whether they used mobility aids, average days per week they went out from their home and the average number of hours per day they were active. Questions in this section also asked if they required help to go up/down stairs, transfer from bed or chair or from sitting to standing, getting around the house or using the toilet. Participants were then asked a series of questions regarding their health. These included whether they felt that their health was poor, if they had had any falls in the previous six months (if so, how many), if they limited their activities because of a fear of falling and if they had been hospitalized in the last six months.. They were asked how many prescription medications they were currently taking. This section also included a list of illnesses and disabilities common among Canadians aged 75+ (e.g. heart and circulation, neurological, musculo-skeletal, metabolic, sensory, and psychiatric) and they were asked if they had ever been diagnosed with any of them by a physician. Lastly, the participants were asked questions related to the health history of their family of origin (e.g. heart disease, diabetes, high blood pressure or cholesterol) and their own history of emotional states and activities that could influence heart rate (e.g. "How many times in the last week did you become angry?", "do you smoke"?, "On average, how many drinks of wine do you consume"?). [2]

Comparison with Population Aged 65+ in British Columbia

The sample ranged in age from 75-91 (mean age = 79.97, s.d. = 4.23), 75% were female; 33% were married and 55% lived alone. One-third of the sample (31%) had not completed high school, 39% had completed high school and/or attended a trade or technical school and 31% had some level of university or college education. As shown in Table 3, compared with the population age 75+ in British Columbia (see Wister, Gutman, Adams & Chou, 2006), this sample had a greater proportion of females (75% vs. 61%), a smaller proportion of married people (33% vs. 45%),and a greater proportion who lived alone (55% vs. 44%).

While 72% reported some difficulty with hearing, as in Study 3a, response to the health and functional status questions revealed a generally high functioning and active group. For example, most reported needing no help performing any of the seven instrumental activities of daily living (IADLs) asked about, only 25% used mobility aids (e.g. cane, walker, scooter), only 17% reported needing help using the stairs, and none needed help rising from bed or chair, getting around the house or using the toilet. In this sample, only 8% had experienced a fall in the last six months, only 6% reported that they limit their activities because of a fear of falling while 81% reported that they go out from home at least four times a week. They are, in fact, more active on a daily basis than

[2] With the exception of the last set of questions, the Participant Profile was the same as that used in Study 3a The additional questions (and some other measures) fulfilled the needs of a sub-study that used ballistocardiography data that were obtained while participants were resting in the two bedrooms.

most British Columbians aged 75+: 86% reported being active for two or more hours daily, compared with 36% in the general population aged 75+ (Wister, Gutman, Adams & Chou, 2006).

Indicative of the good health of this sample, only 8% reported feeling that their health was poor. None had been hospitalized in the preceding six months and 50% of females and 89% of males reported having fewer than three chronic condition. As shown in Table 5, the proportion reporting less than three chronic conditions was substantially greater than for the general population aged 75+, especially among males (89% vs. 53%).

Table 6: Study Participants Compared to all British Columbians Aged 75+ Years of Age

Characteristic	Study 3b & 3c Sample	Population 75+ in British Columbia
Female	75%	61%
Married	33%	45%
Live Alone	55%	44%
2+ Hours/day physically active	86%	36%
<3 Chronic conditions		
Females:	50%	39%
Males:	89%	53%
Prevalence of:		
Arthritis	61%	47%
High blood pressure	44%	37%
Diabetes	17%	11%
Asthma	8%	6%

Between-group comparison

Table 7 compares the socio-demographic characteristics, health, functional status and cognitive status of the two experimental groups. The only statistically significant between-group difference to be found was on the Total Recall Score, one of the four Hopkins Verbal Learning Test Scores ($F_{1,34}$ = 5.499, p,.025). The mean score on this variable was higher in Group 1 than in Group 2. While there was a trend in this direction for the Delayed Recall Score and the Retention Index, the differences were not significant for these measures.

Table 7: Sociodemographic, Health and Functional Status Characteristics of Study 3b & 3c Participants, by Group

	Gp 1 (n=18)	Gp 2 (n=18)
	Typical/Modified	Modified/ Typical
Mean Age (s.d.)	80.72(4.78)	79.2(3.57)
No. (%) Female	13(72.22%)	14(77.78%)
No. (%) Married	5(27.78%)	7(38.89)
No. (%) by Highest Level of Education		
Less than High School Graduation	6(33.33%)	5(27.78%)
High School /Trade School Grad	4(22.22)	10(55.55%)
College/University	8(44.44%)	3(16.67%)
No. (%) by Housing Type		
Conventional Housing (house, apt)	18(100%)	18(100%)
No. (%) Living Alone	9(50%)	11(61.11%)
No. (%) Hospitalized Last 6 Mo	0	0
Prescription Medications being Taken		
Mean No.(sd) Taken	2.94(2.24)	3.28(2.54)
Range	0 - 8	0 - 10
No. (%) Taking None	1(5.55%)	2(11.11%)
Mean No. (s.d.) Chronic Conditions	2.44(1.76)	2.17(1.65)
No. (%) Diagnosed With Selected Conditions		
Hypertension	7(38.89%)	9(50%)
Arthritis/Rheumatism	12(67.67%)	10(55.55%)
Osteoporosis	7(38.89%)	5(27.78%)
Cancer, in the past 5 years (not including skin cancer)	3(16.67%)	0
Diabetes	2(11.11%)	4(22.22%)
Emphysema, Chronic Obstructive Pulmonary Disease, Asthma	2(11.11%)	1(5.55%)
Gastritis	1(5.55%)	0
Renal Failure	0	1(5.55%)

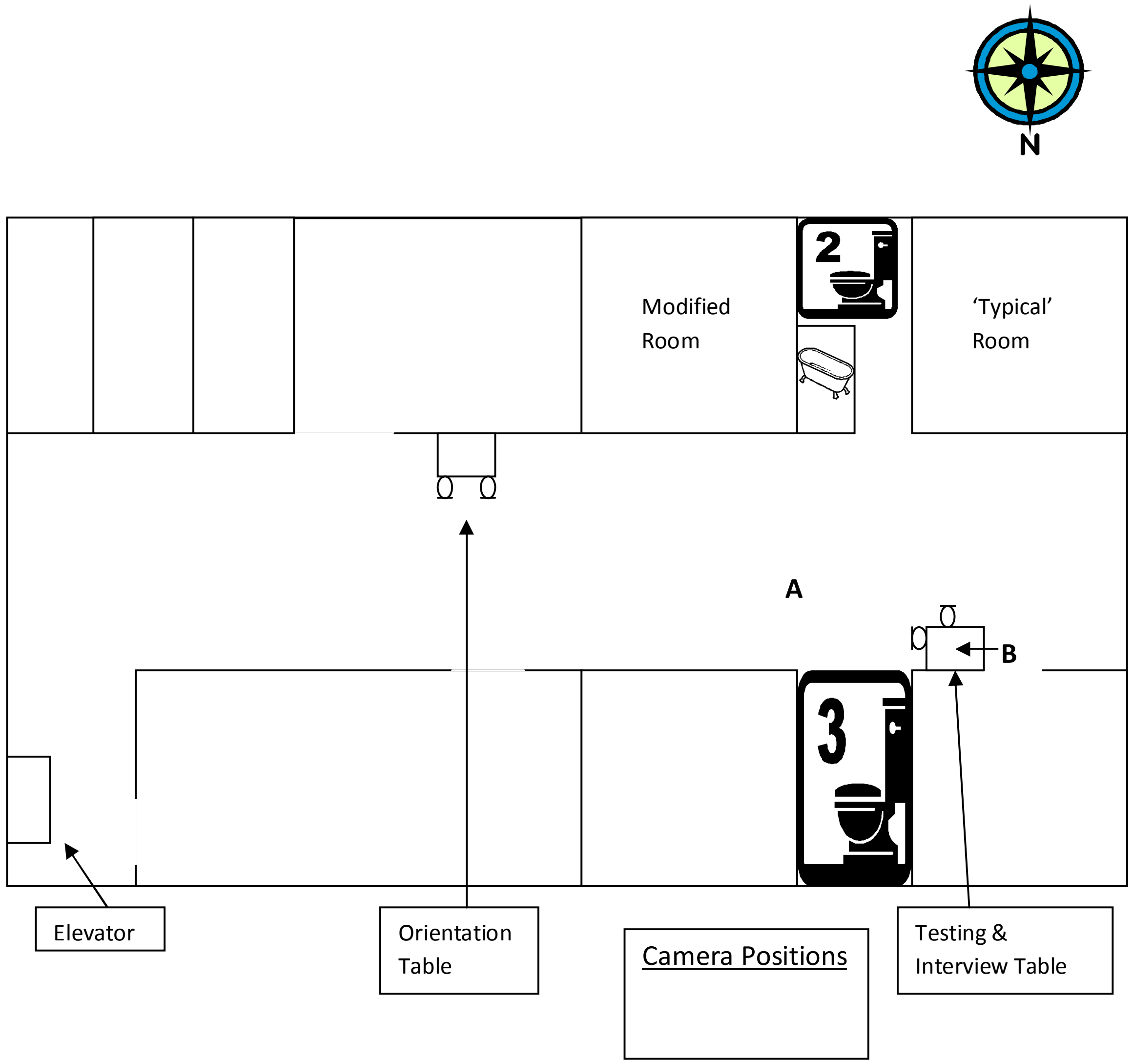
	Gp 1 (n=18)	Gp 2 (n=18)
Thyroid Disease	2(11.11%)	5(27.78%)
No (%) by Level of Hearing		
Hears adequately	6(33.33%)	4(22.22%)
Minimal difficulty	12(67.67%)	14(77.78%)
Mean No.(s.d.) of 7 IADLs Performed w/o Help	6.83(0.51)	6.72(0.57)
No. (%) Performing Selected IADLs w/o Help		
Meal Preparation	18(100%)	18(100%)
Ordinary Housework	17(94.44%)	17(94.44%)
Managing Finances	18(100%)	17(94.44%)
Managing Medications	17(94.44%)	15(83.33%)
Using the Phone	17(94.44%)	18(100%)
Shopping	17(94.44%)	16(88.89%)
Transportation	18(100%)	17(94.44%)
No. (%) Regularly Using a Mobility Aid (cane/walker)	3(16.67%)	6(33.33%)
No. (%)Use Stairs w/o Help	16(88.89%)	14(77.77%)
No. (%) Go Out From Home 4-7 Days/Week	16(88.89%)	13(72.22%)
No. (%) Physically Active 2+ Hours/Day	15(83.33%)	16(88.89%)
No. (%) Feel Health is Poor	1(5.55%)	2(11.11%)
No (%) Fell in Last 6 Months	2(11.11%)	1(5.55%)
No (%) Limit Activities Because Afraid of Falling	0	2(11.11%)
Mean (s.d.) Hopkins Verbal Learning Test T-Scores		
Total Recall	51.11(7.54)	45.5(7.09)*
Delayed Recall	52.11(7.03)	47.44(6.28)
Retention	53.89(6.64)	53.39(7.48)
Recognition Discrimination Index	53.78(7.39)	50.33(6.64)

*= $p < .05$

The Study Setting

Studies 3b and 3c took place in the southwest wing of the seventh floor of Burnaby Hospital in an area no longer used for patient care. The research setting included the same two four-bed patient rooms used in Study 3a and described in detail by Love (2007). These constituted the setting for Study 3b. Study 3c took place in two adjacent hallway-accessed bathrooms. As shown in Figure 2, one of the bathrooms was located on the south side, between the two test patient rooms. The other bathroom was across the hall, on the north side. At the entry to the area there was a table with two chairs where participants sat when they first came onto the floor and during their rest period. The table contained a measuring tape, weight scale and a Fat Loss Monitor (Omron HBF-306, Burlington, ON, Canada) to determine participant body fat percent and body mass index (BMI). This information was required for a sub-study. To one side of the table, there was a walker (Pilot™ Full Life Products, LLC, Moorestown, New Jersey) that the participants used for the last part of Study 3b and throughout study 3c. On the other side of the table, the doorframe had been marked for use in determining height, also one of the sub-study measurements. There were also two carts in the hallway that held monitoring equipment.

Figure 2: Layout of Research Area

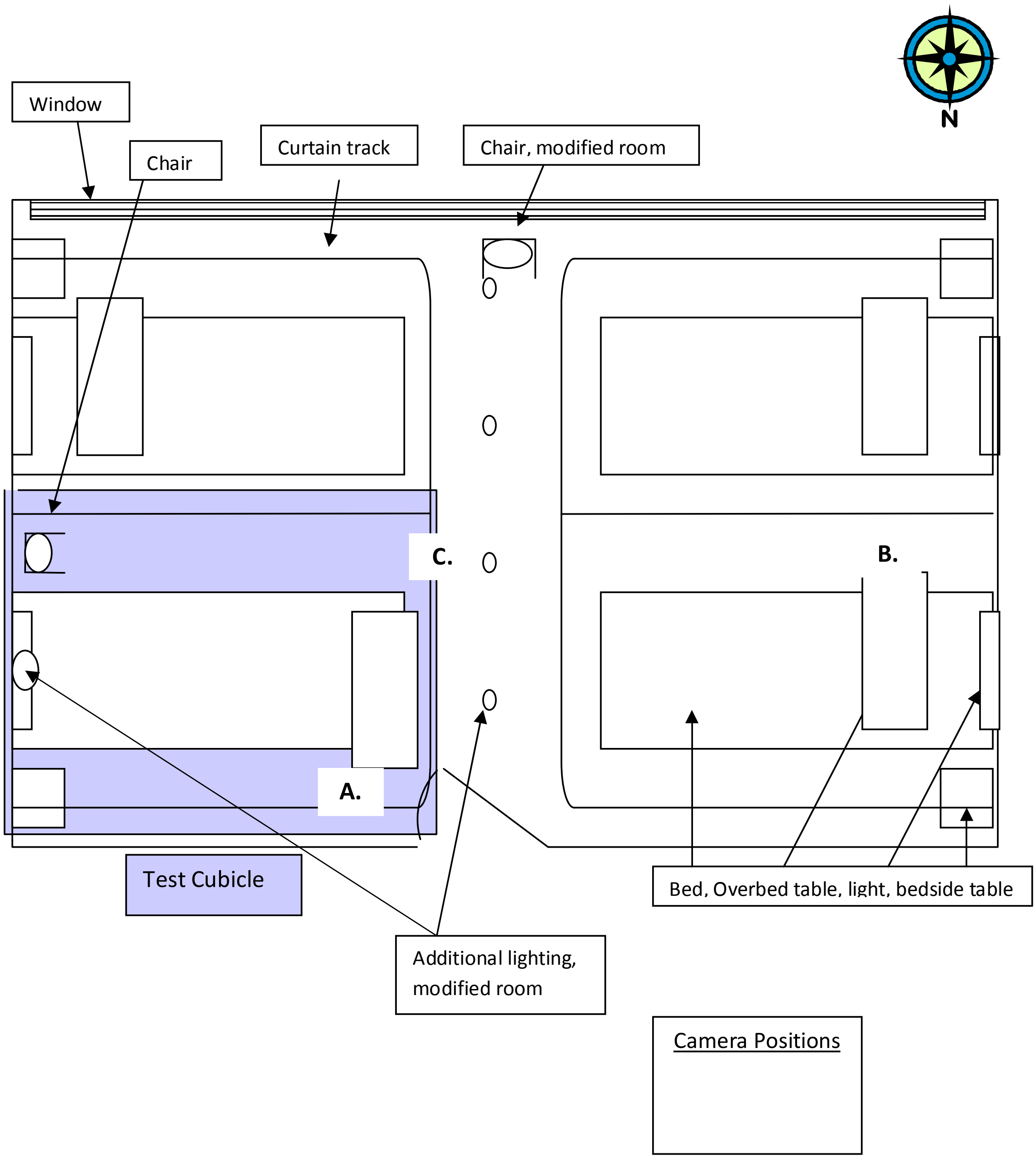


Note: The numbers beside the toilets in Figure 2 indicate that one bathroom had two toilet stalls while the other had three. For this study, only one stall in each bathroom was visible. The other(s) were screened off.

Bedrooms

Figure 3 shows the layout of the two test patient rooms. As can be seen they each contained four cubicles, delineated by the ceiling mounted bed curtain tracks. In each room, the cubicle on the east side nearest to the door was designated the test cubicle. The furniture in each cubicle consisted of a bed, bedside table, and over bed tray and in the test cubicles, a chair was located to the left of the head of bed. There was also a chair by the window in the modified room. The bed in the test cubicle (Model FL14E3), like the other furniture, was on loan from Stryker; it was selected because it could be lowered to 12 inches from the floor, was easily adjustable and had automatic night-lights underneath. The first two characteristics were those most frequently recommended by the ACE units surveyed in Study 1 of the project (Gutman, Love, Parke and Friesen, 2006). As can be seen in Figure 4b, the furniture in the modified room had a wood-laminate finish and appeared more home-like and less institutional than that typically seen in hospitals. The decor also was designed to convey a non-institutional ambience. This was accomplished through colour coordination of bedding, bed curtains, furniture and flooring, adding a patterned border on the wall behind the bed 36 inches from the floor, adding framed pictures (one on the bedside table and two on the wall behind the bed) covering the light box and metal wall plates with floral shelf paper and by adding task lighting (emanating from a wall sconce with an accordion pleated shade) to the traditional florescent tube light box. The chair (Symmetry Highback by Stryker) also was more residential in appearance than is usual in hospitals. The white horizontal blinds with a faux wood-grain that covered the windows and the dropped ceiling that was at a more "residential" than institutional height, also contributed to the effect.

Figure 3: Bedroom Layout



Since the intent of Study 3a had been to reduce noise and visual distraction, the bed curtains installed in the modified room were also different than those commonly used in hospitals. Specifically, they were made of heavier weight fabric (Fantagraph; style "Bezel") and had more folds.

It should be noted that for study 3b, the bed curtains were drawn around all but the test cubicle in each room. To simulate a night-time experience, the windows were covered with black paper and the blinds in the modified room and the curtains in the "typical" room were closed.

Taken together, changes to the modified patient room were designed to:

- Improve sound insulation (dropped ceiling with acoustical tiles; heavier fabric and wider bed curtains; rubber flooring)
- Improve aesthetics (more residential-like furniture finishes and decor)
- Improve lighting, particularly at night
- Increase user-control of the immediate environment (lights; bed height and configuration)

While the acoustical and aesthetics targeted-changes were the focus of evaluation in study 3a, the latter two sets of changes were of major interest in study 3b. Both were considered to be essential in promoting safe, self-transfer from chair into and out of bed and for mobility within the patient room as well as for falls prevention. The rationale for focusing on the night time situation was Alcee's (2000) finding, referred to in the literature review, that the majority of falls documented in a community hospital took place at night.

Lighting and Lighting Controls

In the "typical room", the only light available at night came from two fluorescent tubes encased in a box mounted on the wall behind the head of each bed. To turn the lights on and off, the "patient" had to reach to the right and behind the head of the bed and pull a dangling cord. In the modified room, a task light (Model 30120-1, Kenroy International, Jacksonville, Florida) was mounted on the wall above the head of the bed, controlled by an on-off switch that was fixed to the bedrail. A dimmer switch was also provided and located on the bedrail. As well, four circular lights each eight cm in diameter (DOT·it™, Osram Sylvania, Mississauga, Ontario) were placed on the ceiling down the centre of the room, illuminating the floor between the beds.

Bed Controls

In the case of the "typical" room, controls were located on the bedrails, accessible only when the rails were in the raised position. The controls that raised the head or the foot of the bed were situated on both the inside and outside of the rail. However, the buttons that controlled raising/lowering of the whole bed were only located on the outside of the rail. The bed in the Modified room was controlled by buttons situated on a pendant that could be hooked onto either side rail of the bed or be placed beside the patient. The pendant offered control of the head/foot of the bed as well as the height of the bed itself.

Figure 4: Lighting and Bed Controls in "Typical" Room

Figure 5: Lighting and Bed Controls in Modified Room

Bathrooms

Changes to the bathroom included:

- Covering the windows with black paper to simulate a nighttime experience
- Replacing the standard wall mounted light switch inside the bathroom and to the right of the entry door with a movement-activated timer switch
- Covering the pastel, ceramic tile on the wall behind the toilet with dark solid color paint to maximize contrast and improve the visibility of the white fixture (see Figure 7a)
- Replacing the fixed size, pull-down wall mounted arm supports on either side of the toilet with rotatable, height-adjustable floor-mounted toilet arm supports (Flexi 94B, available from Barrier Free Architecturals Inc, Toronto ON) (see Figure 7a)
- Drawing footprints on the bathroom floor to indicate where a person should stand when attempting to sit on the toilet (see Figure 7a)
- Installing track lighting above the toilet and lights above the sink (see Figure 7b)
- Replacing the fixed wall-mounted mirror above the sink with a framed tilt mirror (Debbie Travis ™, 57.2 x 7.9 x 58.4 cm, from A.J Billis, Brampton, ON) (see Figure 7b)
- Adding a fold down shelf on which to place toiletries while grooming (Bradley 790 pull down shelf from Li'l Chief Specialties Inc Seattle, WA) (see Figure 7b)
- Covering the pastel ceramic tile on the wall behind the sink with a dark solid color paint to maximize contrast and improve the visibility of the white fixture (see Figure 7b)

Figure 6: "Typical" Bathroom

Figure 7: Modified Bathroom

Dependent Variables

Three types of data were collected in Studies 3b and 3c: subjective, physiological and video.

Subjective Data

The environment modifications of interest were rated by participants for ease of use, for helpfulness, and/or for appeal and they were asked to respond to questions such as "what did you like most/least about the rooms and why"?

Physiological Data

Heart Rate Monitoring

Each participant's heart rate was measured for 10 minutes with a Nonin 8600 finger clip pulse oximeter (Plymouth, Minnesota, USA). During the first five minutes the pulse oximeter was the only heart monitor in operation; during the second five minutes ECG (Corscience BT3/6, Erlangen, Germany) and ballistocardiograph (BKG) readings were also taken. The latter measures while technically part of a parallel but unrelated substudy, were included because they approximated medical tests older persons might experience in an acute hospital thus increasing the "reality" of the setting. They also had the potential to yield additional data concerning the stress-mitigating potential of the modified room.

Postural Sway

Postural sway was recorded using a commercially available wireless system (SwayStar™ by Balance International Innovations, Iseltwald, Switzerland). The data collection device consisted of two angular-velocity transducers mounted on the plastic molding of an adjustable, partly elasticized kidney belt. The belt was worn inverted to position the sensors in the lumbar region of the back. One of the transducers measured angular-velocity deviations in the pitch (fore-aft) plane the other in the roll (side-to-side) plane.[3]

[3] See Gill, Allum, Carpenter, Held-Ziolkowska, Adkin, Honegger, and Pierchala (2001) for a description of the type of data this device yields and for age comparisons.

Video Camera Array

To observe the participants while the RA was out of the room (to ensure their safety) and to document gross movement, gestures, coping actions and facial expressions, high resolution (30fps, 640X480) Creative LivePro Webcams (Creative Labs, Milpitas, CA, USA) were mounted in the patient rooms and bathrooms and one Canon camcorder (model DC-40) followed the participants throughout the study. For Study 3b, the webcams were mounted on the curtain rail in front and above the bedside chair as well as across the room and in front of the bedside chair. In Study 3c, the cameras were mounted high on the wall in front of and at the back of the test toilet stall. As Carmichael, Ngai, Love, Chuo, Tavakolian, Kaminska and Gutman (2007) note:

> Privacy concerns are always important when using cameras as a research tool and during the self-toileting portion of our study these concerns definitely affected the activities that were observed. It was felt that participants should not be asked to remove their pants and/or hosiery during the self-toileting exercises while being video recorded and observed by researchers.... all activities were recorded after informed consent was obtained and at all times participants remained fully clothed.

Procedure

Preparation of study setting prior to arrival of participants

Prior to each participant's arrival, the researcher assistant (RA) and an individual with a graduate degree in engineering (EA) did a walk-through of the research area and, using the checklist shown in Appendix 3, verified that all the equipment was in place and operating, that lights were out and doors were closed.

Orientation

Upon arrival at Burnaby Hospital, each participant was welcomed at the main entry by the RA and brought up the public elevator to the seventh floor. Once on the seventh floor, the participant was introduced to the EA, following which the participant and RA sat at the entry table to review the study procedures, discuss any questions the participant might have and review and sign the informed consent form (a copy of the consent form was given to the participant to take home). After this, the RA collected some additional personal data required for the sub-study (time and amount of last caffeinated beverage consumed, height, waist, hip measurements, weight, BMI and body fat %). The participant then removed his/her shoes and donned a pair of cotton socks provided by the RA and then was fitted with the ECG contacts (4 surface-affixed contacts - 2 on upper chest, 2 above hip bones). Next, the RA adjusted the walker to an appropriate height for the participant, demonstrated its proper use and had the participant take several practice steps while using it.

Study 3b

Participants were escorted to the first patient room ("typical" or modified as per their assigned group), and directed to sit on the chair next to the bed in the test cubicle. The participant was instructed to imagine having been hospitalized for several days as the result of hip fracture surgery. The RA brought the walker with her into the room; the EA followed the participant and RA into the room, turned on the webcam above the test cubicle and the camcorder and then exited the room, closing the door. Once the older adult was seated, the RA demonstrated the controls for both the bed and lights then moved to the foot of the bed to recite a pre-scripted set of instructions and questions (see Appendix 3). The instructions told the participant to lower the bed to a comfortable height then get on it and lay down. Once on the bed, the participant was asked to turn off the light without getting out of bed to do so and lay back down; then again without getting out of bed, to turn the light back on (if needed, the researcher had a flashlight available). Next, the participant was instructed to adjust the bed to a comfortable seated position. In the modified room, the participant was also asked to use the dimmer switch to adjust the light. At the completion of each task the researcher asked the participant to rate, on a scale ranging from 1 (very easy) to 5 (very difficult) how easy or difficult each task had been using the controls available. The RA held up an 8.5" x 11" sheet of cardboard showing a scale (see Appendix 4) ranging from 1(very easy) to 5(very difficult) to visually cue the ratings. If a task was rated '4' or '5' (or if participants verbalized that it was difficult) they were asked to provide suggestions for improvement.

At this point in the protocol, the EA re-entered the room bringing in a cart carrying the BKG and pulse oximeter. The RA explained that they she and the EA would be leaving the room in order to prepare for the next part of the study but that while they were gone the pulse oximeter would be clipped to their finger to record their resting heart rate. When the oximeter was attached and confirmed to be recording, the RA drew the curtain around the bed and the EA and RA both exited, closing the door on the way out. After five minutes, the RA and EA returned to the room. The RA opened the curtain, leveled and raised the bed to the height of the bedside table, while the EA prepared the computer for the EKG/BKG substudy protocol[4]. The EKG/BKG was attached to the contacts; the pulse oximeter was clipped to the participant's finger. When the protocol was completed all sensors were removed and the EA left the room, taking the computer cart.

The participant then was instructed to adjust the bed to a comfortable, seated position and to answer a series of qualitative questions about the room. At the end of qualitative questioning the participant was directed to lower the bed and again rated the ease/difficulty of using the control to complete the task. Following this, the EA returned to the room, this time bringing the SwayStar™ belt. The RA opened the curtain across from the cubicle to allow the webcam on the far wall to record the balance of activities, and she turned on the webcam and the lights in the other cubicles. The RA and the EA (one holding the SwayStar™ device in position behind the participant's back) then fitted the participant with the SwayStar™ belt. The EA stepped back to the doorway of the room where the SwayStar™ computer was positioned. The participant was then asked to perform each of the following tasks: rise from the chair; stand, not moving for 20 seconds with eyes open; stand for 20 seconds with eyes closed; and to walk (using a walker with IV pole and bag attached) a straight 3M path towards the RA. These four activities were then repeated with a Posey Bevelled Floor Cushion (J.T.Posey Company, Arcadia, CA) on the floor in front of the chair, parallel to the bed. Each of the eight individual tasks was recorded by SwayStar™. Each time participants rose from the chair or walked 3M, they rated the ease or difficulty of the task. At the end of the SwayStar™ activities the RA turned off the webcams and camcorder and escorted the participant out to the hallway. The participant was given a short break while the RA and EA moved equipment (camcorder, floor mat, walker, script, flashlight) to the second patient room. The same procedure was completed in the second room and again the participant had a short break while the RA and EA moved equipment (camcorder, walker, script) to the first bathroom.

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[4] For the sub-study, two one-minute readings were taken of the participant's heart. For the first reading the BKG sensor was placed on the sternum, for the second it was repositioned over the heart by the RA.

Study 3c

This study began with the participant seated, wearing the SwayStar™ belt, on a chair in the hallway outside the first bathroom they were to visit. They were told that they would be going into the bathroom, using the walker, where they would pretend to perform some routine tasks. They were asked to complete each task as naturally as possible, told that balance data would be collected and that they would be asked questions about the room and their experience in it. When the participant was ready, the webcam in the bathroom, the SwayStar™ and the camcorder were started and the participant was directed to get up from the chair, enter the bathroom and continue until they were seated on the toilet. Once in the bathroom they were reminded to use and then rated the toilet arm supports. In the modified bathroom, they also adjusted the height of the toilet arm supports and swivelled them in and out, used the two toilet paper dispensers, and rated the ease or difficulty of performing each task. Participants then walked from the toilet to the sink where they were instructed to use the items in a bag in the walker's basket, to pretend to brush their teeth and fix their hair (men pretended to shave instead of fix their hair). In the modified bathroom, the fold down shelf and the tilt mirror were pointed out and participants were told that they could be used/adjusted if they wished to. When the grooming tasks had been completed the participant rated the ease/convenience of performing them. If in the modified bathroom they were also asked to rate the helpfulness of each individual modification. In both bathrooms they were asked to rate the overall elder friendliness and ambiance of the room. When the bathroom sequence was complete, the participant was escorted back out to the hallway and had a short break while equipment (camcorder, SwayStar™ computer, and walker) was repositioned for the second bathroom. When ready, the process was repeated in the second bathroom.

When the procedure in the second bathroom was complete the equipment (camcorder, webcam) was turned off, the SwayStar™ belt was removed and the participant was brought back to the entry table. At that time they were thanked for their participation, given their honorarium (receipt was signed) and reimbursed for parking if applicable, they then changed back into their shoes and were escorted back to the main entrance.

Results

The results of Study 3b are presented first. They begin with ease of use ratings for the design modifications selected to make the patient bedroom safer for self-transfer and mobility - viz. bed and light controls, floor covering and chairs. Following are responses to a set of questions designed to provide feedback on participants' overall reaction to the rooms as well as what they specifically did and did not like about each room. Resting heart rate data are presented next followed by data concerning stability and balance deriving from the SwayStar^{TM} postural sway monitoring system. A similar order is followed in presenting data from Study 3c which focused on the bathroom except that there are no resting heart rate data since such was not part of the Study 3c protocol. In both studies, 5-point scales were used to capture participants' subjective ratings, with low scores indicating positive response (1= very easy; very helpful) and high scores indicating negative response (5 = very difficult; not helpful). Responses to the qualitative questions were recorded by the RA as close to verbatim as possible. Gross body movements, gestures, and facial expressions were captured by the camcorder and webcams.

Study 3b

Bedroom Ease of Use Ratings[5]

Bed Controls

As shown in Table 8, **c**ontrols on the beds in both rooms were rated as very easy to use to lower the bed to get in when manipulated from a seated position in a chair beside the bed or when in the bed, to adjust it to a seated position (mean ratings ranged from 1.03 to 1.19). However, lowering the bed to get out was rated as

[5] In interpreting the data reported below, it is suggested that mean ratings of 1.0-1.5 be considered "very easy", 1.6-2.5 "moderately easy", 2.6-3.5 "neither easy or hard", 3.6-4.5 "somewhat hard" and 4.6-5.0 "very hard"

considerably more difficult in the "typical" room (mean rating = 3.78) where up/down controls were on the outer side of the bedrail than in the modified room (mean rating = 1.14) where the Stryker "Rose" bed had up/down controls mounted on pendants that were hung on the inner side of both bedrails.

Light Controls

As one might expect**,** given the need in the "typical" room to reach over and behind the head of the bed to grasp and pull the dangling cord, turning the light off or on (the latter in the dark) was rated as much more difficult in the "typical" room (mean rating off = 3.78; mean rating on = 4.44) than in the modified room (mean rating off = 1.08; mean rating on= 1.50) that had light controls mounted on the top of the bedrail.

In the modified room, study participants were asked to use a dimmer switch to dim and then bring the lights back up to a personally comfortable level. When asked to rate the ease or difficulty of using the dimmer switch, also mounted on the top of the bedrail, participants indicated that they found it very easy to use (mean rating = 1.08).

Bedside Chair and Falls Mat

The chair in the modified room received a slightly more positive "ease of rising from" rating (mean rating = 1.14 without mat) than the chair in the "typical" room (mean rating = 1.31 without mat). In both rooms, putting a falls mat beside the bed and in front of the chair made the task of rising from the chair more difficult (mean rating modified room 1.42; "typical" room 1.58).

Flooring and Falls Mat

As an indirect way of getting at the functionality of the flooring, study participants were asked to rate their ease or difficulty in walking a distance of three meters towards the RA while using a walker. As can be seen in Table 8, ratings were slightly more positive in the modified room which had the rubber flooring (mean rating = 1.33 without mat) than in the "typical" room which had a Terrazzo floor (mean rating = 1.56 without mat). On both types of flooring, walking while maneuvering a walker was more difficult when there was a falls mat in place than without it (mean rating rubber floor with mat = 1.69; Terrazzo floor = 1.78).

Appeal of Ambiance/décor and Perceived Elder Friendliness of Bedrooms

The ambiance/ décor of the modified room were clearly more appealing to study participants than that of the "typical" room. This is reflected in the mean ambiance/décor ratings (1.97 for the modified room compared with 3.11 for the "typical" room). When asked to rate the user friendliness of each room, "especially for the older patient", the modified room was again more positively perceived than the "typical" room (mean user/elder friendliness rating for the modified room = 1.22 compared with 2.81 for the typical room).

Table 8: Bedroom Ease of Use, Appeal, and Elder-Friendliness Ratings

	"Typical" Room (1=Very easy; 5= Very difficult)	Modified Room
	Mean (s.d.)	Mean (s.d.)
Bed controls		
Lowering to get in (from chair)	1.19 (0.52)	1.03 (0.17)
Lowering to get out (while in bed)	3.78 (1.12)	1.14 (0.42)
Adjusting to seated position	1.14 (0.35)	1.11 (0.40)
Light controls		
Off	3.78 (1.12)	1.08 (0.28)
On	4.44 (0.97)	1.50 (0.81)
Dimmer	n/a	1.08 (0.28)
Rising from Chair		
Without falls mat	1.31 (0.82)	1.14 (0.42)
With mat	1.58 (1.05)	1.42 (0.65)
Walking 3 meters using walker		
Without falls mat	1.56 (0.73)	1.33 (0.63)
With mat	1.78 (0.83)	1.69 (0.89)
	(1= Very good; 5= Very poor)	
Appeal of ambiance/decor	3.11 (1.09)	1.97 (1.11)
User/elder friendliness	2.81 (0.89)	1.22 (0.42)

Overall Impression of the Bedrooms

While still in the bedroom, study participants were asked the following three questions:

1) What three words would you use to describe this room?
2) What, if anything, did you like about this room?
3) What, if anything, did you dislike about this room?

As shown in Table 9, regardless of order of exposure, the “typical” room generated more negative than positive words in response to the first question while the opposite was true in the case of the modified room.

Table 9: Number Distribution of Bedroom Descriptors, by Room Order and Affect.

	Positive Affect	Neutral Affect	Negative Affect
“Typical” Room When Seen First (Gp 1)	16	10	27
When Seen Second (Gp 2)	10	5	32
Modified Room When Seen First (Gp 2)	33	6	11
When Seen Second (Gp 1)	46	3	4

Table 10 shows the most common words that study participants used to describe the patient bedrooms. Clearly, the focus was on the ambiance/décor which, in the case of the “typical” room was most commonly described as dull and depressing and in the case of the modified room, as homey/cozy/comforting.

Table 10: Most Common Bedroom Descriptors, by Room Order and Affect

	Positive Affect	Negative Affect
“Typical” Room When Seen First (Gp 1)	Comfortable (4) Spacious/roomy, Clean (3 ea) Quiet/relaxing (2)	Depressing/scary/dismal (9) Small/confining (5) Plain/drab (4)
When Seen Second (Gp 2)	Lighter/brighter (4) Comfortable, Relaxing, Pleasant (2 ea.)	Dull/sparse/dreary/sterile (7) Institutional, unfriendly/non-soothing (5 ea) Lonely/depressing/sad/somber (4)
Modified Room When Seen First (Gp 2)	Homey/cozy/comforting (12) Restful/relaxing (8) Comfortable (7)	Depressing/somber (4) Dull (3) Dark (2)
When Seen Second (Gp 1)	Homey/cozy/soothing/welcoming (11) Comfortable (7) Clean/neat, relaxing/restful, spacious (4 ea.)	Dark/gloomy (2) Intimidating Small

Best and Least Liked Features of the Bedrooms

As shown in Table 11, when in the modified room, study participants most commonly mentioned the bed and light controls in response to the question about what they liked best about the room. Conversely, the bed and light controls were the items most commonly disliked in the "typical" room. This pattern held regardless of whether the modified room was seen first or second. The greater thickness and textured fabric of the bed curtains in the modified room and the greater privacy this provided was another design feature that was positively perceived – particularly when the modified room was seen second. The dark blue colour of the curtains in the modified room and the brown/yellow colour scheme used in the bedding also was mentioned as a positive feature more often when the modified room was seen after the "typical" room.

Table 11: Best and Least Liked Features of Bedroom, by Room Order

	Liked Best	Liked Least
"Typical" Room When Seen First (Gp 1)	Bed comfortable /adjustable (6) Colour scheme (4)	Light control (9) Colour scheme (5)
When Seen Second (Gp 2)	Colour scheme (7) Bed comfortable/adjustable (2)	Light control (12) Bed control (9) Colour scheme (5) Thinness of bed curtain (6) Chair (2)
Modified Room When Seen First (Gp 2)	Bed/ light controls (14) Colour scheme (6) Thickness/texture of curtains (4) Pictures (3)	Colour scheme (6)
When Seen Second (Gp 1)	Bed/light controls (16) Colour scheme (10) Thickness/texture bed curtain(10) Pictures (6) Light fixture (3) Nightlights (3)	Colour scheme (4) Chair (2) Nightlights (2)

Heart Rate Data

Table 12 shows each group's mean heart rate and amplitudes during the first five minutes that study participants lay prone on the bed in each room after having completed the bed and light control part of the protocol. Data were collected via a pulse oximeter clipped to one of their fingers. Whether considering heart rate or the H, I and J peaks, what is most apparent is an order effect (i.e. rate and amplitude were higher in the room they saw first.

Table 12: Mean Resting Heart Rate and Amplitudes, by Group and Room Type

	N	Typical		Modified	
		Mean	s.d.	Mean	s.d.
Heart Rate Gp 1(Typ/Mod)	16	66.26	11.48	63.51	8.92
Gp 2 (Mod/Typ)	15	67.00	5.93	70.89	5.75
H Peak Gp 1 (Typ/Mod)	17	2.75	0.93	2.82	1.12
Gp 2 (Mod/Typ)	18	2.58	0.96	2.20	0.89
I Peak Gp 1 (Typ/Mod)	17	-3.47	0.91	-3.31	0.93
Gp 2 (Mod/Typ)	18	-3.26	0.95	-2.91	1.11
J Peak Gp 1 (Typ/Mod)	17	2.39	0.90	1.98	1.05
Gp 2 (Mod)Typ	18	1.88	0.92	1.89	1.11

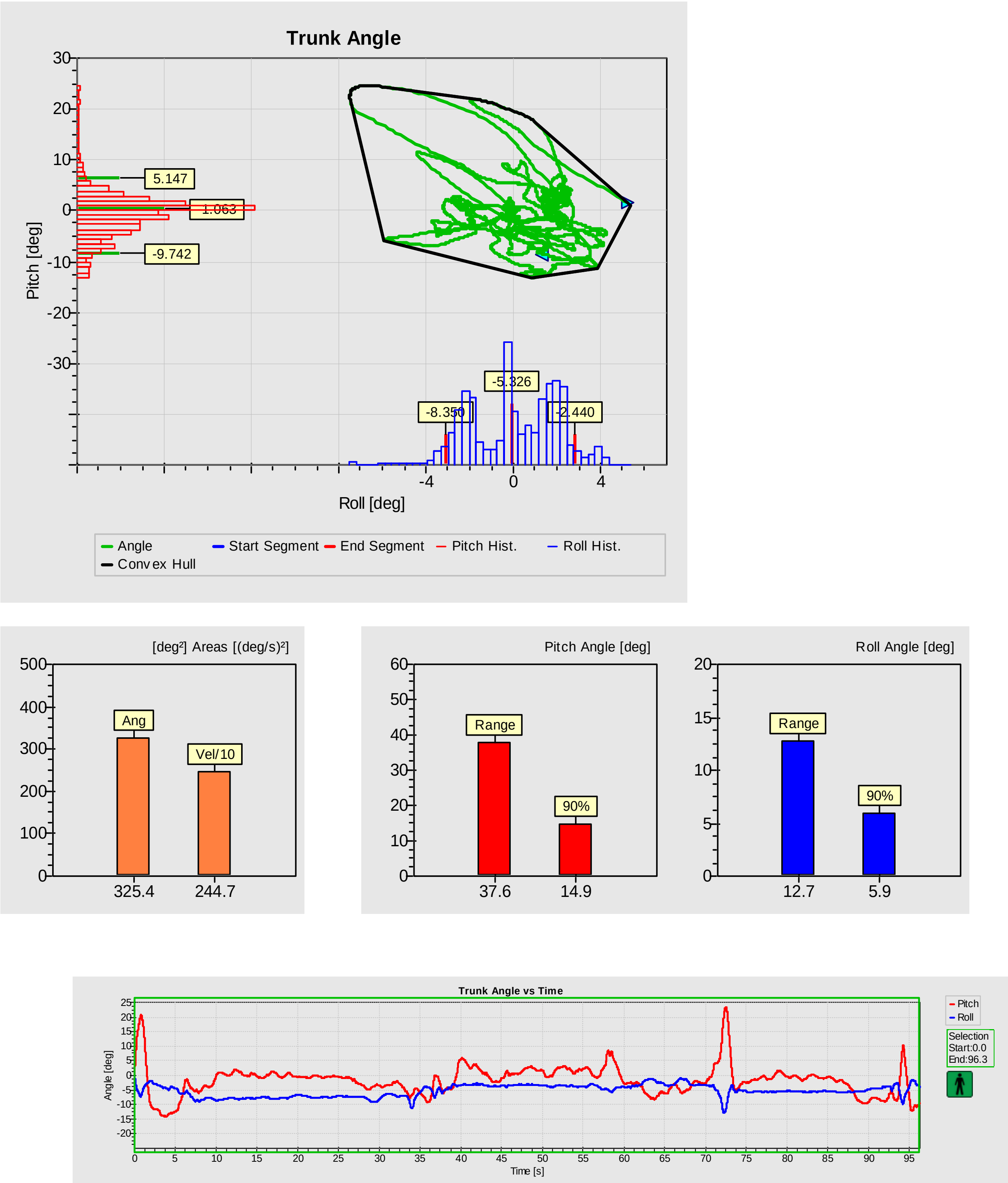
Bedroom Postural Sway Data

The SwayStar™ equipment quantified trunk sway using a system that measured trunk angular velocity and position in the pitch (for-aft) and the roll (lateral) planes at the level of the lower back. Data analysis consisted of comparing the mean range of pitch and roll angular displacement and velocity observed in the two rooms, and under the different study conditions (i.e. we compared the two groups, one of which began in the "typical" room and the other which began in the modified room. The data used were 90% of the peak-to-peak extent of the values for a particular task in the roll and pitch directions. As explained below, the SwayStar™ software generates two types of data.

> The first method used the peak –to-peak extent of the values for the task in the roll and pitch directions following removal of the first second and, for stance trials, the last 2 seconds of the trial. The second method involved binning all samples for the trial to accumulate a histogram of pitch and roll angular displacement and velocity values …. From these histograms, 5% and 95% limits were calculated, and the extent of these limits was assigned to a 90% range value (Gill et al, 2001, p.M441).

We used data generated by the second method in our analyses. As an illustration of the richness of the data generated by the Sway Star equipment see Figure 8 shows the sway envelope and histograms of one of our study participants. The data were generated while this individual stood in front of the sink in the modified bathroom performing mock grooming tasks (e.g. combing hair; brushing teeth).

Figure 8: Postural Sway Histogram, Participant G1P3 at Sink, Modified Bathroom



Bedside Chair and Falls Mat

Table 13 shows the mean trunk pitch and roll angles when study participants rose from the bedside chair to a standing position. Assuming that the greater the angle, the greater the sway or "wobble" they manifested, the pitch data (Tables 13.1 and 13.2) suggest that for Group 1 instability was less in rising from the chair in the modified bedroom (35.67 degrees without mat) than in the "typical" room (40.30 degrees without mat); the trend was in the opposite direction for Group 2 but the difference was small (35.69 degrees modified room compared with 34.70 degrees in "typical" room). The roll data (Tables 12.3 and 12.4) show less instability in the modified room in both groups (Group 1: 4.94 degrees in "typical" room; .4.64 degrees in modified room; Group 2: 5.26 degrees in "typical" room; 3.63 in modified room). Unfortunately it is not possible to determine from these data if the lesser amount of sway recorded in the modified room was a function of the chair design and/or the floor covering since both were different in the two rooms.

Placement of the falls mat on the Terrazzo floor in the "typical" room had little effect on sit to stand pitch in Group 1 but increased it markedly in Group 2. Average trunk roll however, was reduced slightly. In the case of the modified room, placement of the Posey matt on the rubber floor increased both pitch and roll as study participants changed from a seated to a standing position.

Table 13: Mean Trunk Pitch & Roll Angles, Sit to Stand, With and Without a Falls Mat

13. 1 – Trunk Pitch Angles (degrees) Sit to Stand, Terrazzo Floor

	Typical Room (no mat)		Typical Room (with mat)	
	90% of Range	s.d.	90% of range	s.d.
Group1	40.30	9.62	39.88	7.75
Group	34.70	10.62	38.78	11.87

13. 2 Trunk Pitch Angles (degrees) Sit to Stand, Rubber Floor

	Modified Room (no mat)		Modified Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	35.67	8.40	37.23	8.46
Group2	35.69	6.71	37.64	7.78

13. 3 Trunk Roll Angles (degrees) Sit to Stand, Terrazzo Floor

	Typical Room (no mat)		Typical Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	4.98	1.88	4.52	1.38
Group2	5.26	2.17	5.07	3.11

13. 4 Trunk Roll Angles (degrees) Sit to Stand, Rubber Floor

	Modified Room (no mat)		Modified Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	4.64	3.30	5.57	2.29
Group2	3.36	1.31	6.14	3.10

Flooring and Falls Mat

Table 14 shows the mean trunk pitch and roll angles when study participants walked three metres using a walker. Again assuming that the greater the angle, the greater the sway or “wobble”, comparison of the data in the various rows of column 1 of tables 14. 1-4 suggests that instability was greater on the rubber floor installed in the modified bedroom than on the Terrazzo floor in the “typical” room. Comparison of data across columns suggests that the falls mat increased postural sway in both groups regardless of which type of flooring it was placed on.

Table 14: Mean Trunk Pitch & Roll Angles When Walking 3 M Using a Walker, by Floor Type, With and Without a Falls Mat

14. 1 – Trunk Pitch Angles (degrees) Walk 3M, Terrazzo Floor

	Typical Room (no mat)		Typical Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	8.39	2.78	9.43	3.65
Group2	11.42	7.76	14.2	7.93

14. 2 Trunk Pitch Angles (degrees) Walk 3M, Rubber Floor

	Modified Room (no mat)		Modified Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	9.27	3.44	9.86	3.73
Group2	11.01	3.26	12.41	3.95

14. 3 Trunk Roll Angles (degrees) Walk 3M, Terrazzo Floor

	Typical Room (no mat)		Typical Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	3.53	1.10	3.89	1.28
Group2	3.90	1.44	4.28	1.28

14. 4 Trunk Roll Angles (degrees) Walk 3M, Rubber Floor

	Modified Room (no mat)		Modified Room (with mat)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	3.83	1.35	3.89	1.42
Group2	4.05	1.23	4.40	4.40

Study 3c

Bathroom Ease of Use and Helpfulness Ratings

Manual Light Switch ("Typical" bathroom only)

As shown in Table 15, the mean rating study participants gave when asked about the ease of turning on the light in the "typical" bathroom was 1.89. This was more positive than we had anticipated, given that the switch was located inside the bathroom on the wall to the left of the door and the requirement that study participants use a walker when maneuvering to and inside the bathroom.

Automatic Illumination of Bathroom, Extra Toilet and Sink Lighting (Modified bathroom only)

As shown in Table 16, participants were enthusiastic about the movement-activated lighting system that illuminated the bathroom as they opened the door, rating it as very helpful (Mean rating = 1.03). The track lighting over the toilet was also considered very helpful (mean rating = 1.39) as was the lighting over the sink (mean rating = 1.14).

Footprints

The protocol for Study 3c required the RA to record if the study participants spontaneously used the footprints on the floor in front of the toilet in the modified room while in the process of positioning themselves in a seated position on the toilet. The RA noted that 6 of the 9 men (67%) and 14 of the 27 women (52%) did so. As shown in Table 15, the footprints received a mean helpfulness rating of only 2.92 indicating that the study participants were not overly enthusiastic about them.

Table 15: Bathroom Ease of Use, Appeal and Elder Friendliness Ratings

	"Typical" (1=Very easy; 5= Very difficult)	Modified
	Mean (s.d.)	Mean (s.d.)
Toilet Arm Supports — Adjust Height	n/a	2.39 (1.36)
Swivel	n/a	2.17 (1.33)
Use to rise from toilet	1.39 (0.77)	1.03 (0.17)
Turning on Lights	1.89 (1.19)	n/a
Performing grooming tasks at sink	2.67 (1.22)	1.50 (0.85)
Fold-down shelf	n/a	2.22 (1.22)
	(1= Very good; 5= Very poor)	
Appeal of ambiance/decor	3.17 (1.18)	2.31 (0.92)
User/Elder friendliness	2.56 (1.03)	1.50 (0.65)

Table 16: Helpfulness Ratings (Modified Bathroom Only – 1= Very Helpful; 5= Not very helpful)

	Mean (s.d.)
Automatic Lights	1.03 (0.17)
Extra lighting over toilet	1.39 (0.84)
Footprints in front of toilet	2.92 (1.36)
Toilet paper holder on arm support	2.44 (1.48)
Adjustable arm supports	2.28 (1.41)
Light over sink	1.14 (0.35)
Swivel mirror	1.36 (0.76)
Fold-down shelf	2.47 (1.38)

Toilet Arm Supports

When study participants entered the bathroom and first faced the toilet, the arm supports were raised. The protocol for Study 3c required the RA to note if the study participant spontaneously pulled down the arm supports (referred to as "grab bars" in the script included in Appendix 3) and, if so, to record which hand was used to pull down the supports and which they used when positioning themselves on the toilet. When in the "typical" bathroom, a total of three of the 36 participants (8%) pulled down the arm supports without prior cueing by the RA; one used only the right hand support and two used both (of these, both persons were right-handed) . When those who had not spontaneously used the arm supports were asked about non-use, the most common reasons were that they had not noticed them (18 people) or didn't use them because they had the walker for support (9).

In the case of the modified bathroom, the toilet arm supports were spontaneously used by five of the 36 participants (14%); all five used those on both sides of the toilet. Reasons given for non-use were feeling they were not needed because they had a walker (18) and not knowing how they worked (3). Those who had spontaneously used the arm supports were asked to rate the ease or difficulty of positioning them. Whether used or not, all study participants were then shown by the RA how to change the height of the supports and how to swivel them to the side. After the demonstration, they were asked to "change the height of the grab bars to a comfortable level", and to "swing the grab bar away from you and then back again" and to rate the ease or difficulty of making these adjustments.

As shown in Table 15, arm support systems in both bathrooms were rated as very easy to use with respect to getting up from the toilet (mean rating modified room = 1.03; "Typical" room = 1.39). However, while the floor-mounted FLEXI toilet arm supports in the modified bathroom received a rating in the "somewhat easy to use" range for both height adjustment (2.39) and swivel (2.17) there were large individual differences in the ratings (they ranged from 1-5) suggesting that these arm supports were considerably easier for some study participants to use than for others. The helpfulness rating of the FLEXI arm supports (see Table 16) was in the same general range (mean= 2.28) and, like the ease of use ratings, had a large standard deviation. In an effort to determine if sex was a factor, separate mean ratings were calculated for men and women. There was some evidence of a sex effect in the data (raise/lower mean rating was 2.33 (s.d. 1.18) for men and 2.41 (s.d..45); swivel was 1.67 (s.d. 0.87) for men and 2.33 (s.d. 1.18) for women.

Toilet Paper Dispensers

In the modified bathroom, study participants were given the opportunity to try out two different toilet paper dispensers. One was a convention roll dispenser mounted on the wall to the left of the study participant when seated on the toilet and facing forward (requiring the right-handed person to reach across his/her body to extract paper from it). The second was a roll dispenser mounted on the right arm support. After tearing some paper off of each, participants were asked which they preferred and why. The toilet paper dispenser mounted on the arm support was preferred by 50%; those who preferred it stated that it was because it was easier to reach, closer. Those preferring the wall mounted dispenser described it as easier to see.

Swivel Mirror and Fold-down Shelf

Grooming tasks were rated more difficult to perform in the "typical" bathroom (mean rating = 2.67) than in the modified bathroom (mean rating = 1.50). Of the three changes made to the sink area in the modified bathroom, the light over the sink received the most positive elder helpfulness rating (mean = 1.14), followed by the swivel mirror (mean rating =1.36). Study participants were less enthusiastic about the fold-down shelf (mean rating =2.47), commenting that the spring made it difficult for them to keep the shelf level.

Appeal of the Ambiance/Décor and Perceived Elder Friendliness of Bathrooms

The "typical" bathroom was rated less positively than the modified bathroom both in terms of its ambiance/décor (Mean rating "Typical" = 3.17; Modified = 2.31) and its elder friendliness ("Typical" = 2.56; Modified = 1.50). When asked what they liked about the bathroom, among those who saw it before seeing the modified bathroom, only two features were mentioned - the toilet arm supports and the lever tap handles. As shown in Table 17, when seen after having been in the modified bathroom, the toilet arm supports were the only features commented positively about and by fewer individuals. In contrast, a number of features were viewed positively in the modified bathroom, including: the swivel mirror, track lighting over the toilet/enhanced over-sink lighting, and toilet arm supports, when seen first and these same items plus the toilet paper dispenser mounted on the arm supports and the pull-down shelf , when the modified bathroom was seen second. The lack of counter and shelf space in the typical bathroom was among the least liked features, particularly after having seen the modified bathroom.

Table 17: Best and Least Liked Features (Modified Bathroom Only)

	Liked Best	Liked Least
"Typical" Bathroom When Seen First (Gp 1)	Toilet arm supports (10) Lever taps (2)	Lack of counter/shelf (6) Colour scheme (2)
When Seen Second (Gp 2)	Toilet arm supports (6)	Lack of counter/shelf (12) Lighting (5) Fixed mirror (4) Light switch (3) Doorknob (2)
Modified Bathroom When Seen First (Gp 2)	Swivel mirror (11) Lights (12) Toilet arm supports (8) Placement of paper towel disp. (4) Height of toilet (2)	Pull-down shelf (2)
When Seen Second (GP 1)	Swivel mirror (13) Lights (11) Toilet arm supports (7) TP dispenser on arm support (5) Pull-down shelf (6) Lever door handle (2)	Toilet arm supports (4) Pull-down shelf (2)

Bathroom Postural Sway Data

Toilet Arm Supports

Table 18 shows mean pitch and roll angles when rising from the toilet using the wall mounted arm supports found in the "typical" bathroom and when using the floor mounted FLEXI supports. As can be seen pitch was noticeably greater using the floor mounted arm supports.

Table 18: Mean Pitch and Roll Angles When Rising From Toilet Using Arm Supports

18.1 Trunk Pitch Angles (degrees) When Using Arm Supports

	Wall Mounted		Floor Mounted	
	90% of Range	s.d.	90% of Range	s.d.
Group1	31.47	7.02	38.34	7.56
Group2	29.92	6.68	36.48	6.76

18. 2 Trunk Roll Angles (degrees) When Using Arm Supports

	Wall Mounted		Floor Mounted	
	90% of Range	s.d.	90% of Range	s.d.
Group1	4.46	1.82	4.95	1.64
Group2	5.74	2.96	5.34	2.47

Toilet Paper Dispensers (modified bathroom only)

Table 19 shows mean trunk pitch and roll angles when study participants reached for and tore off some toilet paper from the dispenser mounted on the wall and from the dispenser mounted on one of the toilet arm supports. While forward pitch was greater for Group 1 when using the toilet arm support mounted dispenser, trunk roll angles were lower in both groups when using that dispenser.

Table 19: Mean Pitch & Roll Angles When Using Toilet Paper Dispensers (Modified Bathroom Only)

19.1 Trunk Pitch Angles (degrees) When Using Toilet Paper Dispensers

	Wall Mounted		Toilet Arm Support Mounted	
	90% of Range	s.d.	90% of Range	s.d.
Group1	6.93	4.99	9.34	7.98
Group2	7.52	2.65	7.79	4.40

19. 2 Trunk Roll Angles (degrees) When Using Toilet Paper Dispensers

	Wall Mounted		Toilet Arm Support Mounted	
	90% of Range	s.d.	90% of Range	s.d.
Group1	9.12	3.88	8.13	5.34
Group2	11.33	5.32	9.02	5.79

Bathroom Size/Design

The unmodified bathroom was smaller than the modified bathroom, containing two rather than three toilet stalls. It also differed in having a room containing a bathtub outside its entrance door. Further, the test stall in the "typical" bathroom was the one beside the window and directly in line with the sink whereas the test stall in the modified bathroom was the middle of three. Following from these differences, study participants had to walk farther to enter the "typical" bathroom but the distance from the toilet to the sink was smaller. Having the SwayStar™ equipment in place when study participants walked from the toilet to the sink using a walker enabled us to obtain a rough estimate of the addition risk of falling when the greater distance and maneuvering was required. As shown in Table 19, both pitch and roll angles were considerably greater in the modified bathroom.

Table 20: Mean Pitch & Roll Angles When Walking to Sink

20.1 Trunk Pitch Angles (degrees), Walk to Sink

	Typical Bathroom (sink straight ahead of toilet)		Modified Bathroom (sink ahead and to the right of toilet)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	11.87	4.12	18.12	5.94
Group2	13.57	4.10	17.80	4.57

20. 2 Trunk Roll Angles (degrees), Walk to Sink

	Typical Bathroom (sink straight ahead of toilet)		Modified Bathroom (sink ahead and to the right of toilet)	
	90% of Range	s.d.	90% of Range	s.d.
Group1	4.94	5.11	17.04	9.45
Group2	4.99	2.28	15.21	7.63

Discussion and Recommendations

This novel study, in which persons aged 75 and older tested selected design modifications in a hospital setting clearly indicates that older adults can operate bed and light controls of the type provided and, that they preferred these over standard controls. The study also provides direction with respect to criteria to consider when purchasing new beds for acute care hospitals serving large numbers of older persons. These include beds that can go lower to the floor than those currently in use in FH hospitals, and that can be patient controlled while lying or sitting in the bed. Controls on both of the beds study participants were exposed to in this study were rated as very easy to use to lower the bed to get onto. Lowering the bed to get out, however, was found to be considerably easier in the case of the bed in the modified room (i.e. the Stryker "Rose" bed). Models should be chosen that allow the patient to easily control the height while outside the bed and also when seated or lying in it.

Other lessons from Study 3b are that when retrofitting hospitals or in constructing new ones, consideration should be given to locating light controls within easy reach of the patient and including a dimmer switch. Turning the light on or off was rated as much more difficult in the "typical" room than in the modified room. In the "typical" room, the patient had to reach behind the head of the bed to grasp a string attached to the on-off switch of a wall mounted light box. To do so, takes considerable dexterity. Falling out of bed in the process is a distinct risk. It was clear that the older persons who participated in Study 3b had no difficulty understanding how to use the remote control and dimmer switches that were provided.

In addition to the novelty of conducting this study in a hospital setting rather than a university or commercially-based laboratory, this study differed from most that test products with older persons in that it attempted to obtain objective as well as subjective data. Use of the SwayStar™ equipment for this purpose was something new, so far as we are aware.

The SwayStar ™ data obtained while participants walking three meters using a walker backed up the visual observations of the RA and EA in suggesting that attempts to prevent fall-related injuries by placing a soft cushioned material (such as provided by the Posey mat) on Terrazzo or other hand surface flooring may be problematic. Placement of a falls mat at the bedside is also problematic if it is positioned in front of the chair. Postural sway was seen to increase as study participants attempted to rise from the chair. It also increased when they needed to maneuver the walker over its beveled edge and when walking upon it.

The chairs in both rooms were rated as very easy/easy to get up from, with or without the falls mat beside the bed (range 1.14 – 1.58). Both were high back and had arm supports – two attributes recommended in the long term care design literature. Unfortunately the SwayStar™ data, which favoured the chair in the modified room was confounded because the floor in the room as well as the bedside chair differed from that in the "typical" room. In future studies, flooring should be held constant while different chairs are consumer-tested.

With respect to flooring, in both rooms, walking 3 meters using a walker was rated as very easy/easy. The SwayStar™ data as well as visual observation by the RA and EA suggest however, that the rubber flooring may not be as easy to maneuver a walker on as Terrazzo. Given that safety is of primary concern, and that safety is maximized by use of a walker, this disadvantage of rubber flooring may outweigh other potential advantages.

There is no question that the appeal of the ambiance/décor and the perceived user/elder friendliness of bedroom were greater in the modified room than in the typical room. Clearly, there are lessons to be learned from this study with respect to the aesthetics of patient bedroom design. While in the past consideration of making the bedroom less institutional in ambience and décor has been mainly directed to maternity and palliative care units, this study (and study 3a) suggest that similar consideration be given to medical and surgical patient bedrooms.

With respect to toilet areas, whether these be en-suite bathrooms incorporated into the design of single or double rooms (now more in vogue in hospital construction than four-bed rooms), or corridor-based as in the test bathrooms used in this study, we highly recommend automatic lights at the entry door and extra lighting over the toilet(s) and sink. A mirror that is easy to swivel, such as the model used in Study 3c is also recommended. At this time we would not recommend the model of adjustable toilet arm supports used in Study 3c. While on average this model received a rating in the "helpful" range, there was considerable variation across study participants. As reflected in the relatively large standard deviations, some participants experienced considerable difficulty in adjusting their height and in swiveling them. Further, while there was feedback from some participants that the toilet paper holder on the FLEXI arm support system was a good idea, some noted that it was "on the wrong side". These data suggest that placement on both of the arm supports that surround a toilet would be optimal rather than having it mounted on just one side. This also should be considered with respect to placement of bed and light controls operated by the patient. Placement on both sides of the bed or toilet would address the issue of handedness as well as such conditions such as hemiplegia following stroke or other disorders.

Recommendations for Future Research

Beckley (2003) argues that when patients are given control, their stress level is reduced. Unfortunately the heart rate data we collected while study participants rested in each room after having operated the bed and light controls did not yield the result we had anticipated which was a lower rate in the modified room. Rather, it appears that heart rate was lower in the second room they were exposed to regardless of whether it was the "typical" or the modified room. This could be an artifact of the study protocol – participants may have been "nervous" at the start of the study – not knowing exactly what they would be required to do despite the attempts of the RA and EA to explain the procedure and put them at ease. It is also quite possible that the method used in our attempt to gather data on stress was simply not sensitive enough. We had considered obtaining saliva samples so as to assess cortisol levels. However, it was felt that the procedure required to collect and preserve the samples was too demanding in terms of time and effort and in the context of the other duties required of the RA and EA (e.g. setting up and moving the video and postural sway equipment). Further, analysis of saliva samples was determined to be expensive and had not been budgeted for at the time the proposal was developed. As Martin (2000) notes, however, in Ulrich's Theory of Supportive Design, stress is the scientific starting point for understanding how design affects medical outcomes. Cortisol assessment, as a well known and reliable method of assessing stress, should therefore be considered in future research - as well as other methods of physiologically assessing stress. Subjective stress assessments should also be included. These could be as simple as asking study participants to rate, on a five point scale, how stressed they felt in modified as compared with "typical" hospital patient areas and/or while performing selected self-care tasks.

While we found the SwayStar™ equipment to be very promising and would strongly recommend its use in future studies, there were some difficulties with it – in particular, the battery that enabled remote monitoring necessitated more frequent re-charging than we had anticipated. Most disappointing however, was the EKG equipment. It was chosen because it was lightweight and could be easily and unobtrusively worn by the study participants as they performed the various parts of the protocol. Early on in Study 3b it became apparent that in the context of Burnaby Hospital, its ability to remotely communicate signals to a stationary computer was limited. In future studies, greater attention should be devoted to pre-testing participant remote monitoring equipment in the actual study venue. Doing so in the context of the university laboratory obviously was insufficient.

It remains to be said that while this pilot study has yielded promising findings with respect to ways the physical environment of hospitals might be modified so as to foster greater independence in self-care among elderly medical and surgical patients, and to give them more control over their proximate environment while in hospital, it was still only a pilot study. Ideally, the recommendations will be incorporated in future new construction or retrofitting and their impact evaluated with "real" patients.

A larger sample would be desirable so that the performance and preferences of older persons with differing medical and surgical conditions could be compared. We chose CHF and hip fracture for study participants to role play because these are the most common conditions for which older persons are admitted to medical and surgical units in FH hospitals. They most certainly are not the only conditions for which hospitals serve older person.

It must also be recognized that multiple chronic conditions are the rule rather than the exception among older patients, potentially compounding the impact of the acute condition that necessitated hospital admission. The participants in this pilot study had fewer chronic conditions than is typical of British Columbians of their chronological age bracket.

The Environmental Docility Hypothesis (Lawton & Simon, 1968) and the Stress-Competency Model (Lawton and Nahemow, 1973) would predict that those whose competency is most impaired would be most impacted by an elder unfriendly hospital environment. Cognitive impairment springs immediately to mind when the term competency is used. In this study we deliberately deemed individuals with a diagnosis of Alzheimer's disease or other dementias as ineligible for participation and screened out those few volunteers with scores on the Hopkins Verbal Learning Test suggestive of possible cognitive impairment. Ways of meeting the needs of cognitively impaired individuals admitted to acute care settings are, however, increasingly being recognized as a topic that requires investigation (for example, it was one of the priority areas identified in a recent call for proposals put forth by the Alzheimer's Society of BC). Given the central role that stress plays in the Theory of Supportive Design and the hypothesized (Hall & Buckwalter, 1987) lowered stress threshold of persons with dementia, gives such research added urgency.

Persons with vision and hearing impairments and with movement disorders were other groups that were excluded as participants in this study and who may be at extra risk of deconditioning or accidents while in hospital. Additionally, the ethnic mix of British Columbia must be recognized. In future studies it will be important to include in the sample individuals from the various groups that are prominently part of the cultural mosaic of the province.

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Appendix 1: Participant Recruitment Materials

AN INVITATION TO PARTICIPATE IN AN ELDER FRIENDLY HOSPITALS STUDY

A literature review commissioned by Fraser Health (FH) found that there is little research examining how the physical environment of hospitals impacts accidents, loss of function and deconditioning during hospital stays of older adult patients. Considering the substantial number of older adults that currently are hospital patients and their growing numbers as the population ages, it is important to further develop this area of research. A study is being conducted at Burnaby Hospital by Simon Fraser University's Gerontology Research Centre to improve the elder friendliness of FH Hospitals.

To complete the study additional volunteers are needed.

If you choose to participate, you will go to Burnaby Hospital where you will be taken into two differently designed patient rooms. In each, you will play the role of a patient who has just spent several days in hospital recovering from a hip fracture or as a result of congestive heart failure. In your role as patient, you will test hospital bed controls and light switches and a bathroom. We will ask your opinion about how these room's layout or interior design could be improved to make them more elder friendly. During the study we will monitor your vital signs and movements using non-intrusive wireless technology and video recording.

Participation will take approximately 2 hours (1.5 hours at Burnaby Hospital and 0.5 hours for a preliminary phone call). Participants will receive refreshments at the hospital, a transportation allowance of up to $10 **and a $50 honourarium** as a 'thank-you'.

At approximately 6 and 12 months from your participation we will call you to find out if you have been in the hospital since we saw you and if so, to ask you some questions about your experience there and get an update concerning your health and functional status. These two phone calls will only take about 15 minutes each and will give us some follow-up information that could be very useful in evaluating our research methods

We need volunteers who meet the following criteria:

1) age 75 or over

2) living in their own house or apartment

3) fluent in English

4) able to hear normal talk with minimum difficulty (with a hearing aid if used)

5) able to read letters the size of newspaper print (with glasses if used)

6) have not had a hip fracture or been told by your doctor that you have Congestive Heart Failure (CHF), a movement disorder (e.g. Parkinsons), or cognitive impairment (e.g. Alzheimer's or other dementia).

7) have not been the caregiver for a person recovering from a hip fracture or suffering from CHF.

8) were not primarily employed as a health care professional.

To participate or if you have questions, please telephone

Teena at 604-412-6168 or email her at tmlove@sfu.ca.

BE SURE TO LEAVE Your name & telephone number(s)

The project's Principal Investigator is Dr. Gloria Gutman from the Gerontology Research Centre at Simon Fraser University. Co-investigators are Kathleen Friesen – a member of the Fraser Health Geriatric Clinical Services Planning and Delivery Team and Teena Love a graduate student at SFU. Teena will be the person who contacts you to schedule your visit to the Burnaby Hospital study rooms. Before doing so, however, she will also ask you some questions about your socio-demographic characteristics (e.g. age, sex, marital status, housing and living arrangements), about your functional status and health. This information is needed for two reasons: first, to determine eligibility for the study and secondly, so that we can clearly describe study participants in our reports.

Thank-you, we look forward to hearing from you.

Gloria M. Gutman, PhD

Teena Love, BA, MA (gero) Candidate

Kathleen Friesen, BSN, MA

ELDER FRIENDLY HOSPITALS RESEARCH

Simon Fraser University is conducting a study for the Fraser Health Geriatric Clinical Services Planning and Delivery Team. We are recruiting older adults to spend approximately 2 hours in 2 differently designed patient rooms at Burnaby Hospital. You will be asked to complete some typical patient activities such as getting on and off a hospital bed, and walking from the bedroom to the bathroom. Afterwards, you will be asked about your experience and the rooms. During the research your heart rate will be monitored and you will be video-taped.

ELIGIBILITY CRITERIA:

- Aged 75 or older
- Living independently or semi-independently in your own house or apartment
- Fluent in English
- Able to see and hear with minimum difficulty
- Were not primarily employed as a health care professional during your working years

$50 FOR PARTICIPATION

TO VOLUNTEER CALL:
TEENA LOVE 604-412-6168

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Appendix 2: Screening Interview/ Participant Profile

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Participant Profile: Older Adult I.D.#_____________

Introduction: In order to be able to describe who took part in this study I need to ask you some questions about yourself and your health and functional status. Please note that the information that you give will be kept strictly confidential and will be reported in the aggregate only (e.g. the study participants ranged in age from 75-__; ___% were female.

Part A: Personal Characteristics

1. Your age at last birthday__________
2. Gender _____M _____F
3. Marital Status _____Never Married

   _____Married

   _____Divorced

   _____Separated

   _____Widowed

4. Are you fluent in English? ____Yes ____No
5. Which of the following describes your current housing?

   _____Private home/apt. with no home care services

   _____Private home/apt. with home care services

   _____In home of family member

   _____Unit in a Senior's housing project. If so name of project_____________________

   _____Board and care/assisted living/group home. If so, name of home_______________

   _____Other, please specify____

6. Which of the following describes your current living arrangement?

____Live alone

____Live with spouse only

____Live with spouse and others

____Live with child (not spouse)

____Live with others (not spouse or child)

____Live in group setting with non-relative(s)

7. What was your highest level of education? (select one)?

____No schooling

____8th grade or less

____9-11 grades

____High school graduation

____Technical or trade school

____Some college/university

____Bachelor's degree

____Graduate degree

8. What was your main occupation for most of your adult life ?

Primary_________________________________

Secondary ____

Part B: Support Provided and Received

9. Have you ever been a caregiver for a person with Congestive Heart Failure (CHF)?

   ___Yes   ___No

10. Have you ever been a caregiver for a person recovering from a hip fracture?

    ___Yes   ___No

11. Over the last week, please tell us the average amount of help you have received from others (rounded to the nearest 30 minutes).

    - Help from family, friends and neighbours on <u>weekdays</u>

      ______Hours   _____Minutes

    - Help from family, friends and neighbours on <u>weekends</u>

      ______Hours   _____Minutes

    - Help from others (e.g. homemakers, home health aids, volunteers) on <u>weekdays</u> ______Hours _____Minutes
    - Help from others (e.g. homemakers, home health aids, volunteers) on <u>weekends</u> ______Hours _____Minutes

Part C: Physical Function

12. Which of the following best describes your current level of hearing (with hearing aid if used)?

    ____Hear adequately (e.g. talk, phone, TV, doorbell all at normal volume)

    ____Minimal difficulty (e.g. background noise interrupts)

    ____Need some help (e.g. speakers need to adjust tone and speak distinctly)

    ____Highly impaired (e.g. absence of useful hearing without aid)

13. With glasses, if used, do you have difficulty seeing letters the size of newspaper print or doing close work? ____Yes ____No.
14. Do you have difficulty getting around safely due to visual difficulties? ____Yes ____No
15. Please describe your performance of each of the following activities during the last week:
    a. Meal Preparation (e.g. planning, cooking assembling ingredients, setting our food and utensils)

       ____Did without help

       ____Needed some help or help sometimes

       ____Needed help all the time

       ____Done by others

       ____Activity did not occur

    b. Ordinary house work (e.g. dishes, dusting, making bed, tidying up, laundry)

       ____Did without help

       ____Needed some help or help sometimes

       ____Needed help all the time

       ____Done by others

       ____Activity did not occur

    c. Managing finances (e.g. how bills are paid, cheque book balanced, household expenses balanced)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

____Done by others

____Activity did not occur

d. Managing medications (e.g. remembering to take medication, opening bottles, taking the right dosage, giving injections, applying ointment)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

____Done by others

____Activity did not occur

e. Phone use (how calls are made e.g. using assistive devices such as larger numbers or telephone amplification)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

____Done by others

____Activity did not occur

f. Shopping (for food or household items, how are items selected, managing money)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

____Done by others

____Activity did not occur

g. Transportation (getting to places beyond your walking distance)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

____Done by others

____Activity did not occur

16. If you answered 'Activity did not occur' for any of the above activities, please estimate how difficult you feel the activity would have been for you.
    a. Ordinary house work

       ____Not difficult

       ____Some difficulty (e.g. need some help, are very slow or you become fatigued)

       ____Great difficulty (e.g. little or no involvement with the activity is possible)

    b. Managing finances

       ____ Not difficult

       ____Some difficulty (e.g. need some help, are very slow or you become fatigued)

       ____Great difficulty (e.g. little or no involvement with the activity is possible)

    c. Managing medications

       ____ Not difficult

       ____Some difficulty (e.g. need some help, are very slow or you become fatigued)

       ____Great difficulty (e.g. little or no involvement with the activity is possible)

    d. Phone use

       ____ Not difficult

       ____Some difficulty (e.g. need some help, are very slow or you become fatigued)

       ____Great difficulty (e.g. little or no involvement with the activity is possible)

    e. Shopping

       ____ Not difficult

       ____Some difficulty (e.g. need some help, are very slow or you become fatigued)

       ____Great difficulty (e.g. little or no involvement with the activity is possible)

f. Transportation

____ Not difficult

____Some difficulty (e.g. need some help, are very slow or you become fatigued)

____Great difficulty (e.g. little or no involvement with the activity is possible)

17. Do you regularly use a cane, walker or crutch? _____No____Yes (Specify) ________
18. Is a wheelchair your primary method of locomotion? ____Yes ____No
19. Over the last week, which of the following best describes your ability to go up and down stairs?

____Up and down stairs without help

____Up and down stairs with help

____Did not use stairs but could have without help

____Did not use stairs but would have needed help

____Did not go up or down stairs and could not have

20. During the last month, how many days a week on average did you leave the house or building in which you live?

____Every day

____4 to 6 days

____2 to 3 days

____1 day a week

____No days

21. In the last week, how many hours per day (on average) were you physically active (e.g. walking, cleaning house, exercising)?

____2 or more hours ____Less than 2 hours

22. In the last week, did you require help with the following activities of daily living?

a. Transfer (e.g. moving to/from bed, chair or wheelchair, moving to sit or stand)

____Did without help

____Needed some help or help sometimes

____Needed help all the time

b. Getting around the house (including while using a cane, walker, crutches or wheelchair)
   ____Did without help

   ____Needed some help or help sometimes

   ____Needed help all the time

c. Toilet use (including transfer on/off toilet or commode chair, self-cleaning, changing pad, adjusting clothes)
   ____Did without help

   ____Needed some help or help sometimes

   ____Needed help all the time

Part D: – Hopkins Verbal Learning Test

Instructions: Now we are going to do something different. I am going to read you a list of words and ask you to repeat them back to me. You can go as fast or slow as you like. You've heard people make jokes about old dogs not learning new tricks? We need to measure how well you can remember some common English words?

Part E: Health Status

Instructions: The final questions I am going to ask concern your health.

23. Overall, do you feel that your health is poor? ____Yes ____No
24. In the past 6 months how many times have you fallen? _________
25. Do you limit your activities because of a fear of falling? ____Yes ____No

26. Have you been diagnosed, or hospitalized in the last 6 months, with any of the following conditions?

	Diagnosed	Hospitalized
Condition	(Check below if 'Yes')	
Heart/Circulation		
Congestive Heart Failure		
Coronary Artery Disease		
Hypertension		
Peripheral Vascular Disease		
Neurological		
Alzheimer's Disease or other dementia		
Parkinsonism		
Stroke		
Musculo-Skeletal		
Arthritis/Rheumatism		
Hip Fracture		
Other Bone Fracture		
Osteoporosis		
Senses		
Cataract		

	Diagnosed	Hospitalized
Condition	(Check below if 'Yes')	
Glaucoma		
Psychiatric/Mood		
Any Psychiatric diagnosis		
Infections		
HIV Infection		
Pneumonia		
Tuberculosis		
Urinary Tract Infection (in last 30 days)		
Other Diseases		
Cancer, in the past 5 years (not including skin cancer)		
Diabetes		
Emphysema, Chronic Obstructive Pulmonary Disease, Asthma		
Gastritis		
Renal Failure		
Thyroid Disease		
None of the above		
Other current diagnoses, please specify____________________		

27. How many prescription medications are you currently taking? _____

Please list all:

____

____

____

____

____

____

____

____

Appendix 3: Preparation Checklist and Protocol

Study 3b&c **Preparation Checklist & Protocol** Participant #_______

Engineer: -Turn computers on

-Synchronize computer clocks (6) to wristwatch

-Place BKG sensor, pulse oximeter finger clip, electrodes (4)

and SwayStar™ belt on the greeting table

1. Participant greeted by main entrance to hospital

2. Participant brought to research area:

- ____Procedures reviewed
- ____Study instruments shown (electrodes, BKG, Pulse oximeter, SS Belt, socks, walker)
- ____Informed consent read and signed by participant
- ____Caffeine? What__________ When last __________
- ____Participant changes into socks
- ____Participant is outfitted with ECG electrodes
- ____Participant measurements taken: _______Ht _______Wt ____Hip ____Waist ______BMI ______Fat%
- ____Walker is adjusted to appropriate height for participant
- ____Proper use of walker is demonstrated

Engineer: -Make SwayStar™ wireless Bluetooth connection (PIN: 1018)

-Start SwayStar™ software and input new participant parameters

-Connect BKG sensor and pulse oximeter finger clip

3. Participant brought to first bedroom

{As the protocol simulates a night time experience, prior to participant arrival the rooms were prepared by blacking out the windows, closing the window coverings and turning on only the light above the test area bed. In the modified room, the ceiling "night lights" are also turned on. All cubicle curtains except for the test cubicle are closed. The only extraneous light comes from one computer monitor located between the cubicles across from the participant and from the hallway.}

1st Bedroom [*Modified*]

- The participant is brought in to the room by the research assistant and directed to sit on the chair beside the bed. The research assistant brings in the walker to have it ready.

Engineer: -Follow the research assistant turning on: webcam above cubicle, camcorder and soundscape

-Leave room, closing the door

- The research assistant stands beside the bed, in front of the participant and demonstrates the proper use of the bed controls (up/down, tilting feet/head). The second control pendant, on the other side of the bed is pointed out.
- The research assistant then moves to the far side of the bed and demonstrates the lighting controls: on/off, dimmer switch, the second pendant is also shown again.

[After controls (bed, lights) are demonstrated, the participant is given the opportunity to ask and have answered any questions regarding the controls. Post demonstration the bed is left flat and level with the top of the bedside table, the light is left fully on. The research assistant next moves to the foot of the bed to begin reciting the following, pre-scripted instructions:]

SCRIPT

- "Please, lower the bed to a comfortable height and then get on and lay down flat".
- [When the participant is lying flat] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of using the control to lower the bed." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

{Research assistant holds up an 8.5 x 11 inch sheet of cardboard showing a line anchored by 1(very easy) to 5(very difficult) to visually cue the rating scale.}

- "Without getting out of bed, please turn off the light and lay back down as if you were planning on going to sleep"

- [When the light has been turned out and the participant is lying flat] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of turning out the light" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- "Again, without getting out of bed, turn the light back on."
- [When the light has been turned on] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of turning on the light back on" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

{While seemingly redundant, the rating will possibly change, as they are now required to operate the control in the dark. The research assistant has a flashlight to use if it is too dark for the participant to find the switch safely.}

- "Next, please adjust the bed to a comfortable seated position".
- [When seated] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of adjusting the bed to a seated position." _____ [fill-in answer] If rating a '4' or '5', what could make it easier?

- "Please use the dimmer switch to dim and then bring the light to a personally comfortable level."
- [When complete] "Please rate the ease or difficulty on a scale of 1(very easy) to 5 (very difficult), of using the dimmer." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

Engineer: **-**Wait outside the room with BKG cart, ready to wheel in

[Next, the participant is told: "I will need to leave the room for a few minutes. Before I leave, the engineer -- referred to by name -- is going to come in and attach the pulse oximeter that I showed you earlier, to your finger. It will record your resting heart rate while we're out of the room preparing for the next activity." When the oximeter is attached and confirmed to be recording, the research assistant draws the curtain around the bed and the engineer and research assistant exit.]

Engineer: -Clip pulse oximeter finger clip onto participant finger

-Start LabView recording for 300 sec.

-Follow research assistant out

[After 5 minutes, the research assistant and engineer return to the room. The research assistant opens the curtain, levels and raises the bed to the height of the bedside table, and the engineer proceeds with the ECG/BKG protocol.]

Engineer: -Attach ECG electrode clips and BKG sensor (at the sternum)

-Proceed with BKG protocol (one 60 sec recording)

-Move the BKG sensor (to the PMI -over heart) proceed with second BKG recording (60 sec)

-When the readings are complete, the ECG and BKG are removed.

-Wheel cart outside of room

-Ready cart and sensors for second room

-Ready SwayStar™

[The participant is directed to once again adjust the bed to a comfortable, seated position. The participant is then asked a series of qualitative questions about the room.]

Questions:

1. What three words would you use to describe the room?
2. What, if anything, do you like about this room?
3. What, if anything, do you not like about this room?
4. "On a scale of 1(very good) to 5(very poor) [again, showing a visual scale to cue] please rate the overall:"
   a. appeal of ambiance/décor _____ [fill-in answer]
   b. the user friendliness, especially for the older patient _____ [fill-in answer]
      If rating a '4' or '5', what could make it more user friendly?

- "Next I'll ask you to please lower the bed, as you would to get up and then stand up."
- [When standing] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of adjusting the bed." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

Engineer: -Help fit the Sway Star (tethered) around the participant's waist

-Leave room and test operation

-Enter the doorway with the SwayStar™ computer

-Start SwayStar™ sequence for the room, a recording of each of the following eight tasks is made

[Research assistant turns on far-side webcam and lights in cubicles across from test]

[The participant is asked to be seated on the chair, being careful of the pack behind them, not to hurt their back]

- [When seated] "During these next activities we will be recording your balance. For the first activity I want you to simply stand up from the chair. "*Engineer*" will tell you when to stand. Any questions? [Research assistant cues engineer when the participant is ready and again when they are upright.]

Engineer: **"**Please, stand up"- Record with SwayStar™

- "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the chair." _____ [fill-in answer]
    a. If rating a '4' or '5', what could make it easier?

- Next, I'll ask you to remain standing naturally, with your feet slightly separated. When "*Engineer*" says 'start', for 20 seconds I'd like you to stand still, no talking or fidgeting, looking straight ahead with your eyes open. At the end of 20 seconds "*Engineer*" will tell you the time is up and you can move again." Any questions? [answer if applicable] Okay then," [research assistant cues engineer that participant is ready]

Engineer: "Please, stand still, facing forwards, starting - now" Record with SwayStar™: "thank-you, you can relax again"

- Research assistant "We will repeat that same procedure, standing still and facing forward, but this time we will ask you to close your eyes for the 20 seconds. Okay?

Engineer: "Please, stand still, with your eyes closed, starting - now" Record with SwayStar™: "thank-you, you can relax again"

- Research assistant "The last task is to have you, using the walker I showed you earlier, walk from the chair behind you, to the line marked on the floor."

[The research assistant brings over the walker and attaches an IV tube and bag (on the pole attached to the walker) to the participant's hand (with hypoallergenic tape). The IV is always attached to their left hand for consistency and to create the most difficulty in using left-side oriented items (light switch, fold-down shelf) in the washrooms. The research assistant makes sure the participant sees the "stop" line (3M from the chair) and then moves aside to give the webcam a clear view of the participant.] "*Engineer* will tell you when to start and I will tell you when to stop. Ready? If 'yes'"

Engineer: "Please, begin walking - now" Record with SwayStar™

[Research assistant cues engineer to stop recording when participant reaches the line.]

- [When stopped] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of walking over here." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

[The IV is removed, the walker is moved aside]

- "Now I'll ask you to please return to the chair. You're going to repeat those 4 activities but this time there will be a cushioned mat underneath you." Any questions? [Research assistant cues engineer when the mat is in place and the participant is ready, and again when they are upright.]

Engineer: "Please, stand up" Record with SwayStar™

- “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the chair onto the mat.” _____ [fill-in answer]
  If rating a ‘4’ or ‘5’, what could make it easier?

- Next, you’ll remain standing naturally, with your feet slightly separated and on the mat. When “*Engineer*” says ‘start’, I’d like you to stand still for 20 seconds, looking straight ahead, with your eyes open. At the end of 20 seconds “*Engineer*” will tell you the time is up and you can move again.” Any questions? [answer if applicable] Okay then,” [research assistant cues engineer that participant is ready]

Engineer: “Please, stand still, facing forwards, starting - now”: “thank-you, you can relax again” Record with SwayStar™

- Research assistant “And, just like last time, we will repeat that same procedure, standing facing forward, this time eyes closed for the 20 seconds. Okay?

Engineer: “Please, stand still, with your eyes closed, starting - now”: “thank-you, you can relax again” Record with SwayStar™

- Research assistant “And lastly, like before I’m going to have you, use the walker to walk from where you are standing, to the line marked on the floor.” [The research assistant brings over the walker and re-attaches the IV tube to the participant’s left hand. The research assistant reminds the participant of where the line is and then moves aside.] “*Engineer* will tell you when to start and I will tell you when to stop” Ready? Okay.

Engineer: “Please, begin walking - now” Record with SwayStar™

[Research assistant cues engineer when participant reaches the line.]

- [When stopped] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of walking over here with the mat in place.” _____ [fill-in answer]
  If rating a ‘4’ or ‘5’, what could make it easier?

[The IV and SwayStar™ are removed, the walker is left.]

{The participant is given a short break while camcorder, mat and walker w/IV are moved to the next bedroom. The engineer moves the SwayStar™ and cart with ECG/BKG equipment to outside the second room.}

2nd Bedroom [*Typical*]

- The participant is brought into the room by the research assistant and is again directed to sit on the chair beside the bed

Engineer: -Follow the research assistant turning on: cubicle webcam, camcorder and soundscape

-Leave room, closing down the door

- The research assistant stands beside the bed, in front of the participant and demonstrates the proper use of the bed controls (up/down, tilting feet/head). The participant is made aware of the controls on both the inside and outside of the rails.
- The research assistant then moves to the far side of the bed and demonstrates the lighting controls: on/off.

[After the controls (bed, lights) are demonstrated, the participant is given the opportunity to ask and have answered any questions regarding the controls. Post demonstration the bed is left flat and level with the top of the bedside table, the light is left fully on.[The research assistant moves to the foot of the bed to begin reciting the following, pre-scripted instructions:]

SCRIPT

- “Please, lower the bed to a comfortable height and then get on and lay down flat”.
- [When the participant is lying flat] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of using the control to lower the bed.” _____ [fill-in answer]

  If rating a ‘4’ or ‘5’, what could make it easier?

[Research assistant has a portable flipchart showing a scale of 1(very easy) to 5(very difficult) to visually cue the rating scale.]

- “Without getting out of bed, please turn off the light and lay back down as if you were planning on going to sleep”
- [When the light has been turned out and the participant is lying flat] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of turning out the light” _____ [fill-in answer]

  If rating a ‘4’ or ‘5’, what could make it easier?

- “Again, without getting out of bed, turn the light back on.”

[Research assistant has flashlight if needed]

- [When the light has been turned on] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of turning on the light back on” _____ [fill-in answer]

  If rating a ‘4’ or ‘5’, what could make it easier?

- “Next, please adjust the bed to a comfortable sitting position”.
- [When seated] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of adjusting the bed to a seated position.” _____ [fill-in answer]

  If rating a ‘4’ or ‘5’, what could make it easier?

Engineer: -Wait outside the room with BKG cart, ready to wheel in

{Next, the participant is told: “I will need to leave the room for a few minutes. Before I leave, the engineer -- referred to by name -- is going to come in and put the finger clip back on you to record your resting heart rate while we’re out.” When the oximeter is attached and confirmed to be recording, the research assistant draws the curtain around the bed and the engineer and research assistant exit.}

Engineer: -Clip pulse oximeter finger clip onto participant finger

-Start LabView recording for 300 sec.

-Follow research assistant out

[After 5 minutes, the research assistant and engineer return to the room. The research assistant opens the curtain, levels and raises the bed to the height of the bedside table, and the engineer proceeds with the ECG/BKG protocol. While the readings are being recorded the research assistant brings in the walker to have it ready.]

Engineer: -Attach ECG electrode clips and BKG sensor (at the sternum)

-Proceed with BKG protocol (one 60 sec recording)

-Move the BKG sensor (to the PMI - over heart) proceed with second BKG recording (60 sec)

-When the readings are complete, the ECG and BKG and electrodes are removed.

-Wheel cart outside of room

-Ready SwayStar™

{The participant is directed to once again adjust the bed to a comfortable, seated position. The participant is then asked a series of qualitative questions about the room.}

Questions:

5. What three words would you use to describe the room?
6. What, if anything, do you like about this room?
7. What, if anything, do you not like about this room?
8. “On a scale of 1(very good) to 5(very poor) [again, showing a visual scale to cue] please rate the overall:”
    a. appeal of ambiance/décor _____ [fill-in answer]
    b. the user friendliness, especially for the older patient _____ [fill-in answer]
       If rating a ‘4’ or ‘5’, what could make it more user friendly?

- “Next I’ll ask you to please lower the bed, as you would to get up and then stand up.”

- [When standing] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of adjusting the bed." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

Engineer: -Help fit the Sway Star (tethered) around the participant's waist

-Leave room and test operation

-Enter the doorway with the SwayStar™ computer

-Start SwayStar™ sequence for the room

[Research assistant turns on far-side webcam]

[The participant is asked to be seated on the chair, being careful of the pack behind them, so they don't hurt their back]

- [When seated] "During these next activities we will be recording your balance. For the first activity, just like in the first room, I want you to simply stand up from the chair. "*Engineer*" will tell you when to stand. Any questions? [Research assistant cues engineer when the participant is ready and again when they are upright.]

Engineer: "Please, stand up" Record with SwayStar™

- "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the chair." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- Next, I'll ask you to remain standing naturally, with your feet slightly separated. When "*Engineer*" says 'start', I'd like you to stand still for 20 seconds, looking straight ahead, with your eyes open. At the end of

20 seconds "*Engineer*" will tell you the time is up and you can move again." Any questions? [answer if applicable] Okay then," [research assistant cues engineer that participant is ready]

Engineer: "Please, stand still, facing forwards, starting - now": "thank-you, you can relax again" Record with SwayStar™

- Research assistant "We will repeat that same procedure, standing facing forward, but this time we will ask you to close your eyes for the 20 seconds. Okay?

Engineer: "Please, stand still, with your eyes closed, starting - now": "thank-you, you can relax again" Record with SwayStar™

- Research assistant "The last task is to have you, using the walker again, walk from where the chair, to the line marked on the floor."

[The research assistant brings over the walker and re-attaches the IV tube to the participant's left hand as before. The research assistant shows the participant where the line is and then moves aside. "*Engineer* will tell you when to start and I will tell you when to stop" Ready? If 'yes']

Engineer: "Please, begin walking - now" Record with SwayStar™

[Research assistant cues engineer to stop recording when participant reaches the line.]

- [When stopped] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of walking over here." _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

[The IV is removed, the walker is moved aside]

- "Now I'll ask you to please return to the chair. You're going to repeat those 4 activities but this time there will be a cushioned mat underneath you." Any questions? [Research assistant cues engineer when the mat is in place and the participant is ready, and again when they are upright.]

Engineer: “Please, stand up” Record with SwayStar™

- “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the chair onto the mat.” _____ [fill-in answer]
    a. If rating a ‘4’ or ‘5’, what could make it easier?

- Next, you’ll remain standing naturally, with your feet slightly separated and on the mat. When “*Engineer*” says ‘start’, I’d like you to stand still for 20 seconds, looking straight ahead, with your eyes open. At the end of 20 seconds “*Engineer*” will tell you the time is up and you can move again.” Any questions? [answer if applicable] Okay then,” [research assistant cues engineer that participant is ready]

Engineer: “Please, stand still, facing forwards, starting - now” Record with SwayStar™: “thank-you, you can relax again”

- Research assistant “We will repeat that same procedure, standing facing forward, this time eyes closed for the 20 seconds. Okay?

Engineer: “Please, stand still, with your eyes closed, starting - now” Record with SwayStar™: “thank-you, you can relax again”

- Research assistant “And lastly, like before I’m going to have you, use the walker to walk from where you are standing, to the line marked on the floor.” [The research assistant brings over the walker and re-attaches the IV tube to the participant’s left hand. The research assistant reminds the participant of where the line is and then moves aside.] “*Engineer* will tell you when to start and I will tell you when to stop” Ready? Okay.

Engineer: “Please, begin walking - now” Record with SwayStar™

[Research assistant cues engineer when participant reaches the line.]

- [When stopped] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of walking over here with the mat in place.” _____ [fill-in answer]
    If rating a ‘4’ or ‘5’, what could make it easier?

[The "IV tube" is removed; the SwayStar™ is left on to be used in the bathroom protocol.]

5. Participant Break

[During the break the camcorder, walker w/IV and SwayStar™ are moved to prepare for the bathroom sequence. The disc in the camcorder is flipped to the second side.]

6. Bathroom Protocol

<u>**First Bathroom**</u> [*<u>Modified</u>*]

[Prior to testing, the bathroom windows have been blacked-out, the hallway lights have been dimmed, the bathroom lights turned off and the door closed to simulate a nighttime setting. The participant chair is set on the wall across from the door to the bathroom they are to enter. Both chairs are measured to be of equal distance from the bathroom door.]

- The participant is seated on a chair in the hallway outside the bathroom. They are told that they will be asked to go into the bathroom and pretend to perform some routine tasks, they are shown the door which to enter.
- They are also told that they will use the walker and again be tethered to the IV pole, as this is common for patients. [When the participant is ready they are "re-attached" to the IV tube]
- Participants are told that they will be asked to pretend to perform several tasks. They are told to do each as naturally as possible and are told that we will be recording some balance data and asking questions about the room and their experience in it.

Engineer: -Start camcorder recording in hallway

-Start the bathroom webcam recording

SCRIPT

- [When the participant is ready] "When *Engineer* says, please get up from the chair, go into the bathroom and sit down on the toilet in the open stall as you would to go to the bathroom. The toilet has been cleaned so your clothes will not be soiled. Do not close the door behind you, as I will be following you in."

Engineer: -"Please get up and walk - now" Record with SwayStar™

-Follow participant with camcorder (swivel & zoom)

[Research assistant cues when participant is seated, engineer is watching on webcam]

- Research assistant asks if footprints were used ____ Y/N
- Research assistant notes if hand rails were used and if so which hand(s) ___Y/N ___R/L
- [If hand rails used] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of positioning the handrails" _____ [fill-in answer]

  If not used, they are asked to explain why didn't not, if rating 4 or 5, what could make them better?

- The participant is shown how to operate (adjust height/swing) the grab bars that are positioned either side of the toilet after which the participant is asked to change the height of the grab bar to a comfortable level
- The research assistant then asks them to rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of adjusting the grab bar height. ___ [fill-in answer]

  If rating a '4' or '5', what could make it easier?

- The participant is asked to swing the grab bar away from them and then back again
- The research assistant then asks them to rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of swiveling the grab bar. _____ [fill-in answer]

  If rating a '4' or '5', what could make it easier?

- "Like in the bedroom, I will ask you to do some things while I record your balance. When I say 'go' I'd like you to reach and tear off some toilet paper from the dispenser on the wall."

Engineer: -Cue research assistant, who signals 'Go' Record with SwayStar™

- [When done] When I say ‘go’ I’d like you to reach and tear off some toilet paper from the dispenser on the grab bar.”

Engineer: -Cue research assistant, who signals ‘Go’ Record with SwayStar™

- Which toilet paper dispenser did you prefer? ___Wall __Grab bar
  Why?

- “Next, when I say ‘go’ please get up from the toilet using the grab bars for support”

Engineer: -Cue research assistant, who signals ‘Go’ Record with SwayStar™

- [When standing] “Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the toilet using the grab bars _____ [fill-in answer]
  If rating a ‘4’ or ‘5’, what could make it easier?

- “Next, when I say ‘go’, using the walker, please walk over to the sink and stop facing the mirror.

Engineer: -Cue the research assistant, who signals ‘Go’ Record with SwayStar™

-Turn off webcam when participant is out of view

- When I tell you to ‘start’, I’d like you to pretend to complete some routine tasks. In the bag in the walker you will find a toothbrush and toothpaste, mouthwash, a cup, as well there is a can of shaving cream and a razor (men) [or] a bottle of hairspray and a comb (women). Please pull these items out and pretend to use them as you would normally to brush you teeth and shave/fix your hair. Do you have any questions? “You can adjust the mirror if needed and place your things on the shelf there [pointing] if you like" [note, was used ____ Y/N]

Engineer: -Cue research assistant, who signals 'Go' Record with SwayStar™

- Research assistant make note of any poor hygiene activity witnessed (e.g. toothbrush on sink)
- [When at the sink] "Please rate the ease and convenience, on a scale of 1(very easy) to 5(very difficult), of pretending to do these tasks" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- [If the shelf was used] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of using the folding shelf" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier? [If they did not use the shelf they are asked why]

    - [If it wasn't used, the research assistant demonstrates the shelf] "Now, I'll ask you to please place the toiletries on the shelf"
        - [When finished] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of using the folding shelf" _____ [fill-in answer]
          If rating a '4' or '5', what could make it easier?

- "Before we leave this bathroom I would like to ask you some questions about the room"
    1. What, if anything, did you like about the room
    2. What, if anything, did you not like about the room
    3. "On a scale of 1(very good) to 5(very poor) [again, showing a visual scale to cue] please rate the overall:"
        i. appeal of ambiance/décor _____ [fill-in answer]
        ii. the user friendliness, especially for the older patient _____ [fill-in answer]
          If rating a '4' or '5', what could make it more user friendly?

- "Lastly, I'm going to ask you to rate the specific modifications that were made in this room. Please tell me, on a scale of 1(very helpful) to 5(not helpful) how helpful you feel the modification would be for elderly adult patients.

  ____Automatic lights ____ Adjustable grab bars

  ____Extra lighting over the toilet ____ Light over sink

  ____Footprints in front of toilet ____ Swivel mirror

  ____Toilet paper on grab bar ____ Fold down shelf

- Toiletries are replaced in bag, placed on walker and the participant is brought to 2nd hallway chair to begin the protocol in the second bathroom

[Engineer and research assistant move camcorder and SwayStar™ into position for second bathroom]

2nd Bathroom [*Typical*]

- The participant is informed that they will continue to use the walker and IV pole, for the second bathroom. They are reminded to act as naturally as possible and that we will be asking questions about their experience as we did in the first bathroom.
- They are directed which bathroom to enter and are reminded that the toilet has been cleaned so their clothes will not be soiled.

SCRIPT

- [When the participant is ready] "When *Engineer* says, please, go into the bathroom, turn on the lights and proceed to sit down on the toilet in the open stall. Do not close the door behind you." Any questions? Ready? Okay.

Engineer: -Turn on bathroom webcam

-"Please get up and walk - now" Record with SwayStar™

-Follow participant with camcorder (swivel & zoom)

[Research assistant cues when participant is seated]

- [When seated] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of turning on the lights" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- Research assistant notes if hand rails were used and if so which hand(s) ___Y/N ___R/L
- [If hand rails used] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of positioning the handrails" _____ [fill-in answer]

If not used, they are asked to explain why, if rating 4 or 5, what could make it easier?

- "Next, when I say 'go' please get up from the toilet using the grab bars for support"

Engineer: -Cue research assistant, who signals 'Go' Record with SwayStar^{TM}

- [When standing] "Please rate the ease or difficulty on a scale of 1(very easy) to 5(very difficult), of getting up from the toilet using the grab bars _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- "Next, when I say 'go', using the walker, please walk over to the sink and stop facing the mirror.

Engineer: -Cue research assistant, who signals 'Go' Record with SwayStar^{TM}

-Turns off webcam when participant is out of view

- When I tell you to 'start', I'd like you to pretend to complete some routine tasks. In the bag in the walker you will find a toothbrush and toothpaste, mouthwash, a cup, as well there is a can of shaving cream and a razor (men) [or] a bottle of hairspray and a comb (women). Please pull these items out and pretend to use them as you did in the first bathroom. Do you have any questions?

Engineer: -Cue research assistant, who signals 'Go' Record with SwayStarTM

- Research assistant make note of any poor hygiene activity witnessed (e.g. toothbrush on sink)
- [When at the sink] "Please rate the ease and convenience, on a scale of 1(very easy) to 5(very difficult), of pretending to complete these tasks" _____ [fill-in answer]
  If rating a '4' or '5', what could make it easier?

- "Before we leave this bathroom I would like to ask you some questions about the room"
  4. What, if anything, do you like about the room
  5. What, if anything, do you not like about the room
  6. "On a scale of 1(very good) to 5(very poor) [again, showing a visual scale to cue] please rate the overall:"

i. appeal of ambiance/décor _____ [fill-in answer]

ii. the user friendliness, especially for the older patient _____ [fill-in answer]

If rating a '4' or '5', what could make it more user friendly?

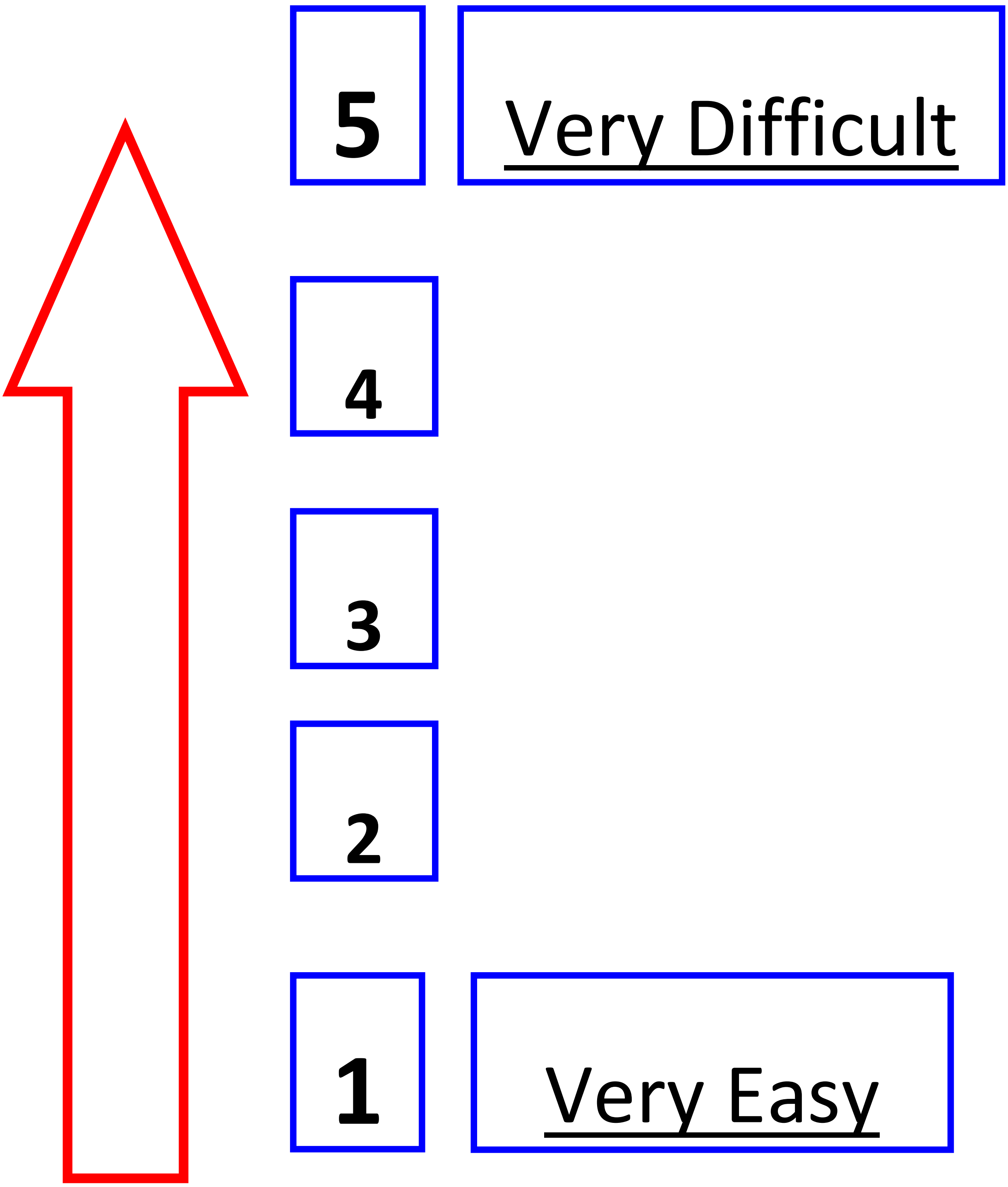
- Toiletries are replaced in bag, placed on walker, the participant is detached from the IV and disconnected from the SwayStar™ then directed to return to the hallway.

5. Participants are thanked for their participation and are given the $50 honourarium and reimbursed for parking (receipt is signed).

6. Participants take off test socks and put their shoes back on.

7. Participants are escorted back to the hospital entrance.

Appendix 4: Rating Scale Cue Card


5
Very Difficult
4
3
2
1
Very Easy