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Hospital Patient Room Design: The Issues Facing 23 Occupational Groups Who Work in Medical/ Surgical Patient Rooms

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Abstract

Objective: The aim of this study was to learn from a wide range of hospital staff members about how the design of the patient room in which they work adversely affects their ergonomics or hinders their job performance. **Background:** In addition to providing a healing space for patients, hospital patient rooms need to serve as functional workplaces for the people who provide clinical care, to clean, or to maintain room functions. Therefore, from a design perspective, it is important to understand the needs of all the users of hospital patient rooms with regard to room design. **Method:** One hundred forty-seven people, representing 23 different occupational stakeholder groups, participated in either focus groups or interviews in which they were asked to identify room design issues that affect the performance of their work tasks. **Results:** Key issues shared across multiple stakeholder groups included an inability to have eye contact with the patient when entering the room, inadequate space around the bed for the equipment used by stakeholders, the physical demands experienced as stakeholders move furnishings to accomplish their activities or access equipment, and a lack of available horizontal surfaces. Unique issues were also identified for a number of stakeholder groups. **Conclusions:** There are a number of issues that should be addressed in the next generation of hospital patient rooms, or when refurbishing existing facilities, so that all occupational stakeholder groups can work effectively, efficiently, and without undue physical stress.

Keywords

patient room, ergonomics, design, human factors, injury prevention, med/surg patient room, hospital-acquired infection, patient safety

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Introduction

While hospital patient rooms need to provide a healing space for patients, they also have to serve as functional workplaces for people who work in these rooms to provide clinical care, to clean, and to maintain the room functions. From a design perspective, it is important to understand the needs of all the users of hospital patient rooms. These users include all the occupational groups that work in the rooms as well as the patients and their visitors. Until recently, patient room design has tended to be the sole purview of architects and interior designers (Stichler & Cesario, 2007). Beyond the examination of ceiling and other mechanical lift devices (Ulrich et al., 2008) to reduce staff injuries associated with patient handling activities, there has been only limited published input on patient room design from ergonomics specialists (France et al., 2005). For example, Hignett and Lu (2007) specifically investigated the space requirements in patient rooms in a critical care unit and in patient bathrooms (Hignett & Evans, 2006). However, much of the limited work investigating room design has solicited input primarily from nursing staff (Gallant & Lanning, 2001; Hignett & Lu, 2007) and by employing effectiveness measures focused almost exclusively on patient-related outcomes (Delvin & Arneill, 2003) and issues related to the nursing staff (Ulrich et al., 2008). Nurses are a critical element of the patient care system, but it must be recognized that many other types of hospital personnel also perform some or most of their daily tasks in patient rooms. Rooms designed to facilitate all types of work performed in the room could improve task performance, efficiency, and safety for staff, which in turn would also be beneficial for patients.

Three trends in healthcare will impact the design of hospital rooms. First, there is a trend toward acuity–adaptable rooms that can be configured to accommodate the needs of patients as they progressively regain their health (Pangrazio, 2003). There is evidence demonstrating the value of this design philosophy with regard to measures of operational cost, patient safety, and error reduction as well as patient satisfaction levels (Hendrich, Fay, & Sorrells, 2004). Second, there is a trend toward the provision of in-room clinical services rather than transporting patients throughout the healthcare facility to obtain these services in the hospital's clinics (Patel, Satiani, Mong, Baetz, & Spiezio, 2006). Both of these trends signify that there will be more healthcare workers and hospital staff providing services in patient rooms in the future. Third, patients are getting heavier, reflecting a trend in the general population (Center for Disease Control, 2014). This means larger beds, larger furnishings for visitors, and less work space for healthcare workers and hospital staff to use in performing their respective tasks as well as many of those tasks being more strenuous due directly to the patient's weight, shape, and physical capability.

Given that there is currently substantial construction, both new builds and remodeling, occurring in the healthcare sector (Bazzoli, Gerland, & May, 2006; Gamble, 2011; Terry, 2011), researchers are presented with a unique opportunity to influence the state of the art in facility design by developing evidence-based recommendations for room designs that meet the needs of all stakeholders providing patient care and services in these rooms. The aim of this study was to identify the key patient room design issues experienced by a wide range of the occupational stakeholder groups that work in patient rooms. Moreover, while the work of Hignett and Lu (2007) has begun to address room layout issues, no research has been conducted to address the full range of room design parameters that impact the performance of direct and indirect patient care tasks that occur regularly in a patient's room. Thus, the current study was designed to learn about challenges faced by each occupational stakeholder group due to room design parameters, including size, layout, positioning, when entering, working in, and leaving hospital medical–surgical (med/surg) rooms.

Method

Research Overview

Focus groups and interviews were conducted with individuals from 23 stakeholder groups working at a large urban academic medical

center in the United States. Private and semiprivate med/surg patient rooms are used at this medical center which, including the bathroom space, range in size from 18.2 to 30.7 m^2 for the single occupancy rooms and from 29.9 to 37 m^2 for the double occupancy rooms. The focus group and interview sessions were designed to elicit each individual's primary issues with med/surg patient room designs. Most of the focus group sessions were comprised of single stakeholder groups. Exceptions included combined groups of physical and occupational therapists, a group with different imaging modalities, and groups with both nurses and patient care assistants (PCAs). Following the sessions, several stakeholder groups were observed while working. This study was approved by the institutional review board at the institution where the research was conducted.

Participants

Across the 23 occupational stakeholder groups, 147 people elected to participate in either a focus group or an interview. Table 1 shows the distribution of the sample across the stakeholder groups and a description of each group's primary function within the patient room.

Procedure

Participants were recruited via short presentations given by the investigators at stakeholder group staff meetings and via posted flyers. Where possible, participants were scheduled for focus group sessions. Individual interviews were conducted where the selected focus group times were not feasible for individual participants or where it would be especially difficult to coordinate schedules for a focus group (e.g., hospitalist physicians).

Prior to attending the focus group and interview sessions, most of the participants were asked to complete an online survey designed to sensitize them to the topics that would be discussed during the meetings. Specifically, the survey queried participants about interactions they have had with many of the objects and items normally present in hospital patient rooms. As part of this survey process, participants were encouraged to upload photographs without patients that illustrated where the interactions with objects and items in their patient rooms were problematic for them. Engineers, housekeepers, and hospitalist physicians were not asked to complete the survey due to the nonclinical nature of the work performed for the first two groups and to minimize the time commitment for the last group.

As participants arrived for the session, each signed an approved informed consent document. After introductions, the participants were shown a series of photographs, some of which had been submitted by the research participants. The photos were used to initiate the conversation regarding the participants' issues and concerns with the setup and design of the patient rooms in which they work. When participant photos were available, these were always used as the participants could use these to clearly describe their issues. The stock photos used by the investigators illustrated the variation in med/surg patient rooms that exist within the hospital system at this institution. During this discussion, members of the research team wrote, on sticky notes, issues that were described by the participants. This discussion phase typically lasted about 30 min for the interviews and about 60 min for the focus groups. Following the discussion, the participants were shown the issues documented on the sticky notes and asked to cluster issues according to the common themes defined by the participants with assistance from the session moderator. Once each note was placed in a cluster and the clusters were named, the participants were provided with five votes, in the form of five adhesive-backed paper dots. The participants were instructed to place the adhesive-backed dots on the clusters or on specific issues that were most important to them. The participants were instructed that their one blue dot was worth four voting points. The remaining red dots were worth one voting point each. Once the participants voted with their dots, the moderator reviewed the placement with the participant(s) to reiterate the key issues and assess the degree of consensus within the focus group. All discussions were audio recorded and professionally transcribed.

Table 1. The Stakeholder Groups Recruited for This Study and Their Primary Job Responsibilities Within the Patient Room.

Stakeholder Category	Stakeholder Group	*n*	Primary Job Responsibilities Within the Patient Room
Patient care	Hospitalist physician	6 (3)	Check in with patient daily to assess their health conditions: sometimes do procedures and also meet with family members to discuss plan for the day
Patient care	Nurse	17 (5)	Provide nursing care: includes medication administration, dressing changes, and pain assessment
Patient care	Patient care assistant	10 (2)	Assist nurse with providing patient care and responding to patient call light, take vital signs, change sheets, assist patient with toileting and bathing
Patient care	Safety care associate (sitter)	3	Protect patient's safety, eliminate safety risks, help patient with personal care (assist with toileting, bathing, and grooming), help care providers if necessary
Patient care	Case manager	2 (1)	Meet with patients in patient room to discuss discharge planning
Patient care	Patient transporter	10	Move patients to and from room to other locations throughout the hospital
Therapist	Physical therapy	11 (4)	Get patient ready to move, get out of bed, sit in chair, walk in hall, use the stairs, etc.
Therapist	Occupational therapy	9	Get patient ready for safely taking care of themselves at home: get out of bed, sit in chair, go to bathroom, etc.
Therapist	Respiratory therapist	5	Provide patients with assistance in breathing through mechanical assistance, pharmaceuticals, or education
Therapist	Speech-language pathologist	4 (3)	Provide oral/swallow evaluation, oral/swallow therapy session, and general care for patients with speech and swallowing disorders
Nutrition	Dietitian	5 (3)	Assess patients' diet, determine meal plans for patients, and educate them on nutritions.
Nutrition	Dietetic technician	5 (2)	Do the meal selections for complicated diets and consult and educate patients
Nutrition	Nutrition aides (food service worker)	7 (3)	Get meal orders from patients and deliver foods to them
Imaging	Echocardiographer	5	Obtain cardiac ultrasound images using a portable ultrasound machine that they bring into the room
Imaging	Sonographer	4	Obtain ultrasound images using a portable ultrasound machine that they bring into the room
Imaging	Vascular technician	2	Obtain vascular ultrasound images using a portable ultrasound machine that they bring into the room
Imaging	Radiographer	7 (5)	Obtain X-ray images using a portable X-ray machine that they bring into the room
Housekeeper	Housekeeping	10 (4)	Clean and disinfect the patient room: includes routine (daily) clearing, discharge cleaning, and the cleaning of isolation rooms
Engineering	Clinical engineer	8 (6)	Fix or replace electronic medical equipment used in the patient room
Engineering	Building operation	3	Maintain heating and cooling ventilation systems and maintain med gases
Engineering	Zone technician	3	Provide immediate room repairs that include fixing the plumbing, lighting, electrical supply, window coverings, as well as mounting white boards, hand sanitizers, hooks in closets
Engineering	System shop	2	Maintain electricity and drywall
Engineering	Mechanical shop (plumber)	4	Maintain water and gas infrastructure

Note. The sample size (*n*) indicated the number of participants within each stakeholders group that participated in focus groups or interviews. The number in the parentheses indicates the number that was observed.

Data Analysis

Qualitative analysis methods were utilized to analyze audio transcripts, issue cluster diagrams, survey data, and observational data. Initially, three members of the research team analyzed the data of one stakeholder group, in order to establish an analysis framework that could be applied to the data of the other groups. After reviewing all the data for the initial group, the three team members proposed a few different analysis frameworks to the whole research team, and consensus was reached on one that organized the data temporally based on the tasks and subtasks the worker performed in the patient room. Each subtask would be classified as occurring during one of the four temporal stages: entering the room, preparing to perform the task for which he or she came into the room, doing the task, and leaving the room. Think of the subtasks as column headings in a spreadsheet. The other dimension of the analysis framework that emerged from the data was categories of issues (difficulties) associated with performing the tasks and subtasks in the patient room, and think of these issue categories as the rows in the spreadsheet. The issue categories were *challenges* to doing the subtask due to room design elements, *physical obstructions encountered* in the room, and what was *needed but not provided* in/by the room. After the analysis framework was developed, each member of the research team took the lead in the initial analysis of the data for one or more stakeholder groups. Each initial analysis was subsequently presented to and discussed by the entire research group. Consensus was reached before finalizing the analysis of the data of every stakeholder group.

Therefore, using our analysis framework, issues were associated with four work phases: (1) *entering the patient room*, (2) *preparing* to do the intended activity(ies) within the room, (3) *doing* the activity(ies) that was (were) the reason for entering the patient room, and (4) *leaving* the patient room. Our operational definition of "entering" included all the room element interactions encountered before entering the patient care area (patient zone). Likewise, our operational definition of "preparing" included all the activities done between the time the stakeholder entered the patient zone and the initiation of the activities in the doing phase. This might include moving furniture to clear a pathway or gain access to the bedside, positioning a computer, plugging in portable equipment brought into the room temporarily, adjusting lighting, and so on. "Doing" was operationally defined as completing the stakeholder's primary activities within the room. "Leaving" included the activities, such as disposal of personal protective equipment (PPE), performing exiting hand hygiene protocols, and so on, performed just prior to exiting the room. The issues posed by the room design elements that were identified in each of these four work phases were then compared across stakeholder groups to identify issues that are common to several stakeholder groups and challenges that are group-specific.

Results

Entering the Room

Table 2 summarizes the challenges the different stakeholder groups reported that they had when entering patient rooms. Some of the more common issues included room designs that make it difficult for patients to see anyone entering the room and, as a result, staff may startle patients when they enter the room, entering through doorways that are narrow relative to portable equipment that staff bring into the room, navigating entryways cluttered with items such as bins for soiled laundry and trash receptacles, locating and accessing PPE, and issues associated with hand hygiene such as inconvenient or inconsistent hand sanitizer locations, sink locations that are not near the door or in view of the patient, and the lack of a separate staff sink. Consistent with the theme of not being able to see the patient was the inability to see what is going on in a patient's room before entering. This was especially noted for isolation rooms where PPE has to be donned before entering. Double occupancy rooms at the medical center where the study was conducted were set up in three different ways. In some rooms, the beds are oriented such that patients look directly at one another. In other rooms, the

Table 2. Room Design Challenges When Entering the Patient Room, by Stakeholder Group.

			Patient Care						Therapy			Nutrition			Imagining				Housekeeping	Engineering				
Task	Room Design Challenges	Frequency	Hospitalist	Nurse	Patient Care Assistant	Safety Care Associate (Sitter)	Case Manager	Patient Transporter	Occupational/ Physical Therapy	Respiratory Therapist	Speech-Language Pathologist	Dietitian	Dietetic Technician	Nutrition Aides	Echocardio-grapher	Sonographer	Vascular Technician	Radiographer	Housekeeper	Clinical Engineer	Building Operation	Zone Technician	System Shop	Mechanical Shop (Plumber)
Identifying a patient	Don't know which pt is in two-bed room	4					xo					x	x	o										
	Cannot see pt from outside the room in an isolation room	2		xo			x																	
Being seen by patient as staff member enters room	Pts facing away from the door (want to avoid startling them)	6	x	x	xo						o	xo	xo											
Determine if there are other staff in room and/or ongoing procedure in the room before entering	Cannot see into the room from outside; don't know whether a patient is available or whether room is empty	6					o				o	o					x						x	x
Determine whether to bring staff's IT devices into a room	No dedicated place in the room to put staff's IT devices	2	xo							x														
Get through the doorway/ entry way	Hit something or somebody behind room door	5									x	x		x	x			o						
	Isolation room hard to enter with equipment	3											o			x		x						
	Narrow doorway	9		xo	x	x		x		x		xo		x			x	xo						
	Cluttered entry way (trash can, soiled linen container)	9	o	xo	xo	x		x			x		xo	o			x							
	Get caught on door handles on way in (and out)	3			x			x	x															
	Do not want to touch the door handles	1															x							
	Cannot navigate the dark room: the location and operation of light controls	4	x	o	o													x						
	Entry way extends into other pt's space (two-bed room)	1										xo												
Put on PPE	Poor location of PPE	9	o	xo	x	x	x		x				xo		x					x				
	Difficult to find PPE/inconsistent locations	5	xo	xo	xo				x						x									
Wash hands	Lack of staff sink	8		x	xo					x	xo	x	x		x			x						
	Poor location of sink/paper towel (relative to work tasks)	6	x	x	xo					x		x												
Use hand sanitizer	Poor location of hand sanitizer	8	x	xo	xo				x	x	x				x			x						
	Dripping gel leads to a slip/fall hazard	1																						x

Note. "x" indicates issues identified via the focus groups and interviews, "o" indicates issues identified via observation. pt = patient; IT = information technology; PPE = personal protective equipment.

beds are oriented parallel to one another. However, in the latter case, the beds may be oriented such that the patients are looking at a side wall, or the beds may be oriented so that patients are looking out the window with the room door essentially behind them. Three stakeholder groups noted the lack of a consistent system for identifying the patients based upon their location when they entered double occupancy rooms.

Preparing

Entering the patient zone, which characterizes the beginning of the preparing phase, was challenging for many of the stakeholder groups (Table 3). The limited space in the room and around the bed was identified as an issue by 15 of the 23 stakeholder groups, posing challenges that result in reduced job performance efficiency and additional physical effort. Nine stakeholder groups specifically mentioned the time and effort to move things and the lack of space for moving things. For example, several stakeholders indicated they often had to rearrange the room in order to get themselves and their equipment into position next to the bed. In many cases, this was due to the overall lack of space in the room which made it difficult to move things that were in the way to a position where they would be out of the way. The definition of what was in the way as opposed to out of the way depended on the stakeholder group. Nursing staff wanted to have clinical care supplies, equipment, and disposal locations within easy reach of the patient bed, whereas physical therapists, occupational therapists, and PCAs needed to have a clear path from the bed to the bathroom, recliner chair, or hallway. Imaging technologists and transporters needed to bring transporter beds or wheeled equipment carts directly next to one side of the patient bed. Likewise, the beds and equipment being brought into the room, for example, portable imaging equipment, tended to catch on protruding features like door handles and things that could not be moved far enough out of the way. Once the stakeholders were in closer proximity to the patient, the numerous power cords lying on the floor near and under the bed interfered with positioning the equipment brought in by the staff members and made it difficult to move the overbed table out of the way, and numerous power cords also create trip hazards for staff and patients.

The challenges of limited space were more salient when participants described their experiences in double rooms where the patients were separated by a privacy curtain. Several stakeholders indicated concerns about disturbing the other patient in the room, catching their equipment on the curtain, touching the curtain (a hygiene concern) as they were working and getting their equipment into position, and bumping into objects and people on the other side of the curtain.

In getting ready to provide clinical care, several stakeholders reported they needed to adjust lighting levels in the room. This could be challenging due to light switches that were not easily accessible or that are not labeled with their function. In the case of double rooms, switching on the wrong light could disturb the other patient.

Some of the stakeholder groups who bring equipment into the room, for example, imaging equipment, indicated they were challenged by scarcity of electrical outlets and their inaccessible locations. This scarcity was exacerbated by the competition with patients and their visitors for outlets, as they bring more electronic devices into the rooms. In preparing for their clinical activities, nurses and PCAs reported being challenged by the location and availability of supplies in the patient rooms that they needed to complete the patient care activities.

Ten stakeholder groups identified the lack of a work surface available to them in the patient room. The rolling overbed table would be convenient for their activities; however, in many cases, this was covered with patient-related items (food tray, water pitcher, reading material, patient's computer, personal items, etc.). Moreover, there were many different makes and models of overbed tables that lead to operability and usability issues. When this overbed table had to be moved, the challenge of limited space reappeared (e.g., interference between the table's wheels and the power cords on the floor under the bed, and where to place the overbed table once it was moved).

Seven stakeholder groups indicated they would like to sit during their interactions with patients. Many indicated a desire to be "at eye level" with the patient. However, finding a chair or creating a

Table 3. Room Design Challenges for Stakeholder Groups When Preparing the Patient Room for Activities.

			Patient Care						Therapy			Nutrition			Imagining				Housekeeping	Engineering				
Task	Room Design Challenges	Frequency	Hospitalist	Nurse	Patient Care Assistant	Safety Care Associate (Sitter)	Case Manager	Patient Transporter	Occupational/ Physical Therapy	Respiratory Therapist	Speech-Language Pathologist	Dietitian	Dietetic Technician	Nutrition Aides	Echocardiographer	Sonographer	Vascular Technician	Radiographer	Housekeeper	Clinical Engineer	Building Operation	Zone Technician	System Shop	Mechanical Shop (Plumber)
Adjust lighting level	Poor location of lighting switch, window shade	7	x	xo							xo				x	x	x						x	
	Shade/blind does not work properly	5		x					x						x		x						x	
	Inadequate lighting	1									x													
	Disturb the other pt in a two-bed room	3		x	x										x									
	No label on light switches (which switch for which light?)	6		xo	xo		x		x		xo				x									
Move furniture, and other things	Lack of space (to move): should not move room items into hallway/bathroom to make room	9						x	xo		xo		x	x	x	x	x	xo						
	Trip hazard from electrical cords	5		xo	xo	x			x									x							
	Electrical cords hinder movement	7			xo			x	xo		x				x			o	o					
	Time and effort to move things	11		xo	x				x		o		x	xo	x	x	x	o					x	
	Furniture bumps into or catches on other things in the room	4		x							xo				x				o					
	Disturb the other pt in two-bed room	4		x	x										x		x							
Position/touch a privacy curtain	Concerns about curtain hygiene and appearance of cleanliness	5		xo								xo		x	x	x								
	Hard to open/close	5									o	x		x	x	x								
	Disturb other pt in two-bed room	3		x	x										x									

(continued)

Table 3. (continued)

			Patient Care						Therapy			Nutrition			Imagining					Housekeeping	Engineering				
Task	Room Design Challenges	Frequency	Hospitalist	Nurse	Patient Care Assistant	Safety Care Associate (Sitter)	Case Manager	Patient Transporter	Occupational/ Physical Therapy	Respiratory Therapist	Speech-Language Pathologist	Dietitian	Dietetic Technician	Nutrition Aides	Echocardiographer	Sonographer	Vascular Technician	Radiographer	Housekeeper	Clinical Engineer	Building Operation	Zone Technician	System Shop	Mechanical Shop (Plumber)
Entering the patient zone (with equipment that I bring in)	**Time and effort to work around things in the way (pt's belongings, IV pole, cords, etc.)**	**14**	o	o		x		x	o		x	xo	x	o	x			xo	xo	x			x	
	Lack of space in the room and lack of space around bed for staff/equipment	**15**	o	xo	xo	x	xo		xo		x	x		x	x		x	xo	xo	x			x	
	Poor location of equipment/things I need to access	3							o											xo			x	
	Clutter leads to trip hazards	5	o		x		x				x												x	
	Bumping into people/things behind curtain and catching equipment on curtain	4		o								xo	xo			x								
	Equipment gets caught on things/ cords	4		xo	x								xo			x								
	Equipment/cart does not fit in the room	1																	x					
	Need to stay in the isolation room—all equipments and supplies must be with me	1																	x					
Interact with television (TV)	Remote control device for TV is out of sight	4		x	x							x	x											
	Poor location of TV	5		x	x	x						x					x							
Plug in a machine	Poor outlet locations	6		xo	o				x		x				x	x								
	Insufficient number of outlets	5		x	xo						x				x		x							
Set up a place to sit for a patient or stakeholder	Finding/creating a place to sit (finding and moving a chair, clearing space on bed)	7	x		x	x	xo		x		xo	x												

(continued)

Table 3. (continued)

			Patient Care						Therapy			Nutrition			Imagining				Housekeeping	Engineering				
Task	Room Design Challenges	Frequency	Hospitalist	Nurse	Patient Care Assistant	Safety Care Associate (Sitter)	Case Manager	Patient Transporter	Occupational/ Physical Therapy	Respiratory Therapist	Speech-Language Pathologist	Dietitian	Dietetic Technician	Nutrition Aides	Echocardiographer	Sonographer	Vascular Technician	Radiographer	Housekeeper	Clinical Engineer	Building Operation	Zone Technician	System Shop	Mechanical Shop (Plumber)
Position a tray table	Poor tray table operability/ usability, malfunctioning tray tables	5			x				x		x	x		x										
	Lack of space to move a tray table around	3							x		o			x										
	Trip hazard with cords/floor pad/ things	2											x	x										
	Lack of compatibility with bed	3									x		x	xo										
	Difficult to position a tray table without turning on lighting in the early morning	2	x											x										
	No place to put an unsanitary item except on a tray table	1					x																	
Find a work surface	**Lack of horizontal work surface**	**10**		xo	xo				x	x	xo	xo		xo					x	o				x
Get information about pt from dry erase white board	Poor dry erase white board location	3		xo			x				xo													
	Lack of information on dry erase white board	4				x	x				xo			o										
Get pt ready to transport	Lack of space for heavy pts	1			x																			
Get supplies (e.g., sharps, pillow, etc.)	Inadequate (size/location) storage for clean and dirty supplies	5		xo	xo	x			xo		x													
	Looking for supplies, disturb patients and their things	1			x																			
	Supplies hard to find/not located in designated place	3		xo	x	x																		
Get into the bathroom	Lack of space to work in bathroom	6		x	xo	x			o										o					x
	Bathroom located on far side of the room: concerns about disturbing pt(s)	1																				x		
	Bathroom sinks—plumbing access	1																				x		

Note. "x" indicates issues identified via focus groups and interviews, "o" indicates issues identified via observation. Room design challenges with frequencies of 10 or more are indicated in bold font. pt = patient.

place to sit was reported to be a significant challenge for these stakeholder groups.

The lack of space in the bathroom and around fixtures was identified in six stakeholder groups which included nurses, PCAs, occupational therapy/physical therapy (OT/PT), housekeeping, safety care associates (sitters), and those fixing the plumbing from the mechanical shop. Zone Techs, who take care of minor plumbing issues, particularly during the overnight periods, described the challenges of getting into the bathroom without waking a patient when the bathroom was in an outer wall location, far from the entry way, as well as the challenges of accessing the plumbing under the sink.

Doing the Activity

Table 4 summarizes the primary room design challenges facing each stakeholder group, as they perform their primary activity(ies) in the patient room. The challenges listed in Table 4 were also used to develop the word cloud visualization (Figure 1). As emphasized in Figure 1, Table 4 indicates that for 10 of the stakeholder groups the primary challenges are the limited access and amount of space available in the room, even though these affect the different stakeholder groups in different ways. Sonographers need to position themselves and their equipment in specific orientations to obtain the highest quality image possible, while not incurring an injury as a result of scanning in postures that are physically awkward and uncomfortable to the point of injury. This requires sufficient access to both sides of the patient bed. It is recommended that two radiographers should perform portable exams in patient rooms, in order to reduce the physical stress of positioning the patient, especially while handling a heavy digital image receptor. Yet, two people working in a tight space may still have to adopt awkward (stressful) body postures in order to accomplish this physically stressful activity. Nurses and hospitalists noted that the lack of space was problematic when there were emergency codes. PCAs indicated that it could be difficult to obtain vital sign data in crowded rooms with limited access to the wall-mounted cuff to obtain blood pressures. Respiratory therapists and speech language pathologists indicated that the lack of space made it more difficult to perform their patient care procedures. Likewise, patient transporters noted limited space on the far side of the bed when transferring patients. An interview with a construction worker indicated the need to frequently repair walls, doorways, and flooring on account of things being moved inside the room, indicating another hidden cost that comes with working in cramped spaces.

The remaining stakeholder groups reported a variety of challenges while doing their primary function within patient rooms. The lack of privacy in double rooms was the most significant challenge for case managers, dietetic technicians, and dietitians who need to converse with patients about personal matters, including their health and living situations. Access to selected items in the patient room was considered a primary challenge during the "doing" phase for a few of the stakeholder groups. Dry erase white boards, used for communicating basic information to patients and families, that are difficult to see or access, pose a challenge to hospitalists who are seeking or updating information about the patient. Interface panels for nurse call controls that are located behind the patient bed and smoke detectors located on the ceiling are two room items that pose access challenges to systems shop personnel. Plumbers may encounter challenges posed by difficult to access plumbing lines. The lack of horizontal surfaces on which to place things was noted as the primary issue for the clinical engineers who need a place to set their test equipment. Likewise, nutrition aides need a place to set the food tray while they make room for it on the overbed table. The building operations participants noted that while access to diffusers and control boxes in the ceiling was difficult, the lack of a standard location for the control boxes made their job particularly difficult because they must spend extra time opening multiple ceiling tiles to find the repair site. The mechanical shop plumbers are challenged by the lack of independent control valves in each room that makes it difficult to locate the water shut-off valves and when closed, they may be affecting multiple patients' rooms during the repair period. Housekeepers reported challenges to cleaning posed by very high and

Table 4. Room Design Challenges for Stakeholder Groups When Doing the Stakeholder Group's Activities in the Patient Room.

Stakeholder Group	Primary Room Design Challenges When DOING Primary Activity
Hospitalist	• Whiteboard not accessible to hospitalist, pt, and family • Need to have consistency of layout of components from room to room • Tray tables get caught on the bed, difficulty to move especially when cluttered • Difficult to move, raise, and lower pt bed without disturbing other room components
Nurse	• Few sterile work surfaces, crowded rooms, and equipment around beds make it difficult to do ordered activities • Disturb pt to do care activities due to location of items • Codes hard in small rooms and difficult when pt codes in a recliner or documentation nurse is in hallway
Pt care assistant	• Crowded rooms and location of wall cuff makes it difficult to take vitals • Limited bedside access makes pt mobility and pt handling difficult because pts might have to get up on their weak side • Inadequate bathroom design compromises provider and pt safety: small space (fall hazard), narrow door, step-up shower, toilet is too low, bumping into shelf, poor grab bar locations • Frequent request of pt/family members to reach inaccessible call lights, TV, and whiteboard
Safety care associate (sitter)	• Difficult to keep pt in view due to room layout while interacting with/using television, call light, phone, computer, sink, and linen storage • Lack of task lighting or dimmer control when using computer without disturbing pt • No place to sit comfortably
Case manager	• Positioning oneself to communicate intimately with a pt • Lack of privacy in double room
Physical therapy	• Inadequate room size • Difficult to clear path for helping pt ambulate: furniture, entangled cords, IV pole, tray table need to be moved • Difficult to move heavy recliner close to bed
Occupational therapy	• Difficult to maintain pt and provider safety in bathroom: toilet is too low, poor grab bar locations, sink doesn't accommodate seated pt • Difficult to clear path for helping pt to get to bathroom: furniture, entangled cords, IV pole, tray table need to be moved • Pt fall risk: outlets are too low and no space for shampoo in shower
Respiratory therapist	• Limited space to provide breathing treatment therapies and a workspace to use their workstations-on-wheels (WOWs) and place their injectable drugs/aerosols • Respiratory monitoring could be completed from the hallway if viewing conditions permit
SLP	• Need privacy to perform speech/swallow evaluation/therapy • Limited access (SLPs and pt) to room components (whiteboard/clock) when performing speech/swallow evaluation/therapy • Inadequate horizontal surfaces to perform pt care procedures and documentation with computer • Space and access to perform pt care procedures
Echocardiographer	• Inadequate space and access to perform pt care procedures on the correct side of pt for an echocardiographer • Interruptions of scanning procedure from other staff going into the room
Sonographer	• Challenge of scanning backward or in other awkward posture if unable to get machine and tech in preferred position due to inadequate space

(continued)

Table 4. (continued)

Stakeholder Group	Primary Room Design Challenges When DOING Primary Activity
Vascular technician	• Limited space and access to perform pt care procedures on the pt's side • Interruptions of scanning procedure from other staff going into the room
Radiographers	• Digital machine—plate is too heavy for one person alone to handle, so two techs must fit into space near pt's bed to position receptor
Dietitian	• When educating a pt, there is a privacy concern in a double room • Lack of space for a rounding team • Inconsistent access to computer in room
Dietetic technicians	• Lack of privacy to discuss dietary issues with the pt • Positioning oneself in front of the pt so there is visual contact
Nutrition aides (food service)	• Lack of clear surfaces on which to place a food tray when delivering meals reduces their efficiency and increases risk of spilling food on the pt
Pt transporter	• There is inadequate space in the room when moving pts
Housekeeper	• Difficult to reach and/or hard to clean room components include ledges, high shelves, picture frames, corners, cracks, crevices, light above pt bed, under the bed and sofa, etc. • Hard surfaces and textiles in room can be damaged by chemical or beach wipes
Building operation	• Lack of uniformity in the rooms for location of boxes and valves • Some diffusers are right over the bed—making access difficult • Inadequate number and poor location of thermostats
Clinical engineer	• Wiring and fixtures are sometimes difficult to access, often up high, and wiring is often mixed with IT cables • Lacking a flat surface on which to place their testing equipment • Need to avoid disturbing pts including minimizing noise when working
Mechanical shop (plumber)	• Need independent valves with shut-offs for each room • Inadequate access to plumbing (lack of access panels)
System shop	• Access to fix interface boxes for call lights and smoke alarms requires coordination with nursing staff to move a pt • Finding locations to mount TV's that work for everyone in the room
Zone technician	• Cramped spaces make access difficult when working on toilets and sinks • Shut-offs not provided for every sink—need in every room • Lamps over pt bed are difficult to access, outlets are often located low on the wall and behind the bed

Note. SLP = speech-language pathologist; IT = information technology; pt = patient.

very low surfaces that were difficult to see and reach, areas that were difficult to reach because they were blocked by furniture or plumbing, and furniture with crevices that collected dirt and particles. The physical and occupational therapists were primarily challenged by the design of the bathrooms. Problematic design features described by these groups included insufficient grab bars and low toilets. Both require stressful physical effort from staff when assisting patients getting on or off the toilet. The safety care associates (sitters) were challenged to keep the patient in view at all times, for example, when they are washing hands or using an in-room computer for charting.

Documentation functions were often performed in the room. Hospitalists, dietitians, and dietetic technicians all noted the lack of horizontal surfaces and/or dedicated workstations available for this component of their work.

Leaving the Room

When leaving the room, some stakeholders described the poor locations of sinks and trash receptacles, particularly in isolation rooms, where these items are sometimes located far from the doorway. This means that once the isolation PPE is removed and hands are washed, the stakeholder

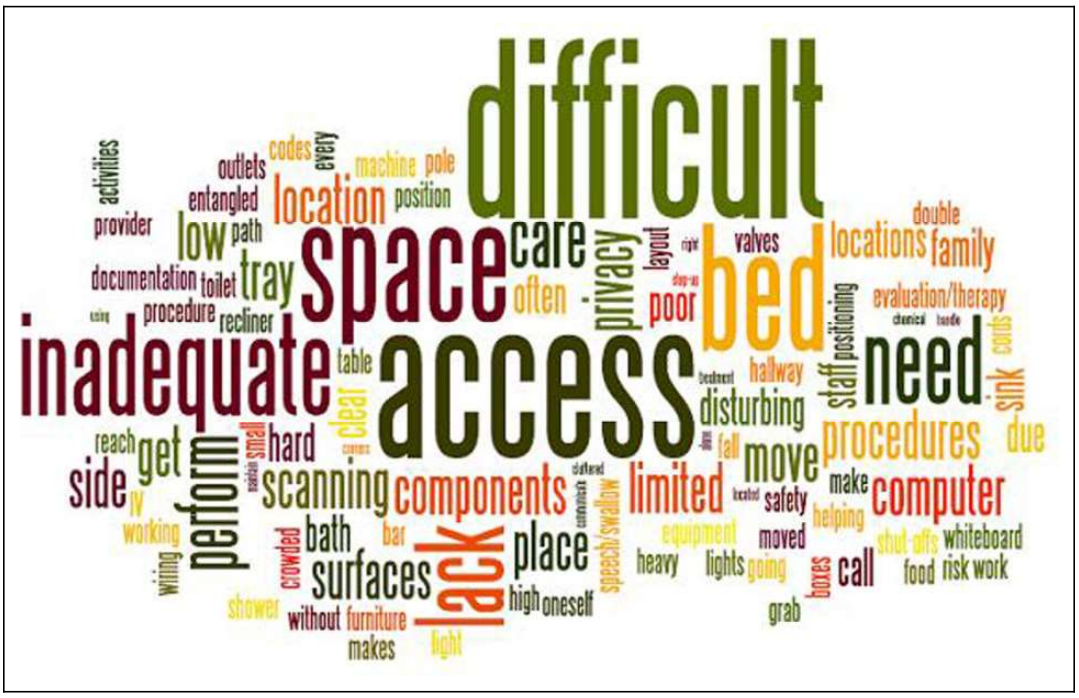

Figure 1. A word cloud showing the relative frequency of the terms used in Table 4 to describe the doing phase (http://www.wordle.net).

still needs to cross the room before exiting. Stakeholders that take equipment into the room are expected to wipe down the equipment before exiting; however, the inconsistent provision of cleaning wipes in the room means that these staff members have to find a way to store the wipes container on their equipment to ensure availability. As such, they would prefer that wipes were provided in all patient rooms. However, the plumbers do not like wipes to be provided in the room because they have found that wipes may also be used by patients or visitors who dispose of them in the toilet, which clogs as a result.

Discussion

The results from this study show that there are many room design challenges affecting how work is performed in med/surg patient rooms. Most of these challenges occurred during the "entering," "preparing," or "doing" phases of work, although the various stakeholder groups reported different challenges across the four phases of the work process.

Many of the participants described themselves as "furniture movers," as they created a path for themselves and their equipment to access the bedside. In 2012, "furniture and fixtures" were identified as an injury source in 4% to 5% of the lost time injuries reported by nurses, PCAs, and radiologic technologists (Bureau of Labor Statistics, 2012). Our participants repeatedly reported that space is limited in many hospital patient rooms. Having more space would address many of the issues in that it would make it easier to move the furniture out of the way and allow patients and family members to temporarily move out of the area surrounding the bed where most patient care activities are performed. One of the buildings at the medical center where this study was conducted has single-patient rooms that are 30.7 m^2 (330 ft^2). There were consistently positive comments about these rooms from all the stakeholder groups when pictures were shown during the focus groups and interviews. However,

smaller rooms, where the layout is optimized, may be a more efficient approach (Harper, Watkins, & Minnier, 2014) in that they are more cost-effective in terms of building costs, operational costs, and energy consumption. Current guidelines (Facility Guidelines Institute, 2014) state that clearances for the bed in med/surg rooms are "36 inches (0.91 m), 48 inches on the transfer side (1.22 m), and 36 inches (0.91 m) at the foot of the bed." Moreover, "In new construction, single patient rooms should be at least 12 feet (3.66 m) wide and 13 feet (3.96 m) deep exclusive of toilet rooms, closets, lockers, wardrobes, alcoves, or vestibules" (Facility Guidelines Institute, 2014).

During the preparation phase, seven of the stakeholder groups noted challenges associated with plugging in electrical equipment (e.g., computers, etc.) due to the lack of or poor access to the power outlets. Current guidelines state that there should be two power receptacles at each side of the head of each bed, and two on each of the other walls (with the exception of the wall with the window), one for each television and one for the motorized bed (Facility Guidelines Institute, 2014). This is a significant increase from the guidelines published 4 years earlier, reflecting the increased demand from patients, their visitors, and the hospital staff. Locating power outlets higher up on the wall also makes accessing the outlets safer for staff and patients, and bending over to reach an outlet near the floor is stressful on the back and can cause problems for a patient who may be unsteady, yet need to unplug or plug in the IV pump when going or returning from the bathroom.

We did hear about inconsistencies that exist between patient rooms and how this becomes problematic for people. The location of items such as light switches, PPE, hand cleaning materials and sinks, and the operation of remotes, window shades, and call lights were issues that were reported by those who travel to many different rooms across the different buildings in a medical center. Even though it may not specifically be part of a particular occupational stakeholder's "job" to operate lights, shades, and so on, they are often asked by patients to adjust these settings as they are the people in the room at the time. Prior work with nursing staff has not identified these issues. This might be due to the staffing patterns where nurses spend more of their time on a single unit than many of the other stakeholders in this study. Nevertheless, nurses are sometimes required to "float" to other units in response to uneven workload distributions, and thus would likely experience these challenges during those assignments. Light switches were particularly problematic, as most of the examples shown to the research team members were unlabeled, which in turn led to uncertainty regarding their function. While documents like the Design Guide published by the U.S. Department of Veteran's Affairs (2011) suggest where switches should be placed, the document does not stress the need for labeling. Labels represent a feasible and low-cost modification that should be applied to existing facilities in addition to new or remodeled facilities.

Concerns about the design of the bathrooms were expressed by PCAs and occupational therapists. Both groups noted that the restrictive bathroom space compromises both the patient and the care provider safety. The certified nursing assistants and licensed practical nurses who participated in Sanford and Bosch's (2013) study strongly preferred having the toilet center be 30 in. from sidewall and having swing-away grab bars located 18 in. on either side of the toilet, as this allows bilateral access for a wheel chair or bilateral access for the care provider. This space is considerably more than the 17 to 19 in. between the toilet center and the side wall that is mandated by the Americans with Disabilities Act Accessibility Guidelines (Department of Justice, 2010). The three main factors identified by the PCAs and OTs in this study, namely, the height of the toilets, the poor grab locations, and sinks that do not accommodate sitting patients, are factors addressed by Fink, Pak, and Battisto (2010) in their bathroom usability assessment tool for patient care facilities.

Limitations

A single institution was used in this study, and thus the findings may not generalize to other institutions. Nevertheless, there are multiple specialty care and satellite hospitals at the institution and thus a large variety of hospital room designs and sizes. In addition, nearly all of the study

participants with the exception of patient transporters had previously worked at other hospitals, and they were instructed to incorporate their insights on challenges from their experiences at those institutions as well during focus groups and interviews.

Sample sizes were limited in some of the stakeholder groups; however, collectively many different points of view were heard. Focus groups and interviews were primarily done within stakeholder groups, and thus some conflicts across groups might not have been identified. Nevertheless, we felt that the stakeholder groups would be more free to represent their issues in single group sessions, particularly for those that have, historically, had less opportunity to provide their perspective on ways in which room design impedes their work productivity and/or imposes added physical stress as they perform their work. In the next phase of this research, we will be using mixed groups engaged in an active participatory design process to create the ideal med/surg hospital room. This process will allow for discussion and resolution of design conflicts that may appear between stakeholder groups.

Conclusions

In summary, this work has shown there are a number of issues that should be addressed in the next generation of hospital patient rooms or when refurbishing existing facilities. Given the trend toward single-patient rooms, there is a need to determine the right size, layout, and content organization that allows all occupational stakeholder groups to work effectively, efficiently, and without undue physical stress while controlling building costs and providing a healing environment for patients and their visitors. This work also indicates that the full spectrum of occupational groups should be consulted during the hospital patient room design process, as each group has specific needs in these specialized work environments.

Implications for Practice

- The design process for hospital patient rooms needs to include all occupational groups that will be working in the planned spaces.
- Patient rooms need to be large enough to accommodate the equipment and working space requirements at the bedside space, while still accommodating the patient's visitors.
- There is a need for horizontal surfaces that are dedicated for those working in the patient rooms.
- There is a need for convenient seating, so several occupational groups can have eye-level conversations with patients and/or family members.
- Patient rooms should be designed such that people do not enter from behind the patient's normal visual field.
- Consistent locations, even for simple features such as light switches and outlets, are desirable.
- Provide more power outlets and locate them higher up on the wall.
- Rooms and bathrooms need to be easily cleaned.
- Bathroom doors need to be wide enough to accommodate the patients and an assisting healthcare provider.

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