Lighting Control in Patient Rooms: Understanding Nurses' Perceptions of Hospital Lighting Using Qualitative Methods

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Abstract

Purpose: This study aims to differ in its methodological approach and reporting from previously-published research concerning environmental perceptions of med-surg nursing staff working in patient rooms. Here, qualitative results are reported, compared, and interpreted against existing literature to understand more extensively how nurses conceptualize med-surg patient rooms as productive work settings in relation to lighting, as well as the ways in which they believe these spaces could be enhanced for patient satisfaction.

Methods: Systematic content analysis was used to compile and interpret themes and sub-categories emerging from med-surg unit nurses' subjective responses to three open-ended items from a previous study done in four hospitals in the Pacific Northwest region of the US. Two of the three items asked nurses to report their perceptions of patient room lighting in relation to their professional duties, both positive and negative. The third asked for their perspectives on what may benefit patients with respect to the lighting environment in these rooms. Three of the facilities (i.e., Hospitals A, B, and C) had older, more traditional lighting systems installed, while one (i.e., Hospital D) had a more contemporary lighting framework.

Results: A general theme of environmental control over both overhead and task lighting in patient rooms emerged from words and phrases offered in response to all three items. Although controllability was reported as being among the 'best' lighting attributes in typical patient rooms, it was also something that nurses thought ought to be considered further by designers, facilities managers, and other decision-makers to refine these spaces for the productivity of staff, as well as for the satisfaction of patients. Daylighting was also considered to be among the best lighting-related design attributes in patient rooms. Control over the light level in patient rooms by providing additional dimming capability for patients, as well as additional light sources, came forward as prominent points in nurses' narratives across the four hospitals. Unique to Hospital D, the trespassing of light was an issue for nurses considering the experiences of patients, suggesting that even when modern lighting models are in place, more attention can be paid to the ways in which window shades, and light sources outside of patient rooms, penetrate spaces and affect users.

Conclusion: The finding that nurses and patients desire greater control over the lighting in patient rooms is consistent with Ulrich's (1991) theory of supportive design for healthcare, and also coincides with recent advances in lighting technology. Further optimization of lighting frameworks in hospital patient rooms is necessary and desired by nursing staff. Despite differences in the level of technology and sophistication in lighting frameworks among the four facilities, lighting control continues to be a primary concern for med-surg nurses.

Lighting Control in Patient Rooms: Understanding Nurses' Perceptions of Hospital Lighting Using Qualitative Methods

The interdisciplinary bodies of environmental psychology and health care design literature have communicated the importance of several attributes of patient room lighting for hospital staff and patients, including the level of control over the intensity and distribution of light, as well as access to daylight and electric lighting (e.g., Alimoglu & Donmez, 2005; Chaudhury et al., 2009; Hendrich, Fay, & Sorrells, 2002, 2004; Lavender et al., 2020; McCunn & Gifford, 2013; Mroczek, Mikitarian, Vieira, & Rotarius, 2005). Nurses and health care professionals' self-perceptions of fatigue and performance levels at work are often influenced by the quality of the lighting in hospitals (CABE, 2004) and, not surprisingly, inadequate lighting has been found to contribute to error-producing conditions on the job (Buchanan et al., 1991). Indeed, these workers acknowledge that lighting significantly affects their health and job efficiency (Ulrich et al., 2008, 2004).

With respect to how nurses in particular psychosocially experience their work environment, lighting appears to be a key factor in their satisfaction (Chaudhury et. al, 2009; Mahmood et. al, 2011). Medical-surgical unit (med-surg) nurses with access to lighting controls tend to report significantly higher satisfaction with the lighting in the unit than those who did not experience such controllability (Hadi, DuBose, & Ryhard, 2016). In a study recently published by the authors (see Davis et al., 2020), control over light intensity from various lighting sources in patient rooms (e.g., task lighting, overhead fluorescent lighting) was an important consideration for med-surg nurses. The present paper uses qualitative data collected from the same population of med-surg staff—while we expect that these same themes will emerge, this research centers on an examination of how nurses describe these themes using terms that are more in-depth than the quantitative data outlined in our earlier work could fully afford.

The present paper also differs from previously-reported data in its methodological approach and reporting. For example, Davis et al. (2020) explored primarily quantitative results from a questionnaire measuring the environmental perceptions of med-surg nursing staff working in patient rooms at four hospitals (i.e., Hospitals A, B, C, and D; see Site Details section). **In contrast, the present research uses a qualitative methodology to examine unique, open-ended questionnaire items.** Here, results of a systematic content analysis per hospital are reported, compared, and interpreted against existing literature to understand more extensively how nurses conceptualize med-surg patient rooms as productive work settings in relation to lighting, as well as the ways in which they believe these spaces could be enhanced for patient satisfaction.]

Qualitative Methodology

Content analysis is a technique for describing systematically the form and content of written (or spoken) material (Sommer & Sommer, 1997). We employed a simple yet rigorous form of this technique to assess words and phrases written by participants in response to open-ended items in an online questionnaire. Frequency counts were made of the themes and sub-categories that emerged from participants' comments.

Two independent raters read each response and sorted them into inductive themes and sub-categories. Thus, appropriate themes and sub-categories emerged from the data itself (as opposed to deductive methods whereby raters assign comments to pre-determined themes and sub-categories). Disagreements between raters concerning the placement of comments into themes were counted before being resolved through discussion so that an inter-rater reliability statistic could be calculated (Cohen, 1960). For the first item analyzed in this study, four disagreements occurred between raters,

yielding a kappa value of 0.42. For the second item, only one disagreement occurred ($\kappa = .50$) and, for the third, two disagreements occurred ($\kappa = .50$). These kappa values can be interpreted as "moderate" (i.e., above .40 according to Cohen, 1960, as well as Altman, 1991), suggesting that themes emerging from this study's qualitative data are generally reliable and internally consistent. Some more recent sources state that only kappa values above .60 should be considered acceptable—but some of these studies do not account for qualitative data or the use of grounded theory (e.g., McHugh, 2012). Indeed, lower kappa values in this study may be because of our use of grounded theory—generating themes that are understood to emerge from data and not, in contrast, applying data to pre-determined themes (Tie, Birks, & Francis, 2019). Thus, the themes used in this paper are the result of consensus between raters after disagreements occurred; all data used for analyses have been placed within agreed-upon themes. Researchers may use these themes in future content analyses (and not have to re-apply grounded theory to data about environmental lighting in hospital rooms).

Site Details

As described in Davis et al. (2020), in 2015, nursing staff working in four hospitals in the Pacific Northwest region of the United States were invited to participate in this research. Three of these hospitals (Hospitals A, B, and C) had a lighting framework installed in their med-surg units typical of older hospitals with a traditional environment of care. The Facilities Guidelines Institute defines environment of care as "those physical environment features in a health care facility that are created, structured, and maintained to support and enhance the delivery of health care" (Facilities Guidelines Institute, 2018, Glossary). Traditional environment of care systems tend to have few luminaires in each patient room (sometimes just a single multi-functional luminaire) with simple on-off switching controls that lack dimming capability.

Although details about each hospital's lighting specifications for med-surg unit patient rooms in each hospital are published in Davis et al. (2020), a brief summary of these details are presented here (and photographs of hospital patient rooms are provided in Figures 1–9; see Appendix). Hospital A included a headwall luminaire using 4 ft fluorescent lamps with separate uplight and downlight compartments controlled from a patient bed remote, and a hinged upper section for use as an examination light when flipped over to afford direct light along the bed. Patient rooms in Hospital B used a single multi-purpose recessed 2 ft by 4 ft luminaire over the bed, comprised of a 2 ft by 2 ft exam light section with four 2 ft fluorescent lamps, and a 2 ft by 2 ft section with two 2 ft fluorescent lamps for reading. Patient rooms in Hospital C had only a multi-function headwall luminaire with 4 ft fluorescent lamps in separate uplight and downlight sections; the uplight section was hinged to serve as a flip-up examination light. In contrast, Hospital D had installed a more advanced patient room lighting system consistent with the hospital's recent construction and modern design. Such contemporary environment of care lighting systems use zones of luminaires, with separate controls for each zone and additional lighting for nighttime navigation. However, the luminaires in patient rooms in Hospital D did not have dimming capability.

Method

Participants

Participants were 138 med-surg employees (128 females, 10 males) working in the four hospitals described above (see Davis et al., 2020). Of these, 130 self-identified their position as a "Nurse," and the remaining eight self-identified as a "Certified Nursing Assistant." Thirty-nine participants worked in Hospital A, 39 worked in Hospital B, and 20 in Hospital C. Thus, 98 participants worked under a

traditional environment of care system, and 40 participants worked under a contemporary environment of care system in Hospital D. The breakdown of participants' ages for each hospital is shown in Table 1.

Table 1. Participants' reported age range by hospital.

Hospital	Under 25 years	25-40 years	41-55 years	Over 55 years	Total
A	2	22	9	6	39
B	3	19	7	9	39[a]
C	0	9	7	4	20
D	4	26	8	2	40

[a] One participant from Hospital B did not report their age.

Materials and Procedure

As described in Davis et al. (2020), a link to an online questionnaire was distributed by email to nursing staff in August 2015 from the executive nurse in each hospital. The questionnaire was created using the online survey platform SurveyMonkey (SurveyMonkey Inc. Palo Alto, California, USA). The first page of the questionnaire explained the study and the voluntary nature of participation, including a statement of informed consent that was accepted when the participant clicked a button to continue. The research protocol was approved by the Pacific Northwest National Laboratory Institutional Review Board, scope number 22475.

Davis et al. (2020) report only the results of quantitative aspects of the questionnaire, along with some qualitative data associated with the quantitative items relevant to that paper. In comparison, the present work reports only on additional open-ended items that were not analyzed in relation to research questions addressed in Davis et al. (2020).

Here, we analyzed open-ended responses to three items. The first two items inquired about participants' perceptions of patient room lighting in relation to their professional duties as nurses (i.e., "For a typical patient room in which you work, what do you think is the best thing about the lighting?" and "For a typical patient room in which you work, are there any changes to the lighting that you think would help you in performing your professional duties, or that would have a positive effect on your work experience?"). The third item asked participants' about their perspectives on patients' feelings about patient room lighting, as well as their own thoughts about what may benefit patients with respect to the lighting environment (i.e., "For a typical patient room in which you work, are there any changes to the lighting that you think would help the patients have a more positive experience—based on your observations and/or patient feedback?").

Results and Discussion

Nurses' Perceptions of the "Best" Lighting Attributes in Patient Rooms

Seventy-nine participants across the four hospitals responded to the item asking about the "best" lighting attributes in a typical patient room at their hospital. One hundred and twenty-two distinct comments were provided, but five were omitted because of a lack of relevance to the question. Thus, 117 usable statements were content analyzed across hospitals. Of these, 76 comments (65%, see Table 2 for frequencies of themes and sub-categories across hospitals) had to do with a theme of "control" and, within this predominant theme, sub-categories emerged whereby participants noted that a sense

of control over "light level" was most important (20 comments or 35%), followed by control over "task lighting" (14 comments or 25%) and patient-related concerns (13 comments or 23%).

Table 2. Emerging themes and sub-categories across all four hospitals for comments made by nurses responding to the item: "For a typical patient room in which you work, what do you think is the best thing about the lighting?"

Theme	Freq.	%	Sub-Category	Freq.	%
Control	76	64.96%	Light Level	20	35.09%
			Task Lighting	14	24.56%
			Patient-related	13	22.81%
			Accessibility	7	12.28%
			Users	2	3.51%
			Maintenance	1	1.75%
Daylighting	13	11.11%	Windows	12	100.00%
Visibility	7	5.98%	Light Level	4	80.00%
			Shades	1	20.00%
Bathroom Lighting	6	5.13%	Nighttime Issues	4	100.00%
Distribution	5	4.27%	Light Level	1	100.00%
Comfort	4	3.42%	Patient-related	4	100.00%
Indirect Light	3	2.56%	N/A		
Functionality	2	1.71%	N/A		
Type	1	0.85%	Overhead	1	100.00%

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme. Number of comments in total = 117.

When participants' responses were examined per hospital (and, therefore, per lighting environment of care), the theme of control remained important. For those working in Hospital A (with a traditional environment of care), 20 of the 35 comments (57%) had to do with control (see Table 3 for frequencies of themes and sub-categories per hospital). Five of these comments were sub-categorized as having to do with participants' perceptions of their patients' level of control over lighting, followed by sub-categories concerning "light level," "task lighting," and "accessibility" (three comments each). These results mirror those revealed at the other two hospitals with a traditional lighting environment of care (i.e., Hospitals B and C), as well as the hospital with a contemporary environment of care (i.e., Hospital D) where control also emerged as the primary theme (70%; 53%, and 73%, respectively) with similar sub-categories to Hospital A. They also mirror the results of our earlier paper with this sample, measuring quantitative variables, suggesting agreement between the quantitative and qualitative methods.

Table 3. Emerging themes and sub-categories per hospital for comments made by nurses responding to the item: "For a typical patient room in which you work, what do you think is the best thing about the lighting?"

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
A (*n* = 35)	Control	20	57.14%	Patient-related	5	29.41%
				Accessibility	3	17.65%
				Light Level	3	17.65%
				Task Lighting	3	17.65%
				Users	2	11.76%
				Maintenance	1	5.88%
	Bathroom Lighting	4	11.43%	Nighttime Issues	2	100.00%
	Daylighting	3	8.57%	Windows	3	100.00%
	Visibility	3	8.57%	Light Level	1	50.00%

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
				Shades	1	50.00%
	Distribution	2	5.71%	N/A		
	Comfort	1	2.86%	Patient-related	1	100.00%
	Functionality	1	2.86%	N/A		
	Indirect Light	1	2.86%	N/A		
B (*n* = 27)	Control	19	70.37%	Light Level	6	35.29%
				Patient-related	5	29.41%
				Task Lighting	5	29.41%
				Accessibility	1	5.88%
	Distribution	3	11.11%	Light Level	1	100.00%
	Daylighting	2	7.41%	Windows	1	100.00%
	Visibility	2	7.41%	Light Level	2	100.00%
	Functionality	1	3.70%	N/A		
C (*n* = 15)	Control	8	53.33%	Light Level	3	37.50%
				Patient-related	2	25.00%
				Task Lighting	2	25.00%
				Accessibility	1	12.50%
	Daylighting	3	20.00%	Windows	3	100.00%
	Bathroom Lighting	2	13.33%	Nighttime Issues	2	100.00%
	Indirect Light	1	6.67%	N/A		
	Type	1	6.67%	Overhead	1	100.00%
D (*n* = 40)	Control	29	72.50%	Light Level	8	53.33%
				Task Lighting	4	26.67%
				Accessibility	2	13.33%
				Patient-related	1	6.67%
	Daylighting	5	12.50%	Windows	5	100.00%
	Comfort	3	7.50%	Patient-related	3	100.00%
	Visibility	2	5.00%	Light Level	1	100.00%
	Indirect Light	1	2.50%	N/A		

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme.

The second-most common theme noted in participants' responses to this item across the four hospitals (receiving 13 comments overall, 11%) had to do with "daylighting"—the desired presence of windows was part of many of these comments. Other themes emerged from participants' words and phrases offered in response to this item asking about the "best" lighting attributes in patient rooms. However, despite the differing standards in the four facilities, nurses generally perceived a sense of control, for themselves and their patients, to be most important, followed by adequate daylighting (preferably through windows).

As stated in this paper's introduction, a number of studies in a growing interdisciplinary body of literature point to the relative importance of lighting control in patient rooms. Over the last two decades, studies concerning daylighting have also noted an effect on occupant satisfaction in a number of settings, along with visual comfort, sense of well-being, and perceptual quality (Andersen, 2015). Other studies note that exposure to daylight in the hospital environment can physiologically and psychologically benefit patients as well as staff (e.g., Ulrich, 1984; Leather et al., 1998; Zadeh et al., 2014). Alimoglu and Donmez (2005) found that as exposure to daylight at work increased, nurses tended to be less likely to feel the effects of stress and dissatisfaction related to their jobs, thus reducing the potential for burnout.

It is noteworthy that the present study supports other research in its finding that nurses describe lighting controllability and daylighting as the two most common design attributes that work best inside patient rooms, especially when one of the participating hospitals had been newly constructed with a modern lighting system. This suggests that designers and hospital administrators ought to emphasize innovations in user control for lighting systems installed in patient rooms, and should continue to carefully consider the extent to which daylighting sources are included in patient rooms—even when a leading edge hospital design model has been used.

Changes to the Lighting Environment for Nurses' Optimal Performance and Positive Experience

Fifty-seven nurses across the four hospitals offered comments in response to the item asking about what changes could be made that could improve their professional duties in patient rooms (or that would have a positive effect on their experiences at work). One hundred and forty-nine distinct comments were collected (16 of which were omitted because of a lack of relevance to the question). Thus, 133 usable statements were content analyzed.

Similar to the results of the previous item asking about the best lighting attributes in patient rooms, most words and phrases offered for the item concerning design improvements had to do with the theme of control (47 comments or 35%; see Table 4) and, within this theme, sub-categories emerged centering on nurses' sense of importance about their own control over light levels and accessibility of lighting controls. The amount of control patients had over their room's lighting was also commonly noted.

Table 4. Emerging themes and sub-categories across all four hospitals for comments made by nurses responding to the item: "For a typical patient room in which you work, are there any changes to the lighting that you think would help you in performing your professional duties, or that would have a positive effect on your work experience?"

Theme	Freq.	%	Sub-Category	Freq.	%
Control	47	35.34%	Light Level	28	60.87%
			Accessibility	7	15.22%
			Patient-related	5	10.87%
			Directional Lighting	3	6.52%
			Bathroom	2	4.35%
			Color	1	2.17%
Light Level	31	23.31%	Additional Lighting	6	46.15%
			Bathroom	3	23.08%
			Nighttime Issues	3	23.08%
			Psychological Effects	1	7.69%
Lighting Source	28	21.05%	Task Lighting	17	62.96%
			Fluorescent Lighting	8	29.63%
			Natural Lighting	2	7.41%
Maintenance	9	6.77%	N/A		
Directional Light	6	4.51%	N/A		
Color	5	3.76%	Nighttime Issues	1	100.00%
Flicker	3	2.26%	N/A		
Accessibility	2	1.50%	N/A		
Glare	1	0.75%	N/A		
Nighttime Issues	1	0.75%	Task Lighting	1	100.00%

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme. Number of comments in total = 133.

The second-most common theme across the facilities concerned brightness (31 comments or 23%) with most comments relating to the need for additional lighting sources (46%). In fact, the third-most common theme concerned lighting sources (28 comments or 21%) sub-categorized, mostly, as a need or preference for more or better task lighting. Thus, a theme of user control came forward for nurses commenting not only on the best attributes about patient room lighting across hospitals with different standards of care, but also as a facet that designers and decision-makers should continue to emphasize, monitor, and change to ensure an optimal work environment for nurses.

When comments were examined per site, the theme of control continued to emerge most commonly for two of the three hospitals using a traditional lighting standard (Hospitals A and B; see Table 5 for all frequency counts and percentages). At these hospitals, comments in this theme could be sub-categorized as being mostly concerned with light level (i.e., 73% of comments at Hospital A; 50% of comments at Hospital B). However, at the other hospital with a traditional lighting environment, and at Hospital D where a contemporary standard of lighting existed, a theme of light level in general emerged slightly ahead of a theme of control (36% and 32%, respectively for Hospital C; 27% and 24% for Hospital D). For both facilities, this theme of light level included only one comment more than the theme of control. This slight difference may suggest that nurses do not perceive light levels in general to be significantly more important than control when considering which lighting attributes should be altered in a typical patient room. In fact, control-related comments made by participants at Hospitals C and D could be sub-categorized as predominantly having to do with light level.

Table 5. Emerging themes and sub-categories per hospital for comments made by nurses responding to the item: "For a typical patient room in which you work, are there any changes to the lighting that you think would help you in performing your professional duties, or that would have a positive effect on your work experience?"

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
A (*n* = 42)	Control	16	38.10%	Light Level	11	73.33%
				Patient-related	2	13.33%
				Accessibility	1	6.67%
				Color	1	6.67%
	Light Level	8	19.05%	Additional Lighting	3	60.00%
				Bathroom	1	20.00%
				Psychological effects	1	20.00%
	Lighting Source	8	19.05%	Fluorescent Lighting	4	50.00%
				Task Lighting	3	37.50%
				Natural Lighting	1	12.50%
	Maintenance	7	16.67%	N/A		
	Directional Light	3	7.14%	N/A		
B (*n* = 30)	Control	14	46.67%	Light Level	7	50.00%
				Accessibility	3	21.43%
				Patient-related	2	14.29%
				Bathroom	1	7.14%
				Directional Lighting	1	7.14%
	Lighting Source	5	16.67%	Task Lighting	3	60.00%
				Fluorescent Lighting	2	40.00%
	Light Level	4	13.33%	Nighttime Issues	2	50.00%
				Additional Lighting	1	25.00%
				Bathroom	1	25.00%
	Flicker	3	10.00%	N/A		
	Accessibility	1	3.33%	N/A		

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
	Color	1	3.33%	N/A		
	Directional Light	1	3.33%	N/A		
	Maintenance	1	3.33%	N/A		
C (*n* = 28)	Light Level	10	35.71%	Additional Lighting	2	66.67%
				Bathroom	1	33.33%
	Control	9	32.14%	Light Level	5	62.50%
				Bathroom	1	12.50%
				Directional Lighting	1	12.50%
				Patient-related	1	12.50%
	Lighting Source	7	25.00%	Task Lighting	6	85.71%
				Fluorescent Lighting	1	14.29%
	Color	1	3.57%	N/A		
	Directional Light	1	3.57%	N/A		
D (*n* = 33)	Light Level	9	27.27%	Nighttime Issues	1	100.00%
	Control	8	24.24%	Light Level	6	66.67%
				Accessibility	2	22.22%
				Directional Lighting	1	11.11%
	Lighting Source	8	24.24%	Task Lighting	5	71.43%
				Fluorescent Lighting	1	14.29%
				Natural Lighting	1	14.29%
	Color	3	9.09%	Nighttime Issues	1	100.00%
	Accessibility	1	3.03%	N/A		
	Directional Light	1	3.03%	N/A		
	Glare	1	3.03%	N/A		
	Maintenance	1	3.03%	N/A		
	Nighttime Issues	1	3.03%	Task Lighting	1	100.00%

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme.

Overall, comments about control and light level represented over half of all comments received (56%). It would seem, as it did in our previous study with the same sample measuring quantitative aspects, that most nurses desire better control in order to increase or decrease light level, indicating that their perceptions of brightness and control are very closely related as attributes that ought to be optimized in patient rooms.

Another distinct theme that emerged equal to the second-most important theme of light level in Hospital A (i.e., 10% of comments made at that hospital), and control in Hospital D (i.e., 24%), had to do with the source of lighting. This theme was also the second- and third-most common in the data gathered at Hospitals B and C. Generally, sub-categories for this theme concerned task lighting (63%) and fluorescent lighting (30%) as aspects that nurses wished could be changed for the benefit of their performance and positive experience at work.

The importance of task lighting at nurses' stations and patient rooms has been stated in other research about nurses' work environments in med-surg and acute care units (e.g., Chaudhury et al., 2009; Hadi et al., 2016). For example, Chaudhury et al. (2009) reported on a focus group with nurses noting that inadequate task lighting can contribute to increased potential for professional errors in patient rooms during the dispensation of medication, charting, and performing procedures on patients. It would seem that, regardless of traditional or contemporary lighting environment standards in place in the four participating facilities, nurses continue to believe that changes to task and fluorescent lighting in patient rooms would be beneficial. In addition, Lavender et al. (2020) worked with 22 nurses, along with

participants from 23 other occupations, to develop detailed recommendations for med-surg patient rooms, including the recommendation to locate light switches consistently in all patient rooms, to design lighting so that it operates consistently, and to label all light switches to reduce staff, patient, and visitor confusion concerning which switch to use (thus, reducing patient disruption). These findings build on a previous assessment by Lavender et al. (2015) whereby staff preparing for clinical care noted the challenges of inaccessible light switches.

Nurses' Perceptions of Changes to the Lighting Environment to Enhance Patient Satisfaction

Eighty-three participants across all hospitals provided comments in response to the item asking about any changes that could be made to the lighting in patient rooms to afford a more positive experience for patients. Participants' comments were based on their own observations of patients, or on their recollection of specific feedback given by patients about their room. Ninety-seven distinct comments were collected; 15 were omitted because of a lack of relevance to the question; 82 usable statements were content analyzed.

Similar to the responses made to the previous two items, statements centered on control; 36 of the 82 comments (44%) across the four hospitals had to do with this theme (see Table 6). Like other items, many control-related responses concerned light levels, many responses also included the location of lighting in the room. The next most important theme concerned the need for additional lighting (18%); most comments had to do with lighting in patient room bathrooms and equipment in the room.

Table 6. Emerging themes and sub-categories across all four hospitals for comments made by nurses responding to the item: "For a typical patient room in which you work during the day, are there any changes to the lighting that you think would help the patients have a more positive experience—based on your observations and/or patient feedback?"

Theme	Freq.	%	Sub-Category	Freq.	%
Control	36	43.90%	Light Level	16	43.24%
			Patient-related	12	32.43%
			Location	6	16.22%
			Bathroom	1	2.70%
			Ease of Use	1	2.70%
			Lack of control	1	2.70%
Additional Lighting	15	18.29%	Bathroom	5	41.67%
			Equipment	3	25.00%
			Nighttime Issues	2	16.67%
			For Family	1	8.33%
			Overhead	1	8.33%
Light Level	9	10.98%	Decrease	5	35.71%
			Increase	4	28.57%
			Nighttime Issues	2	14.29%
			Bathroom	1	7.14%
			Overhead	1	7.14%
			Patient bed	1	7.14%
Light Trespass	8	9.76%	Hallway	6	66.67%
			Exterior	2	22.22%
			Double-room	1	11.11%
Change in Source Type	4	4.88%	Less Fluorescent	3	60.00%
			Increase Daylight	2	40.00%

Theme	Freq.	%	Sub-Category	Freq.	%
General Positive Comments About Existing Lighting	3	3.66%	N/A		
Color	2	2.44%	N/A		
Instruction	2	2.44%	N/A		
Calming Light	1	1.22%	N/A		
Night Staff	1	1.22%	N/A		
Soft Light	1	1.22%	N/A		

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme. Number of comments in total = 82.

When comments from each hospital were examined, the theme of control was, once again, the most important for those working at three of the four hospitals. For Hospital A, 52% of comments had to do with control, most of which concerned aspects from the patients' perspective (e.g., being able to control lights from a bed rather than a wall that is inaccessible from a bed, and the ability to dim lights). The second-most common theme in Hospital A concerned light level (17%), but most of these comments had to do with patients' desiring a decrease in light level. At Hospital C, where the top-most theme of control also emerged, a sub-category of light level was also most common. These results suggest that while participants desire increased light levels (and control over the light level) in patient rooms to do their job efficiently and well, they also perceive that, for patients to experience satisfaction, more control over the light level, possibly through dimming, should be implemented into patient room design. Interestingly, Davis et al. (2020) found that these same nurses reported strong preferences for higher light levels, especially at the patient's bedside. **The nuanced results of the qualitative data collected in the present study underscores that the preferences (and the perceptions of preferences) of different user populations remain a challenge to investigate comprehensively without a purposive mixed-methods research design.** Indeed, as lighting systems become more complex, facets of usability are worth studying in both staff and patient populations. As noted in Andersen (2015), lighting designers and engineers must continue to work to understand and integrate occupants' subjective experiences and perceptions into design.

At Hospitals B and D, with different lighting standards of care, the theme of control was once again most common (53% and 36%, respectively). Important sub-categories in these themes were also linked to patient-oriented aspects about controlling lights from bed, as well as capability for controlling light levels (see

Table 7 for all percentages). Only at Hospital D (with a contemporary lighting environment) did light trespass emerge as the second-most common theme after control (21%). Most of the comments concerning light trespass had to do with light entering patient rooms from hallways, while others related to light entering from the exterior of the building via windows in the room. This theme likely emerged because the hallways in the med-surg unit in Hospital D had windows into patient rooms. **This result suggests that lighting designers and hospital administrators investing in modern patient room build-outs ought to pay special attention to how the building's architecture, in combination with lighting and daylighting, affect the experience of patients and staff.**

Table 7. Emerging themes and sub-categories per hospital for comments made by nurses responding to the item: "For a typical patient room in which you work during the day, are there any changes to the lighting that you think would help the patients have a more positive experience—based on your observations and/or patient feedback?"

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
A (*n* = 23)	Control	12	52.17%	Patient-related	7	53.85%
				Light Level	4	30.77%
				Location	2	15.38%
	Light Level	4	17.39%	Decrease	3	42.86%
				Increase	1	14.29%
				Nighttime Issues	1	14.29%
				Overhead Lights	1	14.29%
				Patient Bed	1	14.29%
	Additional Lighting	2	8.70%	Bathroom	1	100.00%
	Color	2	8.70%	N/A		
	Lighting Source	2	8.70%	Less Fluorescent	1	50.00%
				Increase Daylight	1	50.00%
	Soft Light	1	4.35%			
B (n = 19)	Control	10	52.63%	Patient-related	4	44.44%
				Light Level	3	33.33%
				Bathroom	1	11.11%
				Location	1	11.11%
	Additional Lighting	4	21.05%	Bathroom	2	50.00%
				Equipment	1	25.00%
				Nighttime Issues	1	25.00%
	Light Level	2	10.53%	Decrease	1	25.00%
				Increase	1	25.00%
				Bathroom	1	25.00%
				Nighttime Issues	1	25.00%
	Light Trespass	2	10.53%	Double room	1	50.00%
				Hallway	1	50.00%
	Lighting Source	1	5.26%	Less Fluorescent	1	50.00%
				Increase Daylight	1	50.00%
C (n = 12)	Additional Lighting	5	41.67%	Bathroom	2	50.00%
				Equipment	1	25.00%
				Overhead	1	25.00%
	Control	4	33.33%	Light Level	2	40.00%
				Ease of Use	1	20.00%
				Lack of Control	1	20.00%
				Location	1	20.00%
	Light Level	2	16.67%	Increase	2	100.00%
	Calming Light	1	8.33%	N/A		
D (n = 28)	Control	10	35.71%	Light Level	7	70.00%
				Location	2	20.00%
				Patient-related	1	10.00%
	Light Trespass	6	21.43%	Hallway	5	71.43%
				Exterior	2	28.57%
	Additional Lighting	4	14.29%	Equipment	1	33.33%
				Family	1	33.33%
				Nighttime Issues	1	33.33%
	General Positive Comments	3	10.71%	N/A		

Hospital	Theme	Freq.	%	Sub-Category	Freq.	%
	Instruction	2	7.14%	N/A		
	Light Level	1	3.57%	Decrease	1	100.00%
	Lighting Source	1	3.57%	Less Fluorescent	1	100.00%
	Night Staff	1	3.57%	N/A		

Note: Freq. = Frequency count; N/A is denoted where no distinct sub-categories were apparent to raters in comments within a theme.

Additional lighting was also an important theme for nurses as they considered what might enhance patients' experience and satisfaction in their room: this was the second-most and third-most important theme in Hospitals B and D, respectively. Moreover, additional lighting was the primary theme emerging for those working at Hospital C (42%), followed by control (33%). Thus, two foci emerged for nurses when they considered what would enhance patients' experiences with the physical environment of their hospital room. While more control over lighting in patient rooms is important, having additional sources of light is as well. These themes emerged for nurses working at each of the hospitals participating in the study, suggesting that even with a modern lighting system in place at one facility, the same attributes remain necessary with a need for improvement.

We know that themes of affording patients more control over lighting, and introducing more sources of lighting, are consistent with Ulrich's (1991) theory of supportive design. One key aspect of this theory relates to the role of having greater control over the physical environment. Arguably, recent design recommendations for patient rooms that include providing patients with control over electric lighting and window shades from the bedside (see Lavender et al., 2020; Quan, Joseph, & Nanda, 2017) can reduce the number of requests made to nurses from patients. Taken together, the findings of this qualitative study with nurses across four hospitals echo those found in our previous study—evolving lighting approaches and technologies are worth considering as an investment by hospital administrators looking to improve perceptions of the patient room environment. **Our work suggests that facilities managers and designers must continue to innovate with respect to offering more control over unit lighting environments to both patients and staff, allowing them to adjust light fixtures and, perhaps, increase the number and type of overhead and task lighting fixtures in patient rooms.**

Conclusion

This paper used a systematic qualitative methodology to compile and interpret med-surg unit nurses' subjective responses to three open-ended items from a previous study done in four hospitals in the Pacific Northwest region of the United States. Two of the three items asked nurses to report their perceptions of patient room lighting in relation to their professional duties, both positive and negative. The third asked for their perspectives on what may benefit patients with respect to the lighting environment in these rooms. Three of the facilities (i.e., Hospitals A, B, and C) had older, more traditional lighting systems installed, while one (i.e., Hospital D) had a more contemporary lighting framework.

After a systematic content analysis was performed on participants' comments, a general theme of environmental control emerged from words and phrases offered in response to all three items. The ability to control both overhead and task lighting in patient rooms remains very important to nurses. Although controllability was reported as being among the 'best' lighting attributes in typical patient rooms, it was also something that nurses thought ought to be considered further and altered by designers, facilities managers, and other decision-makers to refine these spaces for the productivity of staff, as well as for the satisfaction of patients. While not mentioned as frequently as control, daylighting

was also considered to be among the best lighting-related design attributes in patient rooms, supporting a growing body of interdisciplinary literature that indicates positive associations between exposure to daylight and wellness at work.

Control over the light level in patient rooms by providing additional dimming capability for patients, as well as additional light sources, also came forward as prominent points in nurses' narratives across the four hospitals. Unique to Hospital D, the trespassing of light was reported as an issue for nurses considering the experiences of patients, suggesting that even when modern lighting models are in place, as they were in Hospital D, more attention can be paid to the ways in which window shades, and light sources outside of patient rooms, penetrate spaces and affect users. Thus, further optimization of lighting frameworks in hospital patient rooms is necessary and desired by nursing staff. Despite differences in the level of technology and sophistication in lighting frameworks among the four facilities, lighting control continues to be a primary concern for med-surg nurses.

The evidence that nurses and patients desire greater control over the lighting in patient rooms is consistent with Ulrich's (1991) theory of supportive design for healthcare, and also coincides with recent advances in lighting technology. Today's LED lighting systems for patient rooms provide opportunities to control the intensity and the spectrum of lighting in ways that were either not possible, or that added significant cost, with fluorescent lighting used in traditional (and some contemporary) systems. The ability of newer systems to adjust the spectrum of white light, and introduce colored light, provides further opportunities for patient room lighting to support a holistic set of patient and staff needs—these opportunities were not available from the lighting systems included in this study. As we learn more about the benefits that these new features afford, healthcare designers, planners, and administrators alike can explore new opportunities to improve the patient room environment through innovative lighting approaches.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest.

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