Investigation of Visual Comfort to Bedside Light in Hospital Wards

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Abstract- Patient satisfaction has evolved as an important tool to evaluate high-value care being given to patient. Also, design of the physical environment is increasingly recognized as an important attribute in patient care. Patient has to cope with not only the disease but also with changes in environmental factors on hospitalization. Light in healthcare environment is known to influence physical and emotional well-being of patients and also enhance their recovery. Optimum bedside lighting condition is vital for patient's personal needs and comfort and also for activities such as clinical examinations, various tests and procedures as also nursing care. The present study was undertaken to test visual comfort relative to bedside light. A structured, interviewer guided questionnaire was used to evaluate 136 adult patients who visited three multi-speciality hospitals and results were compared to standards. The 136 patients consisted of 82 males and 54 females with a mean age of 31 years (±13). Of these patients 72% were satisfied with bedside daylight levels and 68% patients were satisfied with bedside artificial light levels. Dissatisfaction was mainly due to excessive illumination/ glare from brightness of light sources and reflecting surfaces, spotty appearance of light in certain areas in the room especially those near the windows. On the other hand, in ward areas where lux levels were low patients had difficulty in performing routine tasks like eating, reading, etc. The results suggest that patient satisfaction is related to adequate levels of bedside light and practical recommendations can improve visual comfort of patients in ward.

Index Terms- Bedside light, multi-speciality hospital, patient perception, visual comfort

I. INTRODUCTION

Post-occupancy evaluation in hospitals:
Post-occupancy evaluation of buildings ask questions and provide answers on how buildings actually work in technical, social and management terms for the end-users (Ulrich 2008). They can have a significant impact on creating change in terms of improving use of any building (Enright 2002; Zimring & Reinzstein 1980). Preiser et al. (1988) defined post-occupancy evaluation (POE) as the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time. Linder et al. 2011 studied the characteristics of the bedside care environment like sound, light, and temperature for children with cancer. Shepley in 2002 conducted pre and post-occupancy analyses of staff behaviour in a neonatal intensive care unit using surveys and behavioural mapping techniques. Several studies have used post-occupancy evaluation and analysed effect of environmental factors on hospital patients (Kazanjian et al. 2005; Aiken et al. 2011) and staff (Mroczek et al. 2005; Tumulty et al. 1994).

Light and health:
The wards in hospitals form the largest component of any hospital setup. It is here that patients and their families, caregivers and administrators come together for the common purpose of restoring a patient to good health. The characteristic of the physical environment in which a patient receives care affects patient outcomes, patient satisfaction, patient safety, staff efficiency, staff satisfaction and organizational outcomes. Light is an important component of this physical environment. An adequate lighting and minimum glare are fundamental requirements for good visual performance (Morghen et al.2009). Light enables performance of visual tasks and is indispensible for visual function. Light falling on the retina helps regulate the biological clock and also neuroendocrine functions of the body (Arendt 2010, Turner 2009). Previous studies have shown a positive association between abundant daylight levels and physical and psychological well-being after illness or injury (Hansen 2001, Schernhammer et al. 2001, Stevens RG et al. 2007, Meyer TJ et al 1994). It is thereby essential to understand the lighting requirements of various spaces and functions.

Light and hospitals:
Ambient lighting is general lighting in a room for walking round, conversation and identifying objects. Daylight from windows and skylights can also provide ambient lighting. Bedside lighting provides higher light levels in a specific area for performing visual tasks, such as reading, sewing and cutting (Wenham T & Pittad A, 2009). The adequacy of lighting is a quantitative requirement, which depends on the visual task; contrast, fineness of detail and the speed at which the view changes. Also, visual comfort is an important qualitative determinant of adequacy of lighting.
The present study acknowledged the importance of an evidence-based approach to hospital design. The present study by use of POE (Post Occupancy Evaluation) method aims at evaluating user satisfaction for light levels and also suggests practical recommendations for enhancing the patient comfort levels to light.

II. METHODOLOGY

Objectives

The objectives of the study were:

- To objectively measure and compare bedside illumination levels to the visual comfort of patients in wards.
- To compare preferred illumination levels to lighting standards.
- To make suggestions for further improvements based upon the results.

Study site

The investigation was conducted in three multi-speciality hospitals located in Belgaum, Karnataka, India in general/special ward with patients admitted for a variety of ailments. Two types of techniques were used to obtain the results. One was objective photometer measurements that recorded the light levels in the hospital ward. The other was a subjective survey taken by qualified patients that met predetermined specifications and gave consent to participate. While objective measurements can tell us one aspect of the study, it is necessary to assess patient perception data as well.

Measurement procedures

Photometer was pre-calibrated with proper batteries. About 15 minutes for battery fatigue was allowed and lights were switched "on" for 15 minutes in case of florescent or CFL's for actual outputs. The actual illumination levels were measured in "as is" condition. The data collected for lux levels at bed height (600mm) at minimum number of locations as per Bureau of Energy Efficiency (BEE) criteria in the ward (BEE Code Lighting, 2006). While measuring day light component all artificial lights were switched off and measure the amount of daylight. (Due consideration for the sky condition to be given).While measuring artificial light shut all blinds tightly to record the artificial light component (or could be measured at night). Task light shall be measured with and without ambient light.

Participants

In order to accurately obtain patient perception data, specific questions need to be asked by a questionnaire. Voluntary, subjective questionnaire were given to patients to determine their perceptions and satisfaction with ambient light levels during their in-patient stay. 136 consecutive patients were recruited for the study of which 82 (60%) were males and 54 (39.7%) were female patients. The survey data was distributed and collected at 8 hrs, 12 hrs, 16 hrs and 20 hrs respectively. The subjects were recruited as per the following criteria. Subjects were at least 18 years old or older and able to understand cognitively the survey. The study was approved by hospital ethics committee and all measures and procedures in the study were compliant with ethical standards, particularly regarding informed consent and privacy of patients' information. Data obtained was analyzed using the statistical software package SPSS 15.

III. RESULTS AND DISCUSSION

There is a significant variation in illumination levels within the same ward. There is a variation in the day light distribution across the ward largely due to size of ward, orientation, window type, shading type and different elevation of the wards. In our study 72% patients were satisfied with bedside daylight levels and 68% patients were satisfied with bedside artificial light levels. Chun-Yen Tsai et al. (2007) studied the patient perception of physical environment of waiting areas. They found that visual conditions might indirectly influence patient's perceptions of the visual feelings as a whole. In a similar study by Senarath & Gunvardena (2011) the researchers concluded that nursing care is always associated with underlying support services of hospital such as maintenance of cleanliness, ventilation and lighting in the wards.

At the bed area of the patients during 0800 hrs to 1600 hrs, there is a higher percentage of satisfaction for illumination levels range 50 to 150 lux and 150 to 300 lux (Table1-4).

Table– 1 Bed Side Lux levels measured at 0800hrs

Lux levels		Patient :Visual Comfort		Total
		Not satisfactory	Satisfactory	
>50	Count	14	9	23
	% within LLB8H	60.90%	39.10%	100.00%
51-150	Count	4	51	55
	% within LLB8H	7.30%	92.70%	100.00%
151-300	Count	2	25	27
	% within LLB8H	7.40%	92.60%	100.00%
301-500	Count	5	12	17
	% within LLB8H	29.40%	70.60%	100.00%
> 500	Count	5	9	14
	% within LLB8H	35.70%	64.30%	100.00%
Total	Count	30	106	136
	% within LLB8H	22.10%	77.90%	100.00%

Pearson Chi-Square value= 32.568(a) P= 0.00 (highly significant)

Table-2 Bed Side Lux levels measured at 1200hrs

Lux levels		Patient :Visual Comfort		Total
		Not satisfactory	Satisfactory	
>50	Count	12	3	15
	% within LLB8H	80.00%	20.00%	100.00%
51-150	Count	1	40	41
	% within LLB8H	2.40%	97.60%	100.00%
151-300	Count	3	56	59
	% within LLB8H	5.10%	94.90%	100.00%
301-500	Count	4	7	11
	% within LLB8H	36.40%	63.60%	100.00%
> 500	Count	2	8	10
	% within LLB8H	20.00%	80.00%	100.00%
Total	Count	22	114	136
	% within LLB8H	16.20%	83.80%	100.00%

Pearson Chi-Square value= 59.534(a) P= 0.00 (highly significant)

Table-3 Bed Side Lux levels measured at 1600hrs

Lux levels		Patient :Visual Comfort		Total
		Not satisfactory	Satisfactory	
>50	Count	4	8	12
	% within LLB8H	33.30%	66.70%	100.00%
51-150	Count	8	58	66
	% within LLB8H	12.10%	87.90%	100.00%
151-300	Count	4	29	33
	% within LLB8H	12.10%	87.90%	100.00%
301-500	Count	2	4	6
	% within LLB8H	33.30%	66.70%	100.00%
> 500	Count	15	3	18
	% within LLB8H	83.30%	16.70%	100.00%
Total	Count	33	102	135
	% within LLB8H	24.40%	75.60%	100.00%

Pearson Chi-Square value= 42.708(a) P= 0.00 (highly significant)

Table-4 Bed Side Lux levels measured at 2000hrs

Lux levels		Patient :Visual Comfort		Total
		Not satisfactory	Satisfactory	
>50	Count	15	75	90
	% within LLB8H	16.70%	83.30%	100.00%
51-150	Count	3	35	38
	% within LLB8H	7.90%	92.10%	100.00%
151-300	Count	0	1	1
	% within LLB8H	0.00%	100.00%	100.00%
301-500	Count	5	0	5
	% within LLB8H	100.00%	0.00%	100.00%
Total	Count	23	111	134
	% within LLB8H	17.20%	82.80%	100.00%

Pearson Chi-Square value= 26.650(a) P= 0.00 (highly significant)

Todd et al. (2002) carried out an investigation of assessment of attitudes to and perceptions of the built environments of NHS trust hospitals. They found that patient's perceptions of a hospital environment were also influenced by ability to control factors such as lighting and heating in the environment.

The satisfaction levels decrease for illumination levels below 50 lux and illumination levels above 500 lux. The dissatisfaction to higher illumination levels was particularly observed during evening hour. Patients reported glare due to sunlight as the most common cause of discomfort at 1600 hrs. Similarly, dissatisfaction to lux levels below 50 lux was seen at 0800 hrs. A possible explanation for this could be the circadian changes in hormone levels. Ocular light sends signals to our biological clock located in pineal gland through a separate nerve system. This in turn regulates the circadian and seasonal rhythms for a number of bodily processes. The hormones cortisol and melatonin play an important role in governing alertness and sleep-wake cycle. Cortisol levels increase in the morning while melatonin levels decrease. These changes in hormone rhythms increase alertness, reduce sleepiness and allow us to function well while we are awake at daytime (Van Bommel et al. 2002, Venkatramanujam 2010).

The NBC standards (NBC-2005) for ward bed head light levels in morning/ evening are 30-50 lux which are lesser than visual comfort levels of 50-300 lux found in our study. However, light levels recommended for examination/treatment are 750-1500 lux. Hence while considering adequate bedside lighting due consideration needs to be given for patient comfort as well as for performing different tasks appropriately. We suggest following architectural recommendations to enhance visual experience of the patient:

- Achieve adequate and uniform distribution of daylight through design, orientation, window size, location and glazing type, skylight, light shelves, light wells, light tunnels.
- For adequate artificial lighting achieve uniform illumination, brightness and proper color rendition, layout and distribution, fixture selection, controls, etc.
- Prevent glare by providing shading, secondary buffers on inside or outside windows.
- Provide task light for examination/procedures.

The study also highlights many areas for continued research on the impact of light in hospitals. This could involve evaluating visual comfort of doctors/ nursing staff and task specific lighting requirements.

IV. CONCLUSION

The present study has some significant revelations; indicating the preference for higher range of illuminations as compared to the recommended. The concept of proper implementation of optimal bedside light and further providing task light is upheld.

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