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Survey of Hospitals Lighting: Daylight and Staff Preferences

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Abstract Hospital staff's preferences for daylighting to notions of the effects of daylight on patient's recovery times and processes, their experiences of daylight when treating and diagnosing patients and patient comfort levels is studied. A questionnaire survey was developed as a tool to review subjective judgments of the staff lighting needs and satisfaction. Responses obtained from one hundred and thirty four staff showed that seventy nine percent of the participants identify daylight in patient's room as a factor helping them do their work more easily, and Seventy seven percent of the surveyed nurses and doctors claimed that daylight is an important element in patient rooms to aid in reviewing patient recovery through recognizing and interpreting changes in patient skin color. Seventy eight percent of hospital nurses and all the surveyed doctors believe that daylight has many health benefits including fast recovery and reduced length of stay for patients. Moreover, ninety two percent of the surveyed staff stated that patients preferred to stay in rooms with access to daylight as it makes them feel comfortable. These results should be taken on board by hospital designers and regulation makers as an indication of the importance of using good daylight in hospital wards to achieve two important goals of improving both hospital staff working conditions and the patient's healing environment.

Keywords Daylight, Survey, Hospital Lighting, Staff Preferences, Patient Comfort, Recovery Process

1. Introduction

Good daylighting design in hospitals does not just depend solely on the aesthetics or engineering of a space, but it is strongly influenced by the psychology of the viewer, the behavioural opportunities available to them and the interactions between these factors and the Architecture of the space itself. Our knowledge with these interactions is still limited and has been hampered over the last half century by the growing dependence on engineered solutions over less prescriptive and product oriented building designs. Daylighting is commonly understood to enhance comfort and well-being for building occupants[1]. Architects were traditionally masters of daylighting design although in recent decades the increasingly heavy hand of both regulation and standardization of design has led to a significant reduction in the quality of daylighting design in most types of buildings [2]. People in different places and climates respond to the light in very different ways and experience it in terms of what is recognized and felt, not only as visible spectrum. The desert dweller may shun large windows because of excess light and thermal gain while the northern Tundra dweller

will have almost the opposite response as they seek out the visual, thermal and health benefits of sunlight.

Sunlight and human health has shown strong relation in terms of improving wellbeing or causing serious disease. The role of sunlight to boost the body's crucial vitamin D supply was presented by many researchers such as Mead; Altomonte and Osmanovic et al[1, 4, 5]. A recent study by Lusk and Lash has described the light as an important element in hospital to improve mood and reduce stress[3], and it's well-known that sunlight was used as treatment of tuberculosis in the 19th century sanatoria where a TB bug is killed after five hours in sunlight[4].

Beauchemin and Hays found that treating patients in sunny hospital rooms can reduce their stays in hospital compared to other patients in dull rooms[12]. Moreover, Walch et al found that sunlight can work as analgesic therapy for patients and therefore can reduce the use of painkilling medication in hospitals[16]. The power of light in healing psoriasis, herpes and skin disorders were described in a recent study by Osmanovic et al as a reliable curing source [5]. In addition, many studies found that a lack of exposure to sunlight causes many illnesses and syndromes such as vitamin D deficiency, cancer, bone diseases, stress, depression, seasonal affective disorder (SAD) and disturbs the circadian rhythms[1, 3, 4, 6].

A hospital's physical environment is seen as a place imbued with high levels of stress for both staff and their

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vulnerable patients and their families due to its nature[7]. For hospital staff stress can be exacerbated by long hours, the human situations they deal with and the need to avoid making mistakes because of their potential high impact consequences. For patients, research has shown that hospitals are stressful places for three types of reason:

1) Psychological: Patients perceive a hospital as a potential last place they visit in their life (danger of death) and it is also a place where they become socially isolated[8].

2) Fear of the pain inflicted by and the consequences of procedures associated with their treatment exacerbated by the visual reminders of being surrounded by the types of machines that are with both.

3) The hospital environment itself is perceived as abnormal, alien and possibly hostile environments, due to its special activities, odors and noises, especially noises resulting from the pain of other patients[9].

Researchers have investigated a range of factors that reduce the stressfulness of the hospital environment and increase the comfort experienced by both staff and patients, with the aim to increasing their well-being, reducing medical errors and improving patient's recovery times. These studies concluded that lighting regimes in hospitals play an important role in improving hospital environment for staff and patients[6, 12, 14].

This paper investigates the impact of daylight in the hospital in making staff work easier, increasing patient comfort and reducing the duration of patient stays in hospital. The study presents the findings of a survey distributed to hospital staff designed to explore their subjective judgments on daylight and their experience with its impact on their work and on the patients. The needs of the human body in relation to lighting can be categorized into two groups: biological and visual lighting needs. These two needs require balance in any lighting design, as health and performance problems can occur when there are inadequate light levels for biological stimulation or higher light level for visual tasks[18].

1.1. Patient Recovery and Comfort

Recent research has led to an understanding of some factors that influence the recovery of patient in a healing environment such as hospitals[12, 35]. Daylight is seen as one of these factors due to its visual and non-visual impacts on the human body[13]. Studies that have surveyed the impact of daylight on mood or specific task performance in hospitals are very few which trigger the need for more research in this field[21]. A survey conducted at a healthcare facility in Turkey found that hospital staffs have access to sunlight during the working day feel less stress and more comfort[20]. Another study carried out at health care center to explore the impact of natural light on hospital staff comfort found that more than forty percent of the surveyed staff perceive the natural light in their workplace as having positive impact on their work[23]. However, in most hospitals, nurses' stations lack the necessary exposure to

natural light. Therefore there is a need for further studies to understand the significance of sunlight to staff, and its impact on their mood and performance. In addition, some studies on the relation between sunlight and patient healing time suggest that daylight is one of the factors that would help in reducing the length of patient's stay in hospitals[6, 12]. Not only the visual spectrum of sunlight affects the mood and comfort but the non-visual effects of light can have important impact as well and can contribute to reducing depression among people as suggested by recent studies[28]. Three impacts of the light effect on the human body are often cited:

1) Physiologically: daylight has the effect of stimulating the human circadian system and human visual system[14]. When light enters the eye it stimulates a complex process of endocrine and autonomic responses that occur inside the human body. Psychologically it can make a patient feel more comfortable and at ease and this improves mood and the immune system in the body[3].

2) Psychological: a study demonstrated that daylight can help reduce the use of pain killer drugs for patients in a retrospective study on two types of patients. The first of which stayed in the bright rooms and others in dimmed rooms. It was noted that those who stayed in brighter rooms perceived less pain and took fewer analgesics, indicating that they were less stressed[16].

3) Sociability: Lighting affects the emotional and behavioral responses of patients. This had been referenced in some studies which demonstrate the significant impact of daylight on the patient's perceived sociability, emotion and behavior[18,19].

1.2. Staff Comfort

4) Health care facility is a people-centric industry. A variety of professionals are involved in providing different services that include healthcare, medicines, therapy, food, hospitality and extensive use of materials and equipment. Hospitals are often challenging workplaces and can place staff under extremes of stress. Therefore, it is important to give staff easily managed working environments in terms of spatial planning and appropriate visual comfort[13]. The need to minimize the risk of failure in executing necessary tasks requires good visibility by providing sufficient light quantity, with consideration of the nonvisual issues of lighting quality to enable staff to operate optimally. Studies have identified some of the negative factors that significantly impact staff such as inappropriate lighting lux level, color, direction and setting[14, 19, 21]. Other studies suggest a range of positive impacts of lighting on patient and staff well-being arises from many factors which include daylight effects[15, 26, 27].

A key issue for medical staff is the need to identify the changes in the patient's skin color which occurs with physiological changes inside the body. For instance, when a patient's skin becomes yellow it may be due to some liver problems, blue skin color might result from breathing

problems or red because of skin problems.

On the other hand, color changes may result from an improvement in a person's health over time. Therefore it's important to recognize the patient skin color and to do that we need a light type that helps staff easily see these changes and distinguish between them[16]. Researchers have studied the influence of light types on the object's color appearance and found that Color Rendering Index CRI is the reference for lighting ability to give the objects its true color. The high CRI means actual object color. Daylight is considered as owning the highest Color Rendering Index CRI reaching one hundred percent[33, 36]; therefore it's very desirable to have it in any applications that need true colors, such as in hospitals where observing any changes in patient's skin color may be crucial[17].

1.3. Previous Questionnaires

Many survey questionnaires have been conducted to explore the relationship between employee performance and few of these surveys look at the relation between light and patient comfort with daylighting[22, 23, 25]. In a survey conducted at a newly constructed healthcare center in Malaysia, the author of the study showed that staff age has a strong impact on the selection of daylight preference when treating patients[24].

Over sixty percent of participants (nurses) of forty years old or under believed that serving medication orally for patients in open wards with natural lighting is hassle-free, while older nurses expressed their dissatisfaction in performing the same task with natural lighting.

The number of years of experience was another subject studied during one survey, where it was shown that over fifty percent of the hospital professionals who have different years (more than three years) of work experience performed one task using artificial lighting without having difficulty. Less than eighteen percent with less than three years' experience stated that they found some difficulty in performing the same task with natural light[24].

In a study conducted at an office building in South Korea by Geun Young Yun[25], a field survey on illumination levels and light type showed that employees felt more comfortable with good daylight entering into the office, especially when the brightness level was adequate. It demonstrated that a linear relationship exists between the comfort illuminance and the level of illuminance perceived by occupants as being neither bright nor dim. Applebaum et al conducted a survey to explore the relationships between environmental factors like light and perceived stress for nurses.

The study showed a relationship between staff working in acute-care settings and observed stress which was reduced when working in an area lit with daylight. This could be the result of the nature of the acute-care area and the type of light

it used to have (dimmed)[27].

2. Methodology

In the current study a structured interviews technique were selected to collected data from a focus group, face to face interviews were conducted to explore the staff satisfaction with hospital lighting in which the questions were read as it's written on the questionnaire without explanation or clarification. The survey was administered from January 2nd till April 2nd 2013. The questionnaire was aimed at hospital professionals who visit the patient on a daily basis. The survey initially tested with fifteen volunteered participants (pilot survey) to ensure clear and understandable content of the questionnaire, in the next stage, one hundred and thirty four participants volunteered to participate were asked twenty eight questions, but for the purpose of this study we will present their response on four questions that show their preference and experience with daylighting at patient rooms.

The study was conducted at Hamad General Hospital (HGH) the central healthcare facility in Doha, Qatar. The hospital contains 603 beds that offer different health support departments, such as emergency medicine, pediatrics, specialized surgery, critical care, laboratory medicine, specialized medicine, and radiology services[28]. It provides health care services to more than 600,000 people.

The primary focus group consisted of doctors, nurses, administrators and auxiliary staff, the subjective judgment was assessed by the means of a questionnaire. The qualitative professional judgments of staff used as the reference indicator, surveyed in the study for a range of types of work, as daily observations in different patients' rooms.

2.1. Questionnaire

In order to explore the relationship between staff preferences for hospital lighting and current lighting design standard, twenty eight questions have been asked. In this paper we consider the analysis of only four questions and focus on the two groups, nurses and doctors. Following a verbal introduction to the nature and purpose of the survey and acquiring the background information about the participant, the subjects were then asked to rate their satisfaction with the following four questions:

1. Do you think it is easier to treat patients in a room with daylight?

Strongly agree Agree Neither
 Disagree strongly disagree

2. If identifying changes in a patient skin colour is important to you, do you find it easier to do it in a room with daylight?

Strongly agree Agree Neither
 Disagree strongly disagree

3. In your view, do rooms with daylight help patients feel more comfortable and at ease?

- Strongly agree
- Agree
- Neither
- Disagree
- strongly disagree

4. In your opinion, do wards with daylight help patients recover faster?

- Strongly agree
- Agree
- Neither
- Disagree
- strongly disagree

2.2. Sample Size

An important question in any survey is how many participants are needed to make the survey statistically significant, an issue that needs to be determined before the beginning of the survey to ensure useful results[29]. There are many factors that influence this selection, such as the main aims of the survey, the required precision level for results and anticipated response rate. For the current survey a large number of randomly surveyed staff were targeted who were selected from a range of different professional groups working in the hospital. Thus we were able to harvest opinions from most of the working staff in the hospital. In answer to the question of the optimal size for the group surveyed, we referred to the work of Niles[30] who defined a suitable confidence interval for the result with the following the equation:

$$K = 1/\sqrt{N} \tag{1}$$

Where:

K is the confidence interval

N is the number of participants or sample size.

In this study 134 subjects were selected to ensure an acceptable margin of error[31, 32].

2.3. SPSS

For the purpose of this study IBM SPSS Statistics software was used to analyze the staff responses to the survey questionnaire. This software was developed by IBM and is used mainly for handling data, running statistical analyses, and producing tables or graphs to summarize the data. Its features, including the ability to work on different variables at the same time and the range of the tools included in it, it's been considered satisfactory for use in this analysis of the survey database and table production[32]. Especially useful here were the functions it contains for recoding data, tables, graphs and adding many new variables.

3. Results and Discussion

The participants were randomly selected from the professional groups in the hospital including doctors, nurses, auxiliary staff, administrators and technicians, who were asked to participate voluntarily in this survey. Nurses represented the highest percentage of those interviewed as they represent the majority of staff in the hospital. The proportion of staff from different groups in the survey is shown in Table 1.

Figure 1 shows that seventy nine percent of the staff believes that daylight in patient's room helped them do their work more easily, including treating and diagnosing patient health and monitoring their recovery. This is an important finding, especially because it springs from people who spend most of their working day inside the hospital and are thus well versed in the relative merits of daylight versus artificial lighting. Nineteen percent of respondents expressed their uncertainty in responding to this statement. Two percent of the participants disagreed with this statement as they don't consider daylight an important factor that can make their work easier.

Table 1. Participant Staff by groups

Group	Percent
Administrators & technicians	8%
Auxiliary staff	13%
Doctor	7%
Nurse	58%
Technician	14%

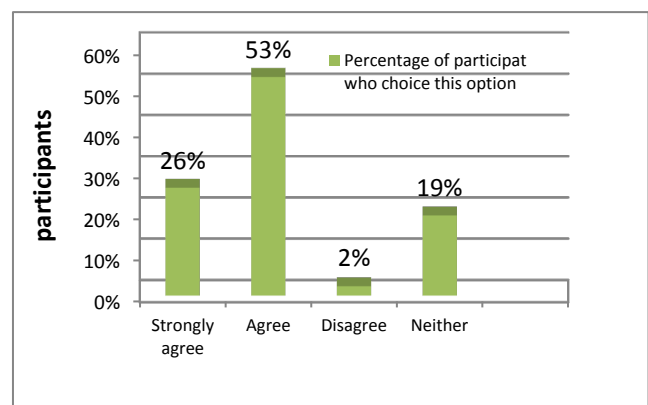


Figure 1. Treat Patient in room with Daylight

Responses from the professional groups on the first question are presented in Table 2. It showed that eighty one percent of the nurses who give treatment to patients support the opinion of having daylight in the patient's room and see daylight as a factor which helps them do their work more easily at the hospital. Most of them said "we feel more comfortable when treating patients in rooms with daylight". All participants from the doctors group showed strong agreement with this statement. Nineteen percent of the nurses groups were unsure whether daylight can make their work in the patient rooms easier. This could be due to other factors which are not linked to the type of the profession, such as age, work shift or years of experience as stipulated in earlier study[24]. However, these factors were not investigated in this study. On the other hand, participants who chose neither as answer or disagreed with the statement came from non-medical staff such as administrators and technicians, who don't spend much of their time in patient rooms or their work is not linked to the patient treatment.

For the second question, the responses were analyzed and the results on the hospital's professional groups who believe that daylight can help identifying changes in a patient skin

colour are shown in Figure 2. Staff were asked if they find it easier to identify changes in a patient’s skin colour in a room with daylight. The results confirmed that the perception of seventy one percent of the staff think daylight plays an important role in recognizing changes in patient skin color. The daylight features of providing brighter light source during the day and having a more balanced colored spectrum than other light sources contribute to it being a suitable source to be used in patient rooms. Two percent of the staff disagreed with this statement as they don’t consider that daylight has this capability, while twenty seven percent were unsure of the ability of daylight helping them see changes in patient’s skin color.

Table 2. Daylight Preferences when Treat Patient

Status	professionals	Percentage
Strongly agree	Administrator	6%
	Doctor	7%
	Nurse	13%
Agree	Auxiliary staff	13%
	Nurse	34%
	Technician	6%
Disagree	Administrator	2%
Neither	Nurse	11%
	Technician	8%

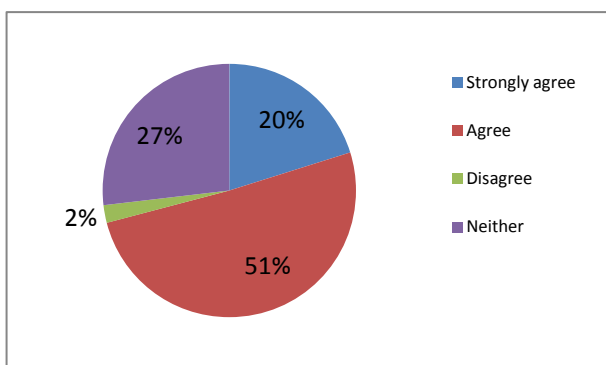


Figure 2. Daylight helps identify patient skin colour

Table 3. Daylight helps identify patient skin colour (by profession)

Status	Profession	Percentage
Strongly agree	Auxiliary staff	13%
	Doctor	7%
Agree	Nurse	45%
	Technician	6%
Disagree	Administrator	2%
Neither	Administrator	6%
	Nurse	13%
	Technician	8%

Question two’s groups were represented in Table 3. The interesting finding is that all doctors participating see daylight as an important factor that can help facilitate their work with the patient, including diagnosis of patient true skin color. Seventy seven percent of the nurse group agrees with this concept and twenty three percent of them are not certain of this idea of daylight’s role in facilitating the diagnosis of

the patient’s changes in skin color. This response from hospital’s staff highlights the need for a hospital architect to take into consideration the effect of daylight on hospitals rooms.

The results of the question asking whether daylight makes patient feel comfortable are shown in Figure 3. A very high percentage (ninety two percent) of the staff agreed with this statement highlighting the need for hospital designers to take this fact on board. This finding also confirms the results of earlier studies on the positive psychological effect of daylight[12, 13, 22].

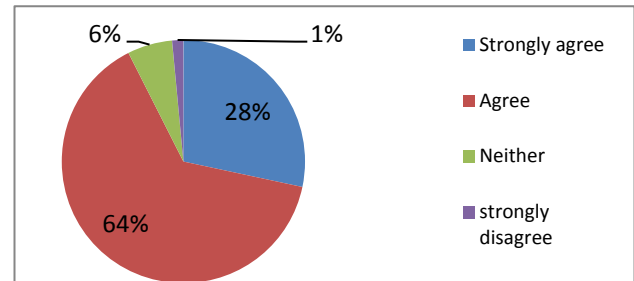


Figure 3. Daylight makes Patient Feel Comfortable

Staff groups who supported the idea of the positive psychological effect of daylight in making patients feel more comfortable were seven percent doctors, fifty six percent nurses. This means almost all doctors and nurses observe the effects of daylight on patients and how it makes them feel comfortable. One percent of the surveyed nurses disagreed with this option. This disagreement with nurses might be due to other factors such as the type of patient illness they work with (i.e. those in intensive care units who don’t have access to daylight or who may have sensitivities to sunlight). The results of the groups’ reply are shown in Table 4.

Table 4. Daylight makes Patient Feel Comfortable

Status	Profession	Percentage
Strongly agree	Administrator	8%
	Auxiliary staff	13%
	Doctor	7%
Agree	Nurse	56%
	Technician	8%
Neither	Technician	6%
	Nurse	1%
strongly disagree	Nurse	1%

As discussed earlier, reducing the length of stay for patients in hospital has large cost benefits for most involved parties, including reduced health care costs for patients and for hospitals[34]. It means a faster turnover rate for beds and enhanced reputation for healing. Moreover, when the healthcare facility is funded by the government (e.g. non-profit facility), it means reduction in the running cost.

The subjective judgment of the surveyed staff shows that eighty two percent of the hospital staff see daylight as an element that can help speed up the recovery process for patients and hence reduce the length of stay in the hospital. However, eighteen percent of the staff were uncertain of the health, comfort or diagnostic benefits of daylight. The

reasons for this were not identified in this study but point to the need for further work in this field.

The agreement among the doctors group reveals that all the surveyed doctors are in consent with this feature of daylight (healing feature), seventy eight percent of the nurses have concluded from their experience with patient and healing process that daylighted rooms result in fast recovery of the patients, twenty two percent of the nurses were unsure of this statement applicability when linked to patient recovery time; the same is illustrated in Table 5.

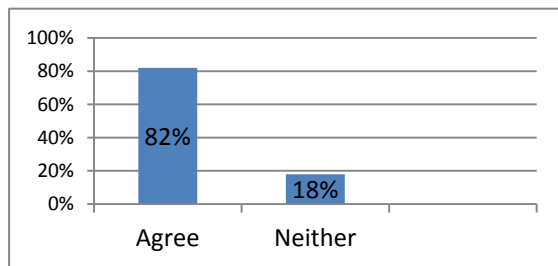


Figure 4. Daylight makes Patient Recover Faster

Table 5. Daylight makes patient recover faster

Status	Profession	Percentage
Strongly agree	Administrator	7%
	Doctor	4%
	Nurse	1%
Agree	Administrator	1%
	Auxiliary staff	13%
	Doctor	3%
	Nurse	44%
	Technician	8%
Neither	Nurse	13%
	Technician	6%

4. Conclusions

This study has confirmed that hospital staff perceive daylight to have a strong health, comfort and diagnostic benefit for staff and patients in hospital wards. The study provided clear evidence of the subjective judgment of hospital staff showing:

- Seventy nine percent of the participants identify daylight in patient's room as a factor helping them do their work more easily.
- Seventy seven percent of the surveyed nurses and doctors claimed that daylight is important element in patient rooms to aid in reviewing patient recovery through recognizing and interpreting changes in patient skin color.
- When it comes to patient comfort ninety two percent of the surveyed staff stated that patients preferred to stay in rooms with access to daylight as it makes them feel comfortable.
- Seventy eight percent of hospital nurses and all the surveyed doctors believe that daylight has many health benefits including fast recovery and reduced length of stay for patients.

This study has presented the view of people who deal with patients on a daily basis and do their work with different lighting regimes (with and without daylight). The clear evidence presented above of the perceptions of hospital staffs of the health, comfort and diagnostic benefits of daylight spaces should be taken on board by hospital designers as an indication of the importance of using good daylight in hospital wards to achieve two important goals of improving both hospital staff working conditions and the patient's healing environment.

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