Night Lighting in Hospitals – and its Impact on Staff and Patients

In a detailed study, Jemima Unwin looks at the implications of the night-time lighting of hospital wards on patients and staff. This is an abridged version of her 2010 dissertation for the MSc in Light & Lighting at the Bartlett School of Architecture

Introduction

That the lighting of UK hospitals is generally poor quality and 'institutional' in feel is something of a truism. However, despite an increasing field of research on the beneficial effects of light on human health, there is a lack of relevant research on healthcare environment design – and no recent studies focusing on night lighting in hospitals. The issues of night lighting affect many people working in hospitals, from nurses, site managers and security staff to doctors working on call. This research is relevant to the people who light hospitals and the architects and contractors who design and build them. And of course patients have valid opinions, based on their experience in hospitals, so this report is relevant them too.

Background Research

The Llewelyn-Davies Nuttfield Provincial Hospitals Trust study began in 1948, with the cooperation of the Building Research Station, which then used the work to propose recommendations for the electric lighting of hospitals. It accepted the 'lights out' policy for night lighting and laid down that only 33 lux was needed for nurses to carry out bedside activities in an emergency, although it was recommended that this be supplemented by bedhead lighting. It also advised that the floor was not lit so that the patient does not become a non-illuminated object against a bright floor. Advice was also given against low-mounted fittings, because they created disturbing shadows on the ceiling when staff walked about.

The recommended illuminance levels given by Hopkinson in 1970 ***(Figure 1)*** imply that staff are not going to make clinical interventions on the ward – patient interventions on a ward were possibly less than they are now. The conditions in a functioning hospital 40 years later are quite different.

Lighting and Health

Roger Ulrich's more recent investigations in hospitals have shown the connection between the built environment and healing times. Through a body of work since the 1980s he has demonstrated the importance of the hospital environment, suggesting that people heal faster if they have a room with a window and view of nature.

Since the discovery of the non-visual photoreceptor in the eye in the 1990s, light has been linked to circadian entrainment of melatonin, which affects sleep cycles. Therefore, in theory, lighting conditions should have an impact on alertness in staff and sleep quality in patients.

Night Lighting

Another relevant study is 'Lighting the Graveyard Shift: the Influence of the Daylight–simulating Skylight on the Task Performance and Mood of Night–shift Workers' (Boyce et al, *LRT* 29, 1997). The 'graveyard shift' is from midnight to 07:59 hours. Workers were put under an artificial 'sky' and asked to perform tasks under different lighting conditions over three nights. The result was that at high illuminance conditions (2800 lux) participants had higher core body temperatures and greater subjective arousal. The high and decreasing (stimulating midday to dusk) illuminance conditions improved complex cognitive task performance relative to the low and increasing light levels on other nights.

Internal Service Rooms (wp)	Corridor(floor at centre)	Ward
330 - 430 lux	220-270 lux	Mimimum DF should not be less than 1 %.
220 lux	150 lux	30-50 lux at bedhead,100-200 lux in centre.
220 lux	5-10 lux	0.1 lux
Local lighting provided for any difficult tasks.		

Fig. 1: Night lighting advice given by Hopkinson in 1970

Existing Advice on Hospital Night Lighting

1.Health Technical Memorandums (HTM 08:03)

HTM 08:03 discusses the requirements for bed head services, which includes lighting. It refers to CIBSE's *Lighting Guide 2*, 2008 (LG2), BS EN 12 464–1 and *Lighting and Colour for Hospital Design* published by the Department of Health. The HTM states that bedhead lighting should include watch lighting and night-time lighting as well as observation, examination, minor procedures, general and patient reading lighting ***(Figure 2)***.

The conflicting interests of patients needing to sleep and the nurses' requirement to see are recognised in LG2 which gives the following advice about night lighting:

'Night lighting needs to achieve two things; first to provide enough light for the safe movement around the general ward area and, secondly, to allow the nursing staff the ability to discern facial features and a patient's general condition.'

The LG2 recommendation for the illuminance of the central circulation space is a maximum of 5 lux average on a 0.85m working plane and a maximum of 10 lux anywhere on the same working plane. The maximum illuminance on the pillow is suggested at 0.5 lux. ***(Figure 3)***.

Area, unit or department	Service IlluminanceE m/ lux	Max. point illuminance / lux	UGR L	Min. Ra	Position of measurement	Type of control	Standby grade
General nursing	300	520	19	80	Bed	S	A
Night light	5	10	-	80	WP	N	B
Nurses' station day	300	520	19	80	Desk	S/V	A
Nurses' station night	30/200	250	22	80	WP	N	-
Observation/night watch	20	40	-	80	Bed head	N	B
Observation/night	1 to 5	n/a	-	80	Bed head	N/Sp	B

Fig 2: Summary of LG2 lighting recommendations for hospital spaces

LG2 also recommends:

- Avoiding indirect lighting because slightly or partially illuminated ceilings can cause nightmares.
- Luminance of the night time setting should not exceed 30cd/m^2 above and including an illuminance limiting angle of 35° from the luminaire's downward vertical at all angles of azimuth.
- Any luminaire at the bed head or within the bedded area as described by the screening curtains should not exceed 30cd/m^2 above and should include an illuminance limiting angle of 20° from the luminaire's downward vertical at all angles of azimuth.
- Areas of particular importance are the bed head and any luminaire which is in direct view of the recumbent patient.
- In order to achieve the required flexibility, it suggests the use of multiple lamp or localised sources and LEDs rather than dimmed or low wattage fluorescent lamps.
- It identifies the main problem with night lighting as the brightness of the lamps or luminaires.

Study Methodology

Three real ward environments were examined at a major central London hospital. Four wards were also visited briefly at a hospital in Northern England, to see if the findings were backed up elsewhere. Quantitative photometric and subjective qualitative assessments were made. Sleep quality surveys were carried out on patients and alertness surveys were undertaken on night-shift nursing staff, to see if the variability in the lighting conditions had any effect on either group. A total of 27 staff and 37 patients were surveyed.

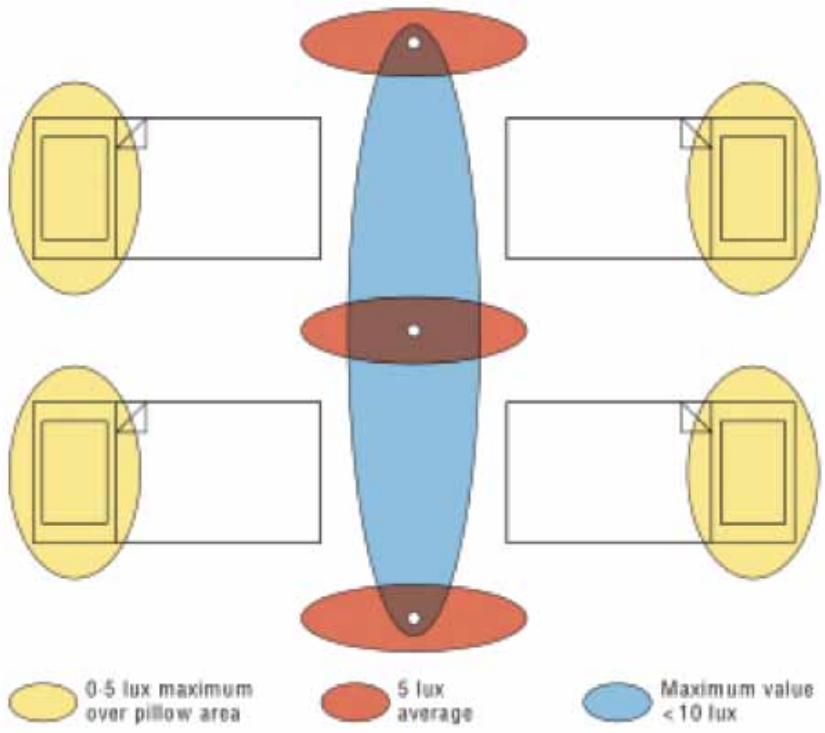

Fig 3: LG2 night lighting requirements on wards.

The main hospital was visited at night, on five occasions. The first visit was to observe the existing lighting on two wards, Ward X and Ward Y. This involved understanding the switching regime, the luminaire types and the luminaire locations. During this first visit it was observed that quite often luminaires were switched off in the bays at night – and in some cases bedside Anglepoise luminaires next to an unoccupied bed were left on in the evening to help with wayfinding and to create an evening setting. A further ward, Ward Z, was later included in the survey.

Two of the lighting scenarios in an empty bay (Bay B) on Ward X can be seen in ***photos A and B*** – this happened to be empty on one of the visit nights, so luminance and illuminance levels could also be measured. The spectral content of the light was also measured, using a Philips Actiwatch Spectrum TM meter. However, spectral measurements are not discussed here because there was no observable trend between the variability in the lighting conditions and sleep quality or staff alertness.

Most of the luminaires were observed to be switched off during these first two visits, so it was decided to undertake three all-night studies of the variability in the lighting conditions from night to night over three wards, recorded on plans.

Photo A. Lighting scenario in Bay B with lighting dimmed

The natural curiosity of the staff and patients led to the researcher being quite honest about the intent of the study. Questions were asked in an open and unstructured way. This resulted in some interesting anecdotal evidence, which is summarised below.

The researcher arrived at about 10:30pm on three alternate nights (one on, one off) in June 2010. A log was kept of movements throughout the night – and alertness surveys given to staff. Each ward was visited at least three times throughout the night. In the morning, sleep quality surveys were administered to patients who opted in and were not asked to do the sleep quality survey. Throughout the night, the staff were asked what they thought of the lighting and commented on any issues about lighting on the night shift. If a member of staff warned that a patient was particularly confused or was difficult to deal with in any way, the individual was not asked to do the sleep quality survey.

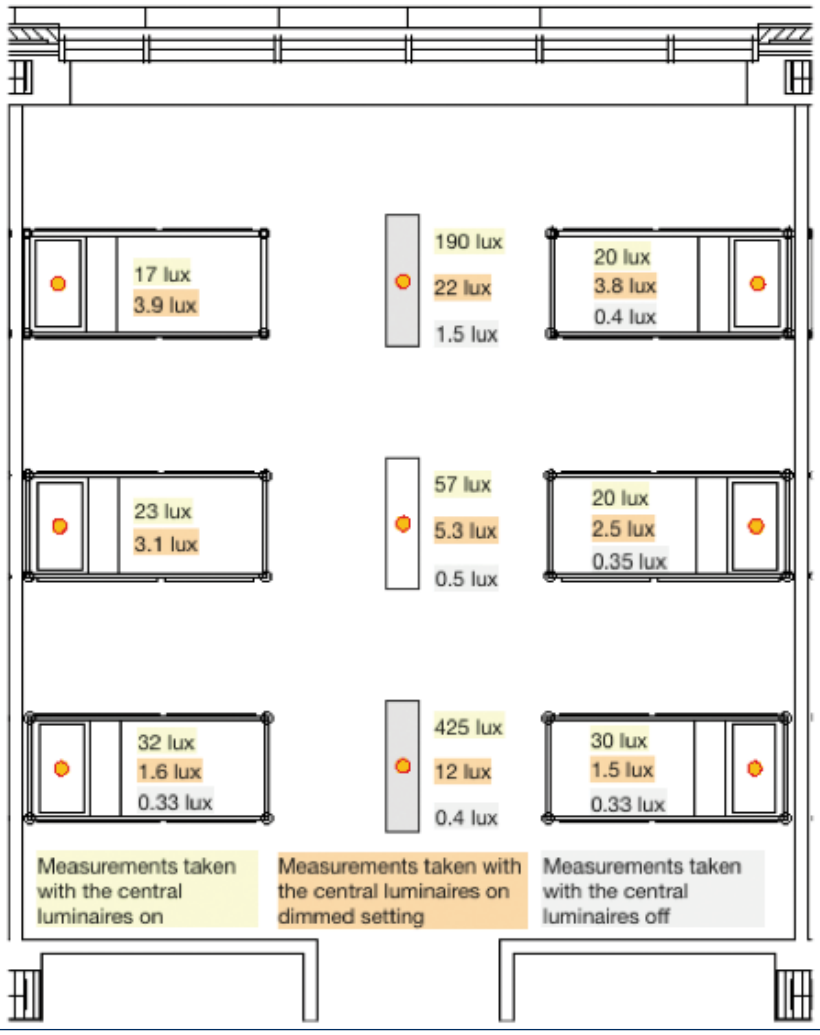

Fig 4: Illuminance measured on the pillow and at working plane height.

Background Information about Shift Work

The night shifts are 12 hours long (from 8.00pm to 8.00am) with a one-hour break. Staff generally undertake three to seven night-shifts a month, in blocks of two, three or four nights. Staff commented that with the cuts they had to do more night-shifts. Some staff were on night-shifts almost permanently, to fit in with their domestic lives or because they did not mind doing the shifts. Some night-shift workers fit the night-shift in with a childcare routine, so they work all night, take the child to school in the morning, sleep during the day, pick up the child from school, and then go to work again at night.

Photometric Measurements

Photometric data could only be collected on the unoccupied Bay B on Ward X, so the scope of the data is limited.

Illuminance Levels

The central luminaire was not working on this bay (Bay B, Ward X). When the central luminaires were off, the illuminance levels on the pillow met the LG2 guidelines of a maximum of 0.5 lux for the general requirements of night lighting ***(Figure 4)***. However, when the central luminaires were off, the 5 lux average recommendation was not met. When the central luminaires were on the 'night' dimmed setting, these levels were exceeded even with one non-functioning luminaire. When the central luminaires were on, the illuminance levels slightly exceeded the observation/night watch levels (20 lux) at the bedhead pillow position, recommended by LG2. It seemed that the lighting condition on this ward did not consistently follow the guidelines. The task lighting on one of the non-refurbished wards at a Northern hospital was well below the guideline of 140 lux.

Luminance Distribution

The ceiling luminance with the central luminaires on was about 5 cd/m^2, which is quite low. It meant that this bay did not comply with the SLL code, which

Photo B: Bay B with the lighting off

recommends that 30% of the light should go onto the ceiling for a well lit interior ***(Figure 5)***. However, during the day the east facing bays were lit by daylight.

Analysis of the Data

The analysis looked at four types of data:

- Photometric data (discussed above)
- Anecdotal Evidence - from Staff and Patients
- Surveys - Staff and Patients
- Usage Patterns

Anecdotal Evidence

1. Staff Observations:
It was not obligatory for the staff to participate – a total of 49% of staff present on the three nights offered anecdotal information and 66% completed the alertness survey. They were asked to fill in the questionnaire at the time of the researcher's visits, but by the next visit the same people were not always present.

However, problems with visual tasks were picked up by 14/19 staff in their anecdotal evidence. This shows that the staff's fundamental lighting needs are not being met. Comments included:

- Insufficient light to see some of the visual tasks, especially due to the inflexibility of the bedside Anglepoise luminaires, which did not reach far enough down the bed.
- Lack of maintenance, so equipment often did not work.
- The importance of finding dark places to sleep was not always recognised in rest room provision.
- Patient requests to turn off the central luminaires, even on the dimmed setting, were common.
- Poor lighting quality (2 comments).
- Lack of communication and staff knowledge about how the switching works, so they did not feel they have control over their own environment.
- The general design of the ward (e.g. some comments about not being able to see patients were related to the physical distance from them, not just the lighting).
- Some staff said that the hospital policy is that at least one central luminaire should be left on the dimmed setting. Not all staff were aware of this.
- Occupancy affects the lighting – so for example if the beds were empty a bedside Anglepoise was left on for wayfinding and/or to create an evening ambience.
- Staff liked the idea that the staff base lights could be dimmed down.
- On wards where no dark restroom was provided, some staff felt 'stranded' when the time came to find somewhere to take their break.
- Using light for wayfinding by leaving the toilet doors open with the lights on was common practice ***(Photo C).***
- The lighting of the staff base had not been considered in the lighting of the newly refurbished wards in the Northern hospital visited. This is worrying because staff spend most of their night shift at the staff base. A light box for viewing X-rays was adapted for use as a night light because the recessed luminaires were uncomfortable for patients.
- Spill light from computers was used to illuminate note-taking at workstations.

2. Patient Observations:
- Patients often took sleeping tablets.
- Stray light from the staff base could cause disturbance.
- Human preference varies – some patients did not mind the light, some did and some did not expect to sleep well in hospitals, regardless of the lighting.
- Pain levels and stress caused by the patient's condition had an effect on their ability to sleep.
- Unwanted noise seemed to annoy patients more than unwanted light.

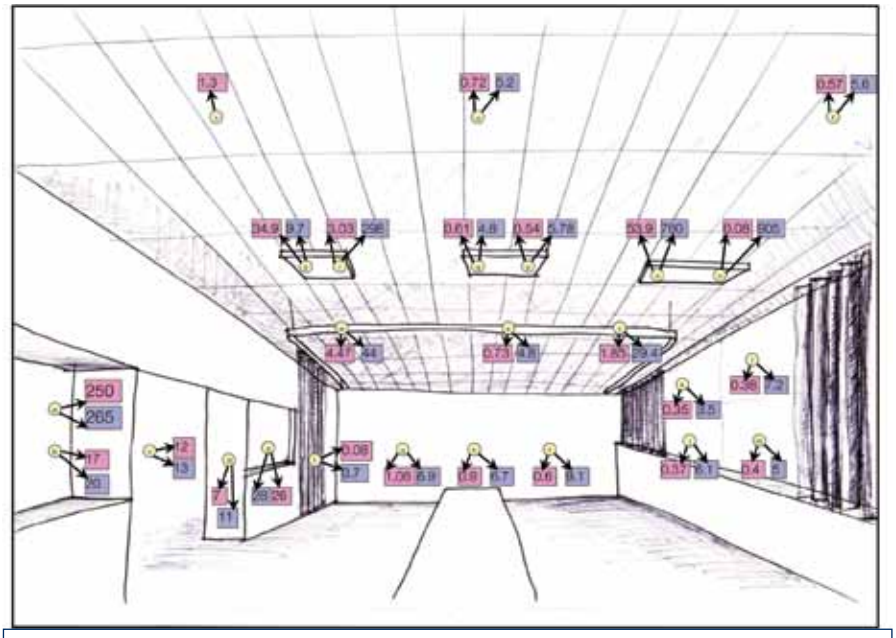

Fig 5: Luminance levels on room surfaces in Bay B on Ward X – full on (pink figures) and dimmed (purple figures)

Photo C: example of toilet door left open to offer wayfinding lighting

Beeping, snoring and other noises often woke patients up or prevented them from falling asleep. If there is a problem with the lighting it could sometimes be solved by drawing the curtains around the bed or switching the light off. The bigger issues could not be solved so easily – clearly the sensory environment should be considered as a whole.

Staff Survey Results

There was no repeatable pattern for alertness or fatigue on because this was a self-reporting study and the following confounding factors applied:

- It was not known when staff would take a break.
- The full extent to which staff were self-medicating with 'Proplus' and other caffeine-based substances was not known.

The Rest Room Issue

The only ward where there was a tendency towards increased fatigue and decreased alertness throughout the night was Ward X. This may be connected to the fact that on that ward there is no suitable dark place to rest. The official hospital stance is that they are not supposed to sleep and they are not supposed to turn the luminaires off in the bays. However, they are allowed to rest with their eyes closed. It was reported anecdotally that what the staff want is a nice dark, cosy place with a bed so they can sleep for a short time. On Ward X, what the staff want, and what the hospital gives them (Photo D) are directly opposed. It is worth noting that staff are not allowed to sleep in the bays, even if they are empty.

There was no observable trend over the three nights towards increasing sleepiness and fatigue on Ward Y (Photo E) and Ward Z, which have more appropriate rest facilities. Therefore, on those wards, staff sleep on the ward, whereas on Ward X they are forced to find places around the hospital. It seems that the fact that the staff sleep for a short time boosts their overall alertness.

On Ward X, the staff did not reveal where they went to take their break, although it was evident on several occasions that they went off the ward. It was not clear whether they told each other where they were going. There is a potential problem of not having a suitable staff rest room – not being able to find the nurses could be a major problem in the case of an emergency. Some nurses have bleepers which would help in this case, but it would still take time to reach the ward.

Photo D: the rest room on Ward X

Photo E: the rest room on Ward Y

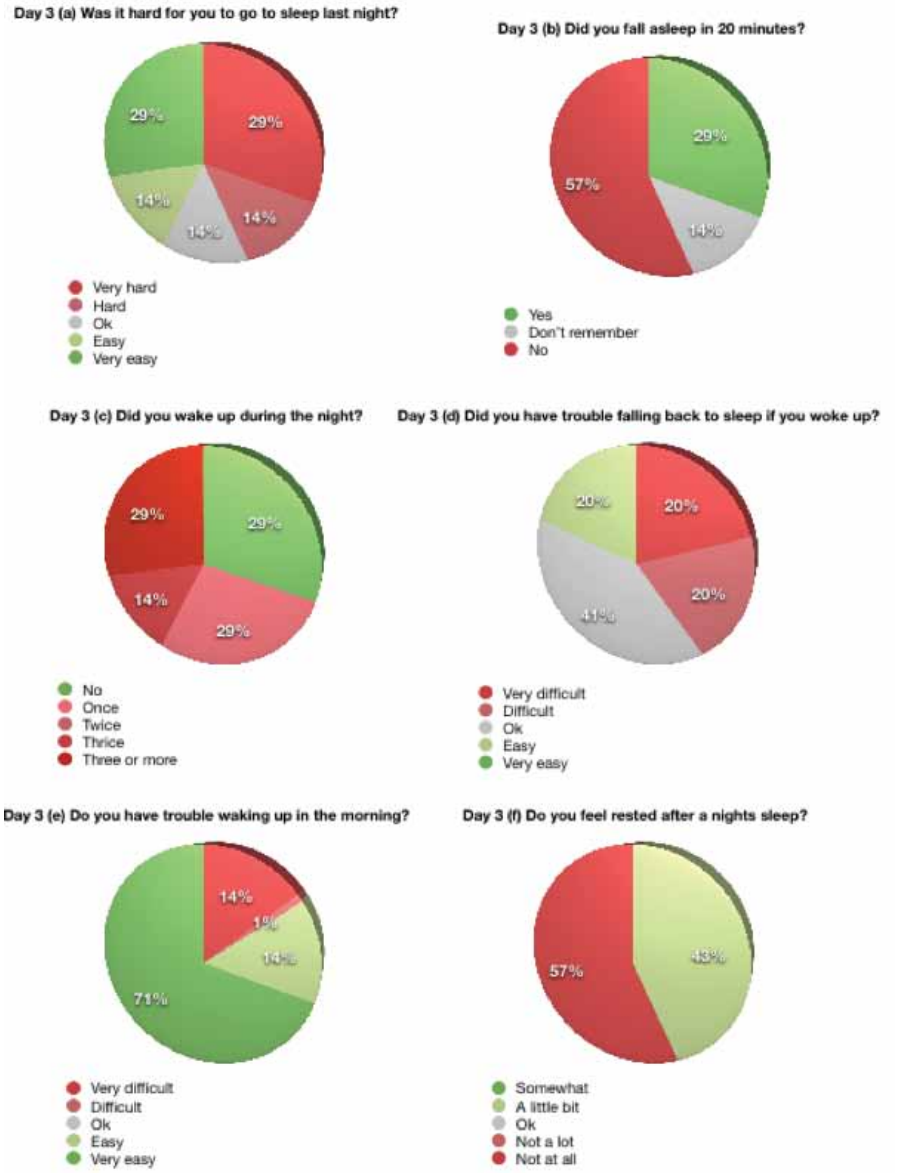

Fig 6: Sleep quality over all nights on all wards visited

- The results of the staff surveys were not reliable because on two occasions staff resting with their eyes closed and with their head on the desk ticked '2. = Very alert' (a check confirmed that they were not confused about the scale).

Extent of Sleeping

A rigorous calculation of when staff were sleeping was impossible due to a number of factors, not least the tiredness of the researcher, but it is clear that staff do sleep during their break. A suggestion for further research is to understand the extent of the sleep on the wards at night, because this would give a clearer indication of what staff need. However, it is unlikely that staff would sleep if they thought they were being observed. In fact, it is possible that the presence of an external observer kept the staff more alert, and maybe affected these results.

Patient Surveys

Thirty seven patients on the three wards over the three nights were surveyed. The patient surveys were not totally reliable because the full extent to which patients were taking sleeping tablets is not known.

However ***Figure 6*** shows that a high proportion of patients woke up at least once during the night. There was slightly worse sleep quality on Ward X, followed by Ward Y, then Ward Z. One factor which may have influenced this was the fact that on Ward Z there are closeable doors between the corridor and the bays, so patients could not hear staff moving about.

Usage Patterns

Limited management control of how the space was operated at night meant the lighting just seems to 'happen'. The usage patterns showed that the lighting was not used consistently across the ward or hospital. In fact the lighting of the bays depended purely on the people who were working there on that night and their understanding of the patient's needs.

On the bays, darkness was preferred rather than light, except to perform visual tasks (for example checking that catheters are draining, reading and administering drips, giving medication). On the corridors and in the staff rest room, darkness was also preferred. ***Figure 7*** summarises the percentage of wards in darkness at the times visited. The night lights were often not used at all – 55% of wards visited between 00:00–05:59 hours were in darkness. This was a significant finding, because it demonstrates that the reality of night lighting is different to expected practice.

Conclusions

Photometric Measurements

The photometric measurements taken on the ward bays are what could be expected of an unmaintained and tired lighting installation which has most likely not been touched, except to replace the odd lamp, since the hospital was built. However, neither had the night lighting needs of the staff been met on two newly refurbished ward at the second hospital visited.

Anecdotal Evidence

Issues arising from the anecdotal evidence:

- Maintenance issues mean that both staff and patients had low expectations of the lighting.
- Darkness at the right time was as important as light.
- Neither staff nor patients felt 'ownership' of the space, often not knowing where the lighting controls were.
- Potentially serious problems with the night lighting in terms of seeing detailed visual tasks.
- Switching was not clearly labelled, which caused confusion for clinical sites managers called to different wards, who were not familiar with how the luminaires operate.
- No apparent management guidance on the way the ward was operated at night.

Survey Evidence

One of the questions asked at the outset of this project, was 'Is there is a connection between lighting and sleep in the hospital environment?' The answer is that there may be, but it is quite a complicated and tenuous link. Also, most patients on the wards visited were in the hospital typically for one or a

few days, so the lighting impact on their circadian systems was not significant before they returned to their normal environment. Circadian effects could be more important for patients remaining in hospital for a longer period (e.g in high dependency units or intensive care).

Rest Areas for Staff
The importance of providing a dark quiet place to rest for staff was evident anecdotally and surveys pointed to a slightly increased alertness on wards which had such facilities. Such areas stop staff leaving the ward and seem to make staff more alert, because they wake up and feel better after a short rest.

Lighting and Patient Sleep
No connection between sleep quality in patients and lighting was found. The hospital is a complex environment and because the conditions of the environment and the patients were so variable this is not surprising.

Usage Patterns

There was an apparent disconnection between management strategy and what actually happens, particularly the running of night shifts, which seemed to be a low priority in management terms. Obviously some staff were stressed because they were working at night. They tended to arrange things to suit themselves, rather than follow any particular policy. Staff took an intelligent judgement that where the patient is not in a life-threatening situation, if he/she asked for the lights to be switched off, they could be. The same applied to nurses sleeping – if the ward was not too busy and the patients were not in a critical condition then they could take longer breaks.

Clearly the dataset of this study is small and the findings may not be statistically significant, so it is not possible to make generalisations about NHS lighting standards and quality as a whole. As pointers to future work, however, these findings are significant because they draw attention to issues not previously identified.

Scope for Further Work

There is no easy solution to the issue of patients needing to sleep and nurses needing to see. However one way of exploring might be based on mock-ups of wards and different lighting set-ups, where staff could be invited to carry out standard night-time visual tasks – and comment on the suitability of the designs.

Any future research in the hospital environment should:

- Understand the weakness of night-time management.
- Be designed to cope with the heavy usage of the wards and bays.
- Understand the effect of fatigue from cumulative night shifts.

What do People Want?
It is quite clear that the needs of the people who carry out night-shifts have been neglected for some time and the only way to understand what they need is by listening to them. In-depth user consultation, although difficult to organise, should be a prerequisite of any hospital lighting design. The NHS is an organisation which often becomes a client to architects and engineers either directly or through an intermediary. Therefore the spokespeople elected to inform the design should include those who use the building during the most difficult shift. It is also important to understand the patient journey and the experience of the environment from the view of the bed.

Why Bother?
The question may be asked that why are the findings important if they are going to be ignored anyway, especially as lighting designers are rarely involved in hospital projects? The answer is that at least we now know what happens in situ, and this information is useful to those who do light hospitals. From the patient perspective, a 'nicer' environment may have an indirect healing effect. From the staff perspective, to facilitate improved working practice and effectiveness, there is a need to understand what affects their feelings about the working environment.

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Editorial Comment:

While the overall quality of hospital lighting in the UK is undoubtedly poor, as our author confirms, it is a pity that her review didn't at least mention the few bright spots that do exist – most notably BDP's work at St Mary's Hospital on the Isle of Wight, which dates back some 20 years, or the practice's more recent Royal Alexandra Children's Hospital in Brighton, where the conflict between lighting for nurses and patients was, in part, addressed. Such examples do establish notable bench-marks against which to judge the rest of hospital lighting.

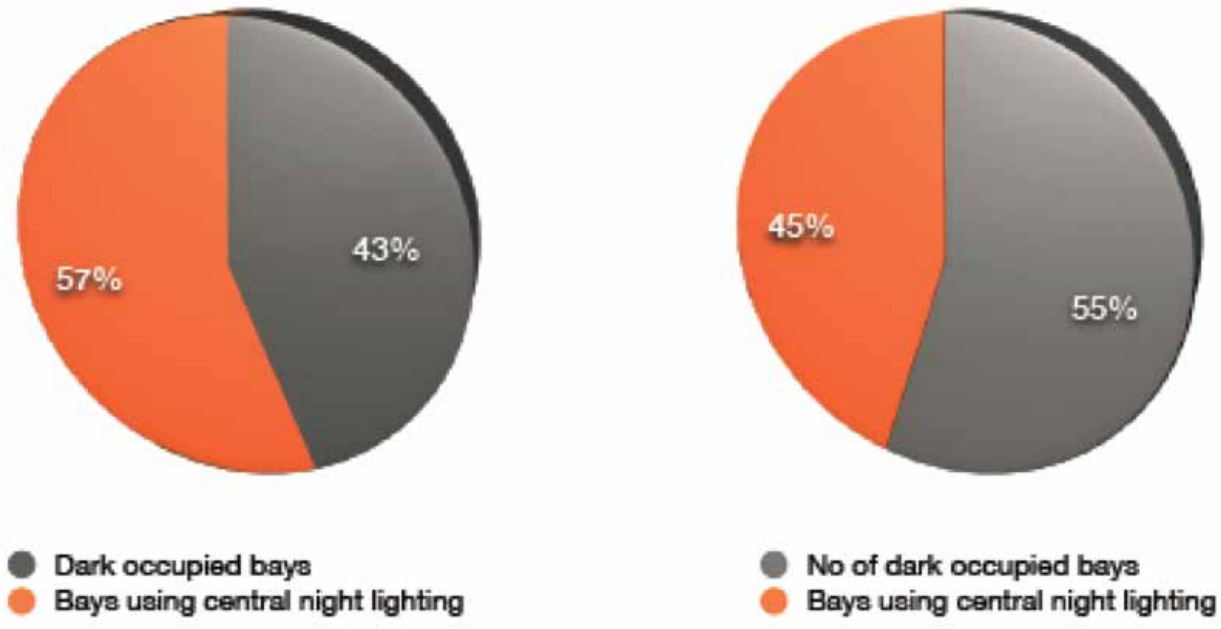

Fig 7: the percentages of time the wards were in darkness on the nights visited