

Hospitalslys

Forprojekt: Energibesparende lys, der understøtter
helbredelse, sundhed og trivsel på hospitaler

SBI-notat



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Indhold

Indhold.....	5
Forord.....	7
Indledning.....	8
Fremgangsmåde.....	9
Beskrivelse af projektteamet (consortium).....	11
1. Proposed title: Helbredsfræmmende lys i danske hospitaler.....	11
2. Objectives of the consortium.....	11
3. Members of the consortium (who we are).....	11
4. Unique tools and services brought to the project.....	12
Arbejdsprocessor i et hospitalsprojekt.....	13
Hypoteser.....	15
Indsatsområder.....	17
List of potential actions.....	17
Bilag 1: Litteraturstudie.....	30
Uddrag fra Helende arkitektur.....	31
Litteraturgennemgang.....	33
Daylight exposure and the other predictors of burnout among nurses in a University Hospital.....	34
Energy Efficient Lighting System Design for Hospitals Diagnostic and Treatment Room - A Case Study.....	35
A framework for predicting the non-visual effects of daylight – Part I: photobiologybased model.....	36
Sunny hospital rooms expedite recovery from severe and refractory depressions.....	37
Dying in the dark: sunshine, gender and outcomes in myocardial infarction.....	38
Morning sunlight reduces length of hospitalization in bipolar depression (Brief report).....	39
Morning light treatment hastens the antidepressant effect of citalopram: a placebo-controlled trial.....	40
Evidence that abnormally large seasonal declines in vitamin D status may trigger SLE flare in non-African Americans.....	41
Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor.....	42
Seasonality of UV-radiation and vitamin D status at 69 degrees north.....	43
Psychometric evaluation of the Pittsburgh sleep quality index.....	45
Colour and lighting in hospital design.....	46
Helende arkitektur.....	47
Associations between seasonal variations in day length (photoperiod), sleep timing, sleep quality and mood: a comparison between Ghana (5°N) and Norway (69°N).....	48
Ambient bright light in dementia: effects on behaviour and circadian rhythmicity.....	49
The Impact of Light on outcomes in Healthcare Settings.....	50
Impact of daylight illumination on reducing patient length of stay in hospitals after coronary artery bypass graft surgery.....	51
Walking on sunshine: effect of weather conditions on physical activity in older people.....	52
Choosing Surgical Lighting in the LED Era.....	53
Outcomes of Environmental Appraisal of Different Hospital Waiting Areas.....	54
Verification of electrical energy savings for lighting retrofits using short- and long-term monitoring.....	55
Effect of simulated dawn on quality of sleep – a community-based trial.....	56
Effect of bright light treatment on agitated behavior in institutionalized elderly subjects.....	57
R&D Project B(01)13: Designing for health: Architecture, art and design at the James Cook University Hospital.....	58

Nurses' perceptions of how physical environment affects medication errors in acute care settings.....	59
Morning vs. Evening Light Treatment of Patients With Winter Depression.....	60
Hospital Design and Staff Perceptions.....	61
Effects on subjective and objective alertness and sleep in response to evening light exposure in older subjects.....	62
Average sunrise time predicts depression prevalence.....	63
A Review of the Empirical Literature on the Relationships Between Indoor Environment and Stress in Health Care and Office Settings.....	64
Effect of Bright Light and Melatonin on Cognitive and Noncognitive Function in Elderly Residents of Group Care Facilities.....	65
Sleep and Circadian Misalignment for the Hospitalist: A Review	66
Therapeutic lighting design for the elderly: A review	67
Melatonin, environmental light, and breast cancer	68
Light in the built environment: potential role of circadian disruption in endocrine disruption and breast cancer	69
Length of Stay Has Minimal Impact on the Cost of Hospital Admission	70
Circadian time of morning light administration and therapeutic response in winter depression	71
Factors associated with objective (actigraphic) and subjective sleep quality in young adult women	72
The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity	73
View through a Window May Influence Recovery from Surgery	74
Assessing Beliefs about Lighting Effects on Health, Performance, Mood, and Social Behavior.....	75
Dimensions of Person-Window transactions in the Hospital Environment.....	76
Actigraphic assessment of the circadian rest-activity rhythm in elderly patients hospitalized in an acute care unit.....	77
Influence of Bright Light during Daytime on Sleep Parameters in Hospitalized Elderly Patients	78
The Effect of Sunlight on Postoperative Analgesic Medication Use: A Prospective Study of Patients Undergoing Spinal Surgery	79
Evening Light Exposure: Implications for Sleep and Depression	80
Bilag 2. Sund hospitalsarkitektur.....	81
Forskellige hospitalstypologier og deres lysforhold.....	81

Forord

I indeværende årti investerer regionerne i Danmark 41,4 milliarder kroner i nybyggeri, udbygning og renovering af sygehuse. I alt 44 hospitalsprojekter sættes i gang, og 16 af de nye sygehuse bliver bygget med tilskud fra staten, nærmere bestemt fra Kvalitetsfonden. Disse 16 sygehusbyggerier kaldes derfor også for "kvalitetsfondsbyggerier".

Det er en enorm investering, og det er uhyre vigtigt, at arkitektur, planlægning, logistik og valg af lægefagligt udstyr bliver optimal. Det er også vigtigt at hospitalernes indretning, møblering og belysning bliver bedst mulig. Begreberne 'helende arkitektur' og 'evidensbaseret design' anvendes i stigende grad som pejlemærker, når det gælder valg af bygningsmæssige løsninger indenfor både psykiatri og det somatiske hospitalsvæsen. Lyset bør have en ganske særlig prioritet, fordi det kan anvendes i behandlings- og helbredelsesprocesser. Samtidig er investering og drift langt mindre omkostningsfyldte end lægefagligt operations-, test- og behandlingsudstyr. Valg af det rigtige lys kan frigøre resurser andetsteds på hospitalet. Kvaliteten af lyset på hospitalet er særlig vigtig, fordi lyset her spiller en afgørende rolle, for restitueringen af patienter, for pårørende og for personalets velvære, koncentration og ydeevne. Som udgangspunktet er vi mennesker mest følsomme overfor lys når vi er syge. I en sygdomstilstand betyder de primære sanseindtryk mere for vores velbefindende, end når vi er raske - vi bliver med andre ord mere følsomme over for bl.a. lys og lyd. Fundamentale virkninger ved lyset er med til at skabe orientering i de ellers uvante og ofte stressende hospitalsomgivelser. Lyset kan være med til at berolige os, lige som lys kan være med til at stresser os. En belysning der tager højde for den menneskelige perception, når vi er svagest, tager også hensyn til den menneskelige perception når vi er raske. Vi kan altså generelt lære meget af at arbejde med lyset på et hospital, og det forventes, at mange af de erfaringer der indhentes i arbejdet med hospitalsslys kan overføres til andre bygningstyper og arbejdspladser, fx skoler, institutioner, m.fl.

På baggrund af de store investeringer er der et enormt behov for evidensbaseret forskning, der kan danne grundlag for anvisninger om, hvordan hospitaler bør udformes og indrettes med hensyn til at udnytte dagslyset optimalt samt benytte kunstlyset til at understøtte døgnrytme, velvære og heling. Målet med projektet har været at kortlægge eksisterende viden, og komme med forslag til et afgørende nationalt projekt, der kan sikre at fremtidens supersygehuse udnytter det helt væsentlige potentiale lys har for at blive en aktiv del af helbredelsesprocessen i hospitalssektoren til glæde og gavn for såvel patienter som personale.

Projektet kan siges at have to hovedresultater, dels en gennemgang af de vigtigste forskningsresultater på området, og dels en gennemgang af udviklingen i hospitalsarkitekturen, med fokus på begrebet helende arkitektur, dets udvikling og sammenhæng med lys, luft og naturlige omgivelser.

Projektet har været støttet af Elforsk, Dansk Energis forsknings- og udviklingsprogram, gennem PSO-projekt nr. 344-047 med titlen *Udvikling af energibesparende lys, der understøtter helbredelse, sundhed og trivsel på hospitaler – forprojekt.*

Statens Byggeforskningsinstitut, Aalborg Universitet København
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Kjeld Johnsen

Indledning

Nyere forskning har vist, at lys har en afgørende betydning for menneskers sundhed og trivsel ikke mindst på grund af den direkte sammenhæng mellem syntese og segregering af neurotransmittere som serotonin og melatonin og lyspåvirkning. Lysets indvirkning på hjernens kemi er derfor en ikke uvæsentlig faktor i dagligdagen og man kan ligefrem tale om sundt og usundt lys. I hospitalssektoren, hvor patienterne i forvejen er ramt af en forringet sundhedstilstand vil det være særdeles oplagt at anvende denne viden til at få patienterne hurtigere i bedring til såvel nationaløkonomisk gavn som til patientens gode. Etableringen af de nye supersygehuse giver en unik mulighed for at tilvejebringe lysmæssige foranstaltninger, der netop på optimal vis understøtter helbredelse, sundhed og trivsel til såvel patienters som de mange ansattes gavn, samtidig med, at der opnås markante elbesparelser til belysningen. Desværre må man konstatere, at i de store supersygehus-projekter er lyset på nuværende tidspunkt langt fra tænkt ind, som en sundhedsstøttende/fremmende teknologi, men mere som et nødvendigt onde.

Ethvert hospital har som hovedmål at reetablere velvære for sygdomsramte mennesker, men tjener samtidig som en arbejdsplads for en stor gruppe ansatte i sundhedssektoren, hvis indsats og succes i det daglige virke også er funderet i trivsel og velvære på deres arbejdsplads. Ansatte med natarbejde er særlig udsatte for uhensigtsmæssig belysning, pga. den unormale døgnrytme. Ved at optimere lyset, både spektralt og i intensitet, i forhold til personalets døgnrytme, blev arbejdsmiljøet markant forbedret for denne gruppe mennesker. LED teknologien er særlig velegnet til anvendelse i sådanne lyssystemer, da de har muligheder for fleksibel spektral tuning samt dæmpning, har lang holdbarhed og er meget energieffektiv. Det er oplagt at anvende viden om disse humanbiologiske effekter af lys og viden om frembringelse af effektivt kvalitetslys baseret på LED til at give fremtidens hospitaler endnu en dimension af optimering, nemlig i forhold til lyset.

Som udgangspunktet er vi mennesker mest følsomme overfor lys når vi er syge. I en sygdomstilstand betyder de primære sanseindtryk mere for vores velbefindende end når vi er raske - vi bliver med andre ord mere følsomme over for bl.a. lys og lyd. Fundamentale virkninger ved lyset er med til at skabe orientering i de ellers uvante og ofte stressende hospitalsomgivelser. Lyset kan være med til at berolige os, lige som lys kan være med til at stresser os.

Nærværende projekt er et forprojekt, der har til formål at: realisere et afgørende nationalt projekt, der sikrer at fremtidens sygehuse udnytter det helt væsentlige potentiale lys har for at blive en aktiv del af helbredelsesprocessen i hospitalssektoren til glæde og gavn for såvel patienter som personale. En belysning der tager højde for den menneskelige perception når vi er svagest, tager også hensyn til den menneskelige perception når vi er raske. Vi kan altså generelt lære meget af at arbejde med lyset på et hospital, og det forventes, at mange af de erfaringer der indhentes i arbejdet med hospitalslys kan overføres til andre bygningstyper og arbejdspladser, fx skoler, institutioner, m.fl.

Fremgangsmåde

Som grundlag for udarbejdelse af en større ansøgning om *energibesparende lys, der understøtter helbredelse, sundhed og trivsel på hospitaler* udarbejdedes en strategi for, hvordan projektteamet kunne opnå den bedste dialog med private fonde, regioner og hospitaler i hele landet. Strategien fulgte nogenlunde oplægget i projektbeskrivelsen, og bestod indledningsvis af følgende aktiviteter:

- Litteraturstudie
- Direkte kontakt med aktører i gode hospitalsløsninger
- Fokus på hospitalet som helhed

Som projektet udviklede sig, blev det klart, at andre aktiviteter var nødvendige for at dokumentere projektteamets kompetencer og identificere særlige indsatsområder, som ville appellere til hospitalerne i den direkte kontakt.

- Beskrivelse af projektteamet og dets kompetencer
- Formulering af hypoteser
- Beskrivelse af mulige indsatsområder / aktiviteter med referencer
- Beskrivelse af den historiske udvikling af hospitalet

I det følgende gives en kort beskrivelse af hver af disse projektaktiviteter.

Litteraturstudie

Projektteamet gennemførte et omfattende litteraturstudie omfattende centrale referencer, der ville være relevante i forhold projektets mål og teamets kompetencer. Litteratursøgningen blev fordelt i forhold til de deltagende institutioners hovedinteresser og -kompetencer:

- a. Lysteknologi: DTU Fotonik
- b. Arkitektur og indretning: Arkitektskolen Aarhus (Carlo Volf) og SBi (Anne Kathrine Frandsen)
- c. Lysets påvirkning af mennesker: SBi (Ásta Logadóttir, Jakob Markvart, Marc Fontoynt og Kjeld Johnsen) og Aarhus Universitetshospital (Henrik Kolstad).

Hovedresultatet af litteraturgennemgangen er samlet i Bilag 1, der giver total oversigt over de vigtigste referencer med evidenspåvisning i internationale projekter om hospitalsbelysning. Alle artikler er samlet i en database (Mendeley reference manager), og for de deltagende institutioner får man adgang til hele artiklen ved at klikke på forsiden, som er vist i listen. Andre har ikke umiddelbart denne adgang, men overskrift og abstract giver i de fleste tilfælde et godt indblik i artiklen, ligesom der gives et link for at få den fulde adgang.

Direkte kontakt med aktører i 'gode hospitalsløsninger'

I de seneste år har der været en meget stor interesse for og øget viden om lysets mulige helbedsfremmende virkninger. Dette kom bl.a. til udtryk gennem deltagelsen i konferencen *Udvikling af energibesparende og helbedsfremmende lys til hospitalssektoren*, som SBi og DTU Fotonik i fællesskab afholdt i 2011. Konferencen var fuldtegnet med 120 deltagere repræsenterede regionerne, sygehusene, belysningsbranchen bredt samt rådgivere og beslutningstagere i byggeriet. Det overordnede mål var, at skabe netværk mellem virksomhederne og forskningen, således at den forskningsmæssige viden kan blive omsat i innovation og produktudvikling i udviklingen af fremtidens belysningsløsninger. Konferencen fokuserede på to hovedområder, nemlig: - Lysets betydning for menneskets velbefindende, trivsel og helbredelse samt - Nye muligheder i belysningsteknikken for at

skabe dynamisk og fleksibelt lys, som både kan tilpasses skiftende behov over døgnet og brugergruppernes forskellige behov

Ideelt set burde hovedprojektet gennemføres på et stort afsnit af et af de først opførte supersygehuse, således at erfaringerne herfra kunne udnyttes og videreudbygges i de efterfølgende sygehusbyggerier. Men sygehusplanerne rummer også mange 'mindre' projekter (0,5 – 1,5 mia. kr.), hvor rammerne synes at være lidt mere fleksible, og bygherrerne (hospitalsledelserne og regionerne) måske mere motiverede

Til trods for den store interesse, der blev vist ved konferencen, ikke mindst fra hospitalerne, viste det sig at være meget vanskeligt at få den nødvendige opbakning eller tilsagn om deltagelse fra hospitalsmiljøerne til forskningsprojekter, der udover at forbedre lyset på hospitalerne også skulle være med til at skabe evidens for lysets virkninger. Projektgruppen har i projektets første år været i kontakt med Rigshospitalet, Det Nye Universitetshospital i Aarhus, Glostrup Hospital og Hvidovre Hospital, i alle tilfælde uden at der kunne skabes grundlag for et lysprojekt med forskning som et vigtigt element.

SBi har efterfølgende været i dialog med Region Sjælland om et projekt på det nye Psykiatrisygehus Slagelse, som ved indvielsen i starten af 2015 vil blive Danmark største og mest moderne psykiatrisygehus. Sammen med Region Sjælland udarbejdedes en ansøgning til Realdania Fonden, men her fik vi et afslag med den begrundelse, at Realdania var ved at omstrukturere og endnu ikke havde formuleret en strategi for lysområdet, som man i øvrigt havde fået mange ansøgninger på.

Konklusionen på det opsøgende arbejde har været, at projektgruppen har været for sent ude, idet der i de nævnte projekter allerede var udpeget byggekonsortier, som i forvejen var hårdt presset på både tid og økonomi. Selv om interessen for det gode lys var til stede hos hospitalerne, var det derfor helt umuligt at presse flere krav og restriktioner ned over den igangværende projektering.

Fokus på hospitalet som helhed

Der er gennemført mange innovative lysprojekter i de senere år på specialafdelinger som fx intensivafdelinger, røntgen- og strålingsafdelinger, hvor dynamisk LED-belysning bl.a. er indrettet efter at skabe et trygt miljø og samtidig giver nemmere skærmaflæsning for specifikke behandlingsfunktioner. Imidlertid er der næppe videnskabelig dokumentation for, at de gennemførte lysprojekter har medført de ønskede forbedringer i forhold til traditionel hospitalsbelysning.

Workshoppen på den nævnte konferencen understregede, hvor vigtigt det er, at de store arealer på hospitalerne som omfatter sengestuerne og de mange gangarealer bliver oprioriteret i planlægning og indretning, herunder også i lyssætningen (inklusive dagslys). Hele filosofien i planlægningen af de nye superhospitaler er, at patienterne skal hurtigt ud af sengen og hurtigt ud af hospitalet. Den eksisterende viden om, at det gode dagslys på sengestuerne og udsigten kan forbedre patienternes helbredelse og nedsætte indlæggelsestiden, er slet ikke blevet udnyttet i tidligere hospitalsbyggeri, og er end ikke tænkt ind i planlægningen af de nye superhospitaler i Danmark. Det samme er tilfældet med gangarealerne, som allerede i dag udgør meget befærdede områder. Heller ikke her har man udnyttet den eksisterende viden, selv om indretningen og lyset har stor betydning for alle målgrupper: patienter, personale og pårørende. Gangarealerne har mange anvendelser med meget forskellige behov for målgrupperne, og derfor skal lyset medvirke til at opfylde de individuelle behov, fx gennem en opdeling af arealerne i mindre afsnit, der indrettes og lyssættes i passende overgange med henholdsvis sengestuer, behandlingsrum og opholdsstuer/adgangsområde/foyer (for hver af målgrupperne).

Det var ud fra disse tanker, at projektgruppen formulerede hypoteser og beskrev mulige tiltag for i samarbejde med hospitalerne at få initieret et nationalt forskningsprojekt, som på et solidt videnskabeligt grundlag kunne dokumentere lysets betydning, og som samtidig kunne være en hjørnesteen i planlægningen af det fremtidige hospitalsbyggeri i Danmark.

Beskrivelse af projektteamet (consortium)

Som grundlag for kontakter til regioner og hospitaler påbegyndtes udarbejdelsen af en beskrivelse af projektteamet. Beskrivelsen kom i realiteten ikke rigtig i brug, og blev ikke færdiggjort til en overbevisende beskrivelse af teamets samlede kompetencer. Nedenfor gengives et udkast til beskrivelsen.

**SBi, Aalborg Universitet København, DTU Fotonik
Aarhus Universitets Hospital og Arkitektskolen Aarhus**

Draft document Hospitalslys-Team.docx, Marc Fontoynt

1. Proposed title: Helbredsfræmmende lys i danske hospitaler

Evidence based lighting solutions for Danish hospitals

Bringing scientific evidence and innovative technologies for improvement of hospital environment and services.

2. Objectives of the consortium

There is today scientific evidence that patterns of lighting influence sleep quality, stress management, well-being of patients and staff. Some population (elderly and visually impaired or neurosensitive) have also demonstrated acute sensitivity to some lighting schemes. Lighting strategies and adapted equipment can also contribute to reduce exposure of population to germs during their stay in hospitals, and reduce cost and maintenance tasks. Our consortium proposes to assist hospital managers in developing high performance lighting schemes using the best of technology. It proposes various processes, involving a large array of professional stakeholders and experts, which will guarantee the feasibility and the cost effectiveness of the solutions. Our consortium proposes to produce evidence based adapted documents at the various phases of hospital design (new and renovation). And to conduct the necessary testing of solutions to guarantee their benefits, before their deployment

3. Members of the consortium (who we are)

SBi Aalborg University Copenhagen	Lighting scheme assessment, rating of visual environment in laboratory and on site, energy optimization, field assessment, development of standards
DTU Fotonik	Innovative lighting system design (sources and optics) , component testing, benchmarking of products, lighting calculation, photometric data collection and management
Aarhus University Hospital	Expertise in relation between the working conditions, physical environment, light exposure and diseases
School of Architecture Aarhus	Influence of architectural design of buildings, windows and facades on the daylight patterns in rooms and the influence on mental and physical health.

4. Unique tools and services brought to the project

Our research institutions have developed and are developing various innovative tools and processes which are expected to be employed in our activities dealing with hospital lighting

1. Field measurement processes, with portable equipment and data acquisition to monitor all the aspects of lighting and energy use in existing hospital spaces and during experimentation
2. Simulation tools providing calibrated High Dynamic Range images of hospital spaces, to explore solution and compare options at the design stage
3. Photometric laboratory, providing capability to measure optical performance of lamps, luminaire and lighting products, using procedures validated by international organisations
4. User assessment procedures, concerning staff, patients and other occupants of hospitals, allowing the identification of preferred lighting schemes. These procedures are applied during field testing, but also during the phase of virtual reality exploration, and when testing prototype solutions
5. Development of metrics: our consortium uses various type of metrics depending on the topic being investigated:
 - Photometry, for characterization of lighting schemes and products
 - Vision metrics, to assess the quality of the perceived environment
 - Physiological markers (for assessment of role of lighting on physiological functions: hormones, EEG, sleep quality, etc.)
 - Sociological metrics (to monitor impact on productivity, safety, ...)
 - Financial metrics (to assess impact of lighting schemes on maintenance cost, energy, and also performance indicators of the hospital service).
6. combination of lighting metrics, physiological with metrics

Arbejdsprocessor i et hospitalsprojekt

For at facilitere kontakter med hospitalerne blev der udarbejdet en kort beskrivelse af de mulige processer, som projektteamet kunne gennemføre i forbindelse med konkrete nybyggerier eller renoveringsprojekter for hospitaler. Processerne omfatter i princippet alle faser af planlægning og projektering, helt fra bistand ve udarbejdelse af projektprogrammeringen til evaluering af de færdige løsninger. Processerne beskrives i det følgende.

Draft document Hospitalys-Processes.docx, Marc Fontoynt

1. Contribution to programming of hospital project (new or refurbishment)

The consortium proposes to produce a document to be sent by the hospital head to the design teams to alert them on various aspects dealing with possible benefits and dangers related to lighting in hospital. The document will bring together various evidence provided by the scientific world.

2. Conducting on site assessment prior to refurbishment / new project

- a) The consortium proposes to conduct two tasks:
 - On-site assessment of performance of lighting installation, related to visual specifications, psychological well-being, energy performance, maintenance problems. This will lead to identification of possible technical improvements, in lighting equipment, controls, and electrical architecture
- b) On-site assessment of satisfaction of staff and patients with respect to lighting quality, lighting controls. Recording of expectations. Determination of priorities for improvement in design.

This task is essential in the case of the launching of a program of refurbishment. It can also be used to justify update of specifications in new projects.

3. Conducting exploration of innovative solutions, using HDR computer generated images

This technique is ideal to explore and compare with the hospital directors and their partners various possible lighting scenarios. Calibrated High Dynamic Range Images of indoor scenes are proposed to a panel of selected observers for comments. A procedure to collect these comments and classify the scenes is part of the process ("Thurstone Paired Comparison"). Results are then presented to the clients and partners and general strategies establishes. This can suggest the procedure for testing real schemes.

4. Conducting field experimentation

Field experimentation is necessary to identify possible benefits (and draw-backs) of some lighting schemes on health, well-being, sleep quality, healing, stress management, etc. The consortium proposes to use adapted procedures, based on field monitoring capabilities, data acquisition of key parameters, and field assessment.

5. On site verification of performance of solutions

The above procedure can also be used to validate prototype lighting solutions, prior to their deployment.

6. Production of guidelines

The described testing campaigns are expected to raise knowledge on hospital lighting opportunities. Results can be produced to upgrade existing guidelines, based on evidence gathered either from bibliography or experimentation conducted by the consortium.

7. Verification, for the client, that design proposals are in line with the guidelines

During a project, the consortium can provide a third body independent expertise to assess the quality of the proposals by the design teams (architects and engineers).

8. Third party testing of equipment

Innovative lighting equipment needs to be carefully verified by a third party before being implemented. This concerns safety issues (electrical safety, fire safety, waterproofing, etc.). It also concerns the quality and quantity of light emitted, flickering effects, EM radiation, and how these matches the specifications. On-site verification of product performance is also of high interest for non-conventional solutions.

Hypoteser

På baggrund af eksisterende erfaringer, viden og litteraturstudiet opstilledes en række hypoteser, som projektteamet kunne planlægge delprojekter ud fra, afhængigt af de enkelte hospitalers interesser i forhold til konkrete afdelinger og behandlingsformer. Hypoteserne blev til i en form for brainstorm, og er derfor ikke organiseret i en bestemt rækkefølge eller prioritetsorden. Til hver hypotese søgtes tilknyttet litteraturhenvisninger for kortlægning af tidligere forskningsresultater på de givne områder. Der blev også udarbejdet en kort beskrivelse af en mulig fremgangsmåde til at eftervise hver hypotese, ligesom der i nogle tilfælde blev identificeret mulige samarbejdspartnere. Der blev dog ikke fulgt op systematisk på dette. Listen med hypoteser blev ikke færdiggjort, hovedsageligt fordi vi aldrig kom i en realistisk dialog med hospitaler eller regioner. De opstillede hypoteser er gengivet i det følgende.

Emne	Hypothesis	Action	Partners	Litterature
PATIENTER				
Tilfredshed	Patienter har ubehag ved rum, der er uden vinduer og dagslys	Skabe rum med vinduer og dagslys og hvor dette ikke er muligt: installere kunstige vinduer	Servodan	
Orientering	Markant øget hyppighed af postoperativt Delirium i intensiv afdeling uden dagslys. Intensivafdeling uden vinduer synes at svække patienters hukommelse og evne til at orientere sig i forhold til tid og sted og øge antallet af syner/hallucinationer	Skabe intensivafdelinger med vinduer og dagslys og hvor dette ikke er muligt: installere kunstige vinduer	Rigshospitalet	Wilson, 1972 Keep, James, & Inman, 1980
Døgnrytme og søvn	Ældres søvn: Jo mere tid tilbragt i lys om dagen jo bedre søvn (dybere søvn med færre afbrydelser og færre bevægelser) om natten	I mangel af dagslys med høj intensitet kan øget kunstig belysning have den samme effekt. Installering af kunstlys der kan kompensere for manglende dagslys	Glostrup Hospital	Wallace-Guy et al., 2002 Wakamura & Tokura, 2001
Døgnrytme og søvn	Mørke om natten. Når belysningsniveauet sænkes markant om natten, får både børn, for tidligt fødte og ældre både længere søvnperioder og dybere søvn med færre bevægelser	Belysningsniveauet sænkes markant om natten. Dvs. Installering af funktions-lys til at varetage 'arbejdsopgaver' om natten.	Glostrup Hospital	Cureton-Lane & Fontaine, 1997 Slevin, Farrington, Duffy, Daly, & Murphy, 2000 Vinzio, Ruellan, Perrin, Schlienger, & Goichot, 2003
Døgnrytme og søvn	For demente har lys med høj intensitet om dagen en positiv betydning for forholdet mellem aktivitetsniveau og ro i løbet af døgnet	Kompensation for manglende dagslys om dagen og sænkning af lyset om natten (funktionslys)	Glostrup Hospital	Lovell, Ancoli-Israel, & Gevirtz, 1995 Van Someren, Kessler, Mirmiran, & Swaab, 1997
Indlæggelsestid og dødelighed	Observeret på intensiv hjertemedicinsk afdeling: patienter indlagt på sydvendte stuer er indlagt kortere tid end patienterne indlagt på nordvendte og markant mørkere stuer. Navnlig for kvinder! Dette gælder også dødeligheden der formodes lavere blandt patienter, der ligger på sydvendte lyse stuer, end blandt patienterne på de nordvendte mørke stuer. Morgenlys især vigtig!	Brug af hovedsageligt sydvendte stuer for at opnå kortere indlæggelsestider. Brug af kompenserende kunstlys og test af om kunstlyset kan kompensere på nordvendte stuer	Rigshospitalet	(K. M. Beauchemin & Hays, 1998) Benedetti et al., 2001

Depression	Lys har en positiv terapeutisk effekt flere typer af depression. Hvis behandling med lys gives tidligt om morgenen forstærkes effekten, navnlig hvis tidspunktet for behandlingen følger patientens egen døgnrytme	Behandling med kunstigt lys og dagslys i morgentimerne. Foretrække østvendte og lyse stuer for signifikant kortere indlæggelser	Klaus Martiny	Lewy et al., 1998; Terman, Lo, & Cooper, 2001 Benedetti et al., 2003 Beauchemin & Hays, 1996; Benedetti, Colombo, Barbini, Campori, & Smeraldi, 2001
Smerte og stress	Patienterne på de lyse stuer forbruger mindre smertestillende medicin har ved udskrivningen lavere målinger af oplevet stress	samme som ovenfor	Smerteklinikken, Rigshospitalet	(Walch et al., 2005). Leather et al., 2003
Udsigt og placering af vinduet	mulighed for at orientere sig i forhold til de ydre omgivelser er vigtig	udsigt hvor man kan se langt opprioriteres	Arkitektskolen Aarhus	Verderber, 1986
Udsigt og placering af vinduet	personale og patienter vurderer rum, hvor vinduet sidder meget højt eller rum, hvor vinduet vender ud til en væg og således hverken giver udsigt eller nævneværdigt meget lys, ligeså uattraktive som rum helt uden vinduer	Samme som ovenfor men da det tyder på at udsigten til natur også har stor betydning, bør udsigt opprioriteres	Arkitektskolen Aarhus	Verderber, 1986 Ulrich 1984
Udsigt kontra privathed	Blandt de nybagte mødre, der ikke syntes at vinduer/ udsigt er vigtigt, er der langt flere, der modtager farmakologisk smertestillende medicin end blandt dem, som fandt vinduet vigtigt. Dog er vinduer i føderum mindre vigtige end privathed, og sikkerheden for at ingen kan se ind.	Sikre at privathed ikke negligeres		Symon et al., 2007
Privathed på opholdsarealer	Mange følsomme og private samtaler føres i stigende grad på gangarealerne, hvilket ikke er rart for hvor hverken patienter eller personalet. Lyssætningen og indretning i områder hvor disse samtaler foregår kan virke beroligende og give mere privathed og er vigtig	Lave 'private rum' vha. speciel lyssætning i fællesarealerne hvor samtaler kan foregå uforstyrret		

Indsatsområder

Ud fra de opstillede hypoteser og litteraturgennemgangen blev der formuleret en række forskellige indsatsområder, som projektteamet kunne tilbyde hospitalerne at gennemføre som evidensbaserede delprojekter. De mulige indsatser blev grundigt diskuteret, hvilket førte til, at nogle blev slået sammen mens andre blev droppet. De endelige indsatsområder er listet nedenfor, og de syv første er nærmere beskrevet på de følgende sider. Specielt indsatsområde 4 om en sund/helbredende arkitektur for hospitaler blev genstand for en større udredning om den historiske udvikling af hospitalsbyggeri i Danmark. Gennemgangen viser bl.a., at en del viden og erfaringer om godt hospitalsbyggeri er gået i glemmebogen, en konstatering man kan frygte stadig gør sig gældende i meget af det igangværende hospitalsbyggeri. Den historiske gennemgang er gengivet som separat Bilag 2 på side 81.

List of potential actions

- Action 1: Quality of Daylight and view
- Action 2: Lighting and sleep quality, light during sleeping time
- Action 3: Daylight simulation and artificial windows
- Action 4: Healthy hospital architecture? Case-studies from Denmark 1900 - 2000. (i.e. forgotten knowledge in a 'new Light' in future hospital building).
- Action 5: Building for better light and better darkness (in the construction phase)
- Action 6: Superbugs, MRSA and UV-light UV-light (can improve the hygiene at hospitals)
- Action 7: The role of lighting in the building-process of a new hospital
Identify controversies between medical and financial reasoning. Are there long term considerations in the planning?
- Action 8: Light and Stress (stress of nurses?)
- Action 9: Elderly and light (major market!)
- Action 10: Healing by light (sleep disorder etc.)
- Action 11: Photometry
- Action 12: Lighting simulation
- Action 13: Light sources used in hospitals

Proposal of action # 1**Title: Quality of Daylight and view.**

1. General scope and objectives

Quality of Daylight and views is a high concern by patients in hospitals. Various studies demonstrate that daylight and views contribute to the well-being, reduce stress for persons particularly sensitive to winter depression and possibly lead to faster healing. The proposed action will investigate improvement of the design of apertures, and more globally, propose daylighting strategies for hospitals. Solar shading and reduction of excessive daylight penetration while maintaining the view out is part of the scope.

2. Proposed deliverables

Design guidance and examples of solutions for various rooms: sizing with respect to room dimensions, orientation, and functions

Proposed global daylighting and view strategy expressed through a document: "Procurement for optimal daylighting and view management in hospitals"

3. Level of evidence justifying the action

- Patients hospitalized in south-facing rooms are hospitalized less time than patients admitted to a north-facing and significantly darker room. This applies especially for women. This also applies to the mortality which is presumed to be lower among patients who are hospitalized on south-facing bright rooms, than among patients in the north-facing dark rooms. Especially the morning light is important [KM Beauchemin & Hays, 1998], [Benedetti et al. 2001]. Furthermore research show that patients hospitalized in the bright rooms (south-oriented?) opposed to darker rooms use less pain-relieving medication and upon discharge the measurement of experienced stress is lower [Walch et al, 2005], [Leather et al, 2003].
- The ability to orientate yourself with respect to the outer environment is important [Mroczek et al, 2005], [Macnaughton et al. 2005], [Verderber, 1986], [Ulrich, 1984]. Even though there is a window wall, where light is penetrating through, this is not being regarded as a problem, even though the behaviour shows that the curtains are subtracted [Mroczek et al, 2005], [Macnaughton et al., 2005]. Furthermore, patients and staff assess rooms where the window is located very high or where the window is facing a wall, just as unattractive as rooms without windows [Verderber, 1986]. This suggests that the view to the nature and the surroundings are important and should be given high priority.
- A higher proportion of the mothers giving birth who did not find windows or view to be important, receives pharmacological pain medication than among those who found the window important. However, windows in the delivery room are less important than privacy and certainty that nobody can see in. [Symon et al., 2007]
- Light has a positive therapeutic effect of several types of depression. If treatment with light is given early in the morning this effect is enhanced, especially if the time of treatment follows the patient's own circadian rhythm [Lewy et al., 1998].

4. Process

The proposal required a critical review of constraints and opportunities concerning hospital designs, to identify how management of daylighting and views could be improved and guaranteed. This will require the analysis of various existing schemes proposed by architects, depending of the types of sections of a hospital.

Task 1: Gathering hospital schemes, and information on window design

Task 2: Performing a critical assessment of daylight penetration and views

Task 3: Proposing solutions through brainstorming with professionals

Task 4: Optimize sizing, verify feasibility of solutions

Task 5: Write proposal of procurement for investors in hospital buildings

5. Proposed partners

Here is a proposal of partners:

- A) A team to collect data (plans), interview hospital managers, and collect technical material. This team perform the critical assessment, identify constraints and possible opportunities and propose the metrics
- B) A panel of architects and engineers to identify possible solutions, through brainstorming sessions
- C) A team to express proposals (procurements) and possibly perform calculations to verify sizing (could be the same as team A).

6. Time Frame

Task description	Year 1				Year 2				Year 3			
Task 1: Gathering hospital schemes, and information on window design												
Task 2: Performing a critical assessment of daylight penetration and views												
Task 3: Proposing solutions through brainstorming with professionals												
Task 4: Optimize sizing, verify feasibility of solutions												
Task 5: Write proposal of procurement for investors in hospital buildings												

7. Funding

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Proposal of action # 2**Title: Lighting during sleeping time**

1. General scope and objectives

Night darkness, and the absence of light in the blue section of the visible spectrum seem to be an important factor for maintaining a high quality of sleep. During sleep, the sleep hormone "melatonin" which is produced contributes in many "repairing tasks". In hospitals in Denmark, two issues concerning lighting have identified in hospitals which could lead to inappropriate exposure of patients to light during sleeping hours:

- 1) Excessive daylight exposure (late in the evening and early in the morning) between April and August, due to day length at the latitude of Denmark.
- 2) Use of security lighting, or other technical lighting at night-time which could reduce sleep quality, the impact being stronger with blue-rich light sources.

However, during the same hours, the staff has to perform an large amount of tasks requiring lighting conditions which may be counterproductive with specifications for sleep quality. The objective is to identify lighting schemes offering optimal sleeping conditions and satisfactory for the operation of the hospital.

2. Proposed deliverables

A set of proven solutions, and specification gathered in a document entitled: "lighting specifications for optimal sleeping conditions in hospital wards"

3. Level of evidence justifying the action

- When the lighting levels are significantly lowered at night; children, premature and elderly persons get longer periods of sleep and deeper sleep with fewer interruptions and movements [Cureton-Lane & Fontaine, 1997; Slevin et al., 2000, Vinzio et al. 2003]
- For people with dementia, high intensity light during daytime has a positive impact on the relationship between activity level and calmness during the day [Lovell, Ancoli-Israel, & Gevitz, 1995]
- The more time spent in daylight the better sleep (deep sleep with fewer interruptions and less movements) at night [Wallace Guy et al. 2002][Wakamura & Tokura, 2001]. In the absence of daylight with high intensity increased artificial lighting can have the same effect.

4. Process

First a field survey will monitor lighting conditions in various spaces occupied by patients at period when they should normally sleep. This task will gather illuminance data and spectral distribution of light, and record exposure during time allocated for sleeping.

Critical analysis of specifications by staff will be conducted. Alternative scenarios will be proposed and designed technically. They will be implemented and tested. Best solutions will be selected and included in specifications.

Task 1: Field monitoring of light exposure during sleeping periods.

Task 2: Analysis of data, and study of specifications by staff.

Task 3: Propose alternative solutions, through brainstorming with staff and engineers

Task 4: Conduct field testing of solutions, and produce results

Task 5: Write proposal of specifications for lighting conditions during sleep.

5. Proposed partners

All tasks could be performed by the same team.

- D) A team to conduct the field monitoring of lighting conditions during sleeping time: continuous recording of illuminance, light exposure and spectra.
- E) A team to design alternative solutions, in relation with professionals
- F) A team to write specifications

6. Time Frame

Task description	Year 1				Year 2				Year 3			
Task 1: Field monitoring of light exposure during sleeping periods.	■	■	■									
Task 2: Analysis of data , and study of specifications by staff.				■								
Task 3: Propose alternative solutions, through brainstorming with staff and engineers					■							
Task 4: Conduct field testing of solutions, and produce results						■	■	■				
Task 5: Write proposal of specifications for lighting conditions during sleep.									■	■		

7. Funding

Proposal of action # 3**Title: Daylight simulation and artificial windows**

1. General scope and objectives

In hospitals, there are moments, and places, where daylight is not available. Because spaces are windowless (far from the envelope), because daylight and sunlight may create possible problems, or more simply, because it is nighttime, or winter. Evidence demonstrated however that daylight spectrum, natural impression of daylight and view to the outside are important factors to maintain well-being, alertness and faster healing. Modern technology proposes various techniques to simulate both the colour quality, and the “naturalness of views”, and propose ways to vary effects “naturally”

This study proposes to investigate solution and install them in key areas of a building. Staff and patients will be interviewed to assess satisfaction with the systems. Technical and financial study will be made to investigate feasibility.

2. Proposed deliverables

- A list of technical solutions to simulate daylight and windows with evidence of the acceptance and benefits.
- An assessment of technical constraints and costs associated to the systems
- A descriptive document to describe the solutions, for implementation in “procurement documents”

3. Level of evidence justifying the action

- Circadian rhythm and sleep elderly sleep: The more time spent in daylight the better sleep (deep sleep with fewer interruptions and less movements) at night [Wallace Guy et al. 2002][Wakamura & Tokura, 2001]. In the absence of daylight with high intensity increased artificial lighting can have the same effect.
- Light has a positive therapeutic effect of several types of depression. If treatment with light is given early in the morning the effect is enhanced, especially if the time of treatment follows the patient's own circadian rhythm [Lewy et al., 1998; Terman, Lo & Cooper, 2001; Benedetti et al. 2003; Beauchemin & Hays, 1996; Benedetti et al. 2001]
- Patients have discomfort in spaces that have no windows and daylight. Create space with windows and daylight and where this is not possible, install artificial windows [Servodan]
- Significantly increased incidence of postoperative Delirium in the intensive care unit without daylight. Intensive care unit without windows appear to impair patients' memory and ability to orient themselves in relation to time and place and increase the number of visions / hallucinations [Wilson, 1972; Keep, James & Inman, 1980]
- Need for view to the outside, view of objects located far in the field of vision and view toward vegetation are clearly expressed by patients during interviews [Fontoynt, 2002]

4. Process

The principle will be to assess the feasibility, and the benefits of lighting schemes allowing the simulation of daylight (spectrum and variations in intensity and colours) as well as the simulation of views to the outside.

First we will identify spaces in hospitals where such solutions could be developed . Then we will collect information about existing technical solutions in the domain (global, or concerning components). Solutions will be proposed for these spaces. They will be installed, in such a way that they could be compared with reference “classical” lighting solutions. A

testing procedure will be developed, to record comments by staff and patients, and most efficient schemes will be identified. In parallel, we will conduct technico-economical assessment of the solutions to identify their feasibility. Finally, the most successful solutions will be installed in a number of relevant spaces.

Task 1: Identification of spaces which would benefit from simulation of daylight

Task 2: Survey of existing solutions for daylight simulation

Task 3: Design of solutions to tests

Task 4: Conduct field testing of solutions, and production results

Task 5: Conduct technico -conomical assessment

Task 6: Identify best solutions and express specifications in procurement

Task 7: Deploy solutions in various hospitals

5. Proposed partners

All tasks could be performed by the same team, if it gathers expertise on lighting, field measurement, technico-economical assessment capabilities. Possible involvement of companies developing the system could allow further developments

6. Time Frame

Task description	Year 1			Year 2			Year 3		
Task 1: Identification of spaces which would benefit from simulation of daylight									
Task 2: Survey of existing solutions for daylight simulation									
Task 3: Design of solutions to tests									
Task 4: Conduct field testing of solutions, and production results									
Task 5: Conduct technico -conomical assessment									
Task 6: Identify best solutions and express specifications in procurement									
Task 7: deploy solutions in various hospitals									

7. Funding

Proposal of action #4

Title: A healthy architecture? Case-studies from Denmark 1900 - 2000

1. General scope and objectives

Architecture has reflected different beliefs and different diseases over the last 100 years. Different approaches towards a healthy architecture have been made (a healthy architecture being an architecture that prevents diseases). This study discloses different typologies and beliefs and their different impact on the daylight, the electrical lighting and the architecture. Raising some critical questions regarding more health-related issues for future hospital architecture.

The study will answer the following questions:

- 3) What has been gained and what has been lost over the decades?
- 4) Which contradictions can be a problem and how should they be addressed in future planning of hospitals?
- 5) (How) Can forgotten knowledge be useful today?

Thesis:

Looking at different hospitals in DK the guide can provide a valuable knowledge that may help create a healthier and more sustainable architecture in the future.

2. Proposed deliverables

A guide explaining past ideas about light and health, suggesting how hospital-architecture can play a more explicit role and how it can promote general health and healing processes at hospitals.

3. Level of evidence justifying the action

Focusing on b) the geographical orientation and its impact on the daylight

- a) The main structure of the hospital and the daylight amount
- b) The geographical orientation and its impact on the daylight
- c) The electrical lighting and its role in the hospitals and in design of the hospitals

4. Process

Task 1: Gathering material about each typology of hospitals

Task 2: A critical analysis of each typology will be conducted

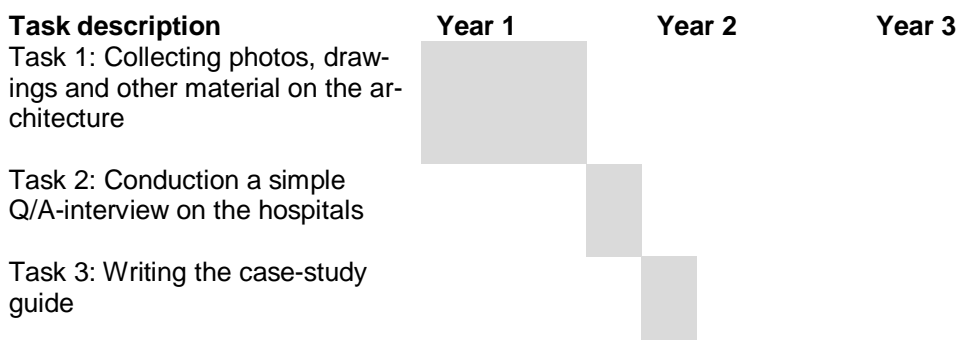
Task 3: Finally a comparison of the typologies regarding daylight and electrical lighting

5. Proposed partners

All tasks could be performed by the same team. CV/AKF

- G) Collecting photos and drawings
- H) Conduction simple Q/A-interviews
- I) Writing a case-study guide

6. Time Frame



7. Funding

1. General scope and objectives

Exposure to light has become a much more complicated issue in the recent years, this due to the discovery of the light-sensitive ganglia cells in the Retina 2002, and its impact on melatonin and serotonin. Light seem to be not only beneficial and can actually be the opposite, e.g. late in the evening and too early in the morning. Planning the architecture can balance these opposite needs and is a necessary prerequisite for a more healthy environment of patients and staff.

- 6) Architectural solutions that differentiate between areas directly lit by the sunlight and skylight with areas protected from direct sunlight and skylight
- 7) Better planning of activities according to the geographical orientation; light in the morning at wards – no light in the evening at wards - light in the evening at dining areas – etc.
- 8) As a result of 1) and 2) electric lighting that facilitates these differences in daylight, needs and activity

In Denmark this raises challenges because we may have too much daylight in the summertime and too little in the wintertime. We need to look at how we can establish a better daylight and a better darkness. This however is difficult and involves architectural solutions that provide room and space for both light and darkness.

We know that the impact of the sun can't be mimed by electrical lighting. Intensities of 25.000 lux is easily achieved by daylight but not possible using electrical lighting. However on the other hand we need to supplement this with good electrical lighting in the evening and when and where this is relevant, especially in the evening and during the dark seasons.

2. Proposed deliverables

A study of how the architecture is generally planned at different hospitals, how are the wards oriented, how are the dinning-facilities and offices oriented? How is the daytime-scenario? How is the evening/night-scenarios?

3. Level of evidence justifying the action

- A better quality of daylight
- A better quality of electrical lighting
- A better interplay between daylight and electrical lighting. We know that electrical lighting uses appr. 15 – 20% of the electricity in a building. Reducing the energy consumption and at the same time improving the health and wellbeing can be made. Earlier research (Computer- and daylight-controlled lighting at hospitals 2009) suggests that this is possible and that it can indeed save energy and at the same time provide a better environment at hospitals.

4. Process

- 1) A field study
- 2) A critical analysis of the daytime- and night-time-scenarios. Best solutions will be selected and included in specifications.

Ad. Alternative scenarios will be proposed and designed technically. They will be implemented and tested?

5. Proposed partners

6. Time Frame

Task description

Task 1: Field study

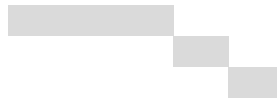
Task 2: Critical analysis

Task 3: Conclusion

Year 1

Year 2

Year 3



7. Funding

Proposal of action #6

Title: Superbugs, MRSA and UV-light?

1. General scope and objectives

Exposure to UV-light is known to have an antiseptic effect and can kill and reduce germs at hospitals. MRSA (Methicillin-resistant *Staphylococcus aureus*) and other bacterias cause great problems in the healing process of patients. It is estimated that in the UK 10% of the patients acquire some sort of illness during their stay – a number that has steadily increased over the recent years.

- 9) Glazing can support UV-light in the hospital
- 10) Opening of windows can further eliminate germs and ventilate wards with fresh air
- 11) UV-light can raise the hygiene at hospitals

Antibiotics seem to have made redundant the earlier function of UV-light, however germs is a raising problem and evolving multi-resistant bacterias challenge the medical treatment. At the new and larger hospitals and antibiotics may not be the most rational antiseptic if not supported by other means.

We know that UV-light has advantages that can support antibiotics and other sterilization-processes.

2. Proposed deliverables

A study of how the glazing is – measuring the amount of UV-light at wards, etc. Combined with a statistical body of work, the study will look at the emergence of superbugs and the incidents of illnesses related to the amount of UV-light at different hospitals.

3. Level of evidence justifying the action

- A study of hygiene-reports and reported post-operational illnesses
- A detailed study of the existing UV-light

4. Process

- 3) A field study, measuring amount of UV-light summer/winter
- 4) A critical analysis statistical information about superbugs and illnesses at the hospital summer/winter

5. Proposed partners

6. Time Frame

Task description	Year 1				Year 2				Year 3				
Task 1: A field study (glass, UV-light, bugs)	■	■	■	■									
Task 2: A critical analysis				■									
Task 3: A final conclusion					■								

7. Funding

Title: The role of lighting – in the building-process a new hospital

1. General scope and objectives

Over the next years many hospitals will be built in Denmark. This gives a rare opportunity to look behind the scenes and focus on which parameters that decide the building-process and the way a new hospital will look like. This study will look at the design-process, studying the variables when designing the lighting at a new hospital. Focusing on the process and on the different actors in the process: How is the lighting planned economical? How is the lighting planned medical? How is the lighting planned architectural?

- 12) Are there controversies between medical and financial reasons?
- 13) Are there any longterm-considerations in the planning? (Maintenance vs. building costs, etc)
- 14) Can the different factors be organized in a better and more sustainable way?

There are many factors affecting the lighting. This study will make a brief overview of which factors are involved and how they interact with the final architectural result.

2. Proposed deliverables

A qualitative study involving politicians, economists, doctors, patients and architects in one of the new regional hospitals

3. Level of evidence justifying the action

- The study can help revealing what goes on "behind the scene" and which factors that seem to play the major roles in the process of creating a better lighting/environment – factors that may not be visible in the final end-result.

4. Process

- 5) Qualitative interviews of 3-4 different building-partners on one of the new hospitals (at DNU)
- 6) This followed by a critical analysis

5. Proposed partners

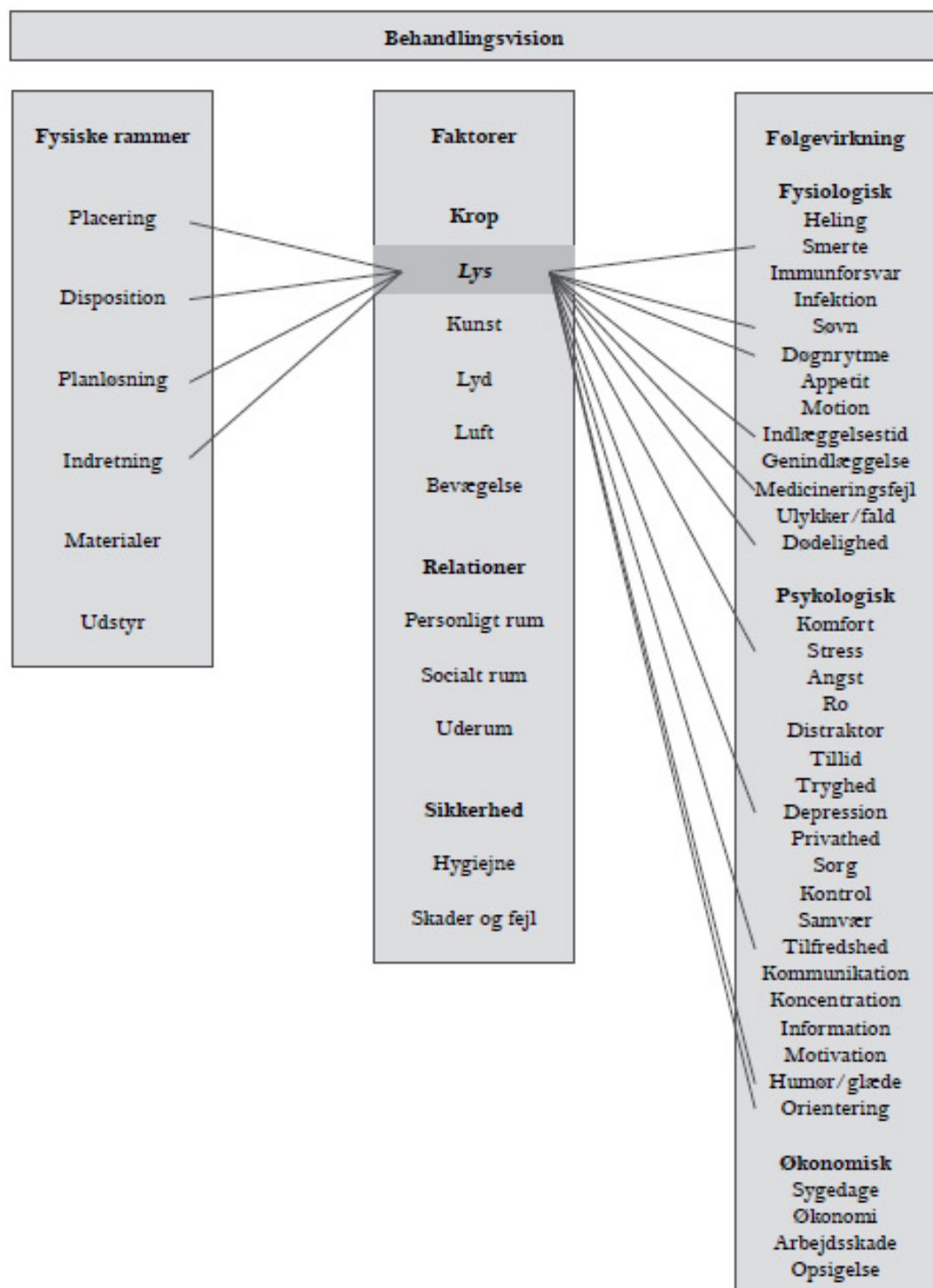
6. Time Frame

Task description	Year 1				Year 2				Year 3				
Task 1: 3-4 qualitative interviews													
Task 2: A critical analysis													

7. Funding

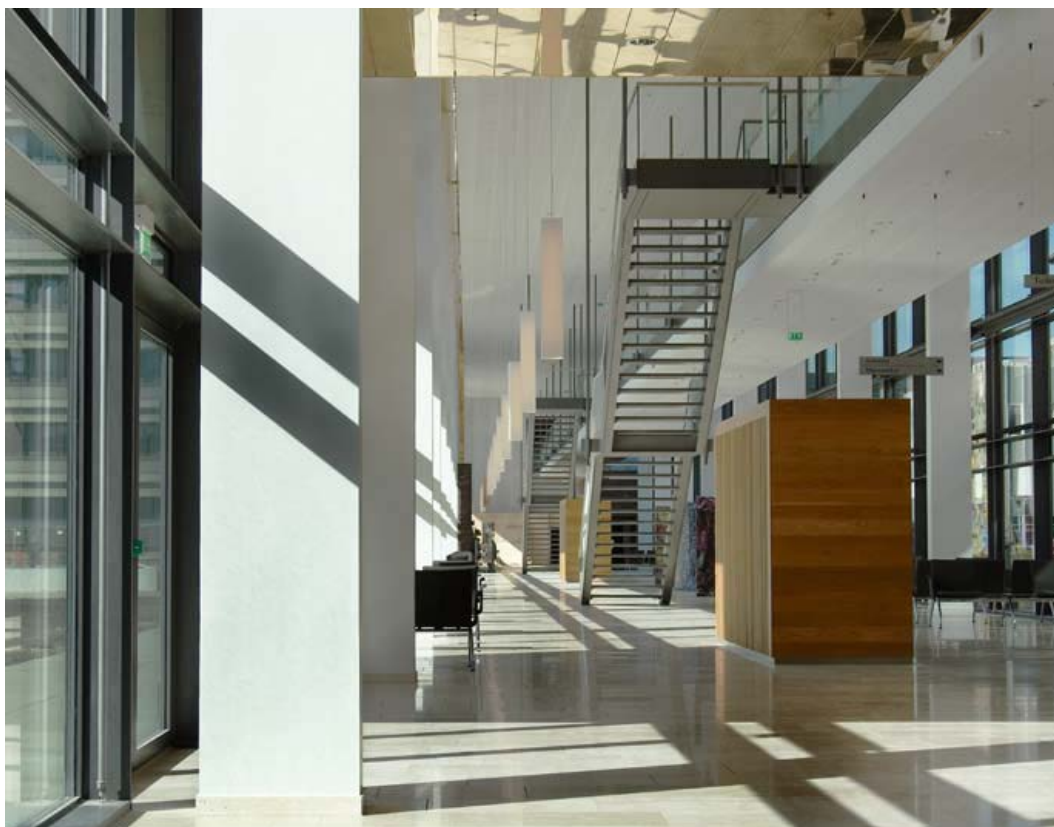
Bilag 1: Litteraturstudie

Som et godt grundlag for litteraturstudiet kunne projektgruppen bruge rapporten *Helende Arkitektur*, udgivet af Aalborg Universitet, Institut for Arkitektur og Design (Skriftserie nr. 29) med Anne Kathrine Frandsen som hovedforfatter. Rapporten er en omfattende litteraturgennemgang af arkitekturens betydning for helingsprocessen på hospitalet. Rapporten indeholder også et stort kapitel om lysets betydning, som gengives i uddrag i det følgende. Rapporten dokumenterer bl.a. at lyset har betydning for en lang række forhold, som er afgørende for menneskets velbefindende og patienters helbredelse, som illustreret ved nedenstående figur.



Uddrag fra Helende arkitektur

Dette afsnit drejer sig om det lys, både dagslys og kunstigt lys, som patienter, personale og pårørende opholder sig i om dagen og nogle gange om natten. Som en undtagelse er lys som behandling taget med i denne gennemgang, fordi disse forskningsresultater er med til at give en forståelse af den betydning, lyset har for os mennesker. En forståelse som understøtter de øvrige resultater og fremhæver den indflydelse, lys har på vores fysiske og psykologiske sundhed. Litteraturen gennemgået nedenfor beskriver lysets betydning i forhold til tilfredshed, orientering, døgnrytme og søvn, depression, indlæggelsestid og dødelighed, smerte og stress og endelig fejl. Samlet peger resultaterne på lys som en meget vigtig faktor i udformningen af de fysiske rammer på hospitaler.



Tilfredshed

Adgang til dagslys er vigtigt for alle, der opholder sig på et hospital, uanset om de arbejder eller er indlagt på stedet. Dette fremgår tydeligt af flere undersøgelser, der enten er baseret på spørgeskemaer og interviews, enkelte kombineret med målinger af fysiologiske indikatorer. Adspurgt om hvilke elementer eller egenskaber ved de fysiske rammer, der har betydning for deres velbefindende eller for deres arbejdsglæde, er dagslyset og vinduer det som nævnes af flest ansatte og patienter i flere evalueringer af nye fysiske omgivelser (Lawson & Phiri, 2003; Leather, Beale, Santos, Watts, & Lee, 2003; Macnaughton et al., 2005; Mroczek, Mikitarian, Vieria, & Rotrius, 2005; Shepley, 2002). I flere undersøgelser udtrykker de adspurgte ubehag ved rum, der er uden vinduer og dagslys, og blandt ansatte udtrykkes der bekymring for deres egen heldbredstilstand, når konsultationsrum eller arbejdsstationer er uden dagslys. (Macnaughton et al., 2005; Symon, Paul, Butchart, & Carr, 2007; Verderber, 1986).

Orientering

Ophold i længere tid i rum helt uden dagslys synes at have en række negative effekter. På en intensivafdeling helt uden dagslys var der en markant øget hyppighed af postoperativt delirium i forhold til en tilsvarende afdeling med vinduer, viser en retrospektiv undersøgelse (Wilson, 1972). Ligesom et ophold af længere tids varighed på en intensivafdeling uden vinduer synes at svække patienters hukommelse og evne til at orientere sig i

forhold til tid og sted og øge antallet af syner/ Kantine hvor der er mulighed for at følge døgnets rytme med udsigt og dagslys, Ahus, Oslo hallucinationer, i forhold til patienter indlagt på en tilsvarende afdeling med vinduer. (Keep, James, & Inman, 1980).

Døgnrytme og søvn

Dagslys er en vigtig faktor blandt flere i fastholdelsen af døgnrytmen, viser flere undersøgelser af både ældre og for tidligt fødte børn. For ældre synes der at være et forhold mellem hvor meget lys, de er udsat for om dagen, og hvor dyb deres søvn er om natten. Jo mere tid tilbragt i lys om dagen jo bedre søvn (dybere søvn med færre afbrydelser og færre bevægelser) om natten (Wallace-Guy et al., 2002). I mangel af dagslys med høj intensitet kan øget kunstig belysning have den samme effekt (Wakamura & Tokura, 2001). Hvis der er markant forskel mellem belysningsniveauet om dagen og om natten, øges for tidligt fødtes aktivitetsniveau i forhold til for tidligt fødte, der opholder sig i det samme halvmørke belysningsniveau hele døgnet. Og forskellen mellem aktivitetsniveauet om dagen og om natten øges (Altimier, Eichel, Warner, Tedeschi, & Brown, 2005; Rivkees, Mayes, Jacobs, & Gross, 2004).



Men ligeså vigtigt det er at blive udsat for lys med en vis intensitet i løbet af dagen for at fastholde døgnrytmen og sove godt om natten, ligeså vigtigt er det, at der er forholdsvis mørkt om natten. Når belysningsniveauet sænkes markant om natten, får både børn, for tidligt fødte og ældre både længere søvnperioder og dybere søvn med færre bevægelser (Cureton-Lane & Fontaine, 1997; Slevin, Farrington, Duffy, Daly, & Murphy, 2000; Vinzio, Ruellan, Perrin, Schlienger, & Goichot, 2003). Hos de for tidligt fødte fører denne større ro og bedre søvn om natten til en signifikant forbedring af babyernes fysiologiske tilstand og i sidste ende til forkortelse af indlæggelsestiden (Altimier et al., 2005; Slevin et al., 2000).

Også for demente har lys med høj intensitet om dagen en positiv betydning for forholdet mellem aktivitetsniveau og ro i løbet af døgnet. I et par undersøgelser, hvor ældre demente blev udsat for mere lys i løbet af dagen, faldt aktivitetsniveauet navnlig markant om natten, og stabiliteten øgedes i rytmen af aktivitet og ro (Lovell, Ancoli-Israel, & Gevirtz, 1995; Van Someren, Kessler, Mirmiran, & Swaab, 1997).

Depression

Terapeutisk behandling med lys med høj intensitet har igennem en årrække været en anerkendt behandling af depressive med Seasonal Affective Disorder (SAD). Resultaterne af en række undersøgelser tyder på, at tidspunktet for behandlingen har betydning for effekten af den, ligesom at lys også har en positiv terapeutisk effekt på andre typer af depression. Hvis behandling med lys gives tidligt om morgenen forstærkes effekten, navnlig hvis tidspunktet for behandlingen følger patientens egen døgnrytme (Lewy et al., 1998; Terman, Terman, Lo, & Cooper, 2001). Også behandling med lys med forholdsvis lav intensitet givet tidligt om morgenen forbedrer hurtigt depressives humør og forkorter den tid, det tager før antidepressiv (SSRI) begynder at virke (Benedetti et al., 2003 Jun).

Det er ikke kun behandling med kunstigt lys, der har en positiv terapeutisk effekt. Dagslys - navnlig morgenlys - har en positiv effekt, både på svært depressive og depressive med bipolar forstyrrelse. Et par retrospektive undersøgelser har vist, at svært deprimerede der var indlagt på østvendte og lyse stuer havde signifikant kortere indlæggelser end tilsvarende patienter indlagt på mørke og vestvendte stuer (K. M. Beauchemin & Hays, 1996; Benedetti, Colombo, Barbini, Campori, & Smeraldi, 2001).

Indlæggelsestid og dødelighed

Interessant nok har dagslys med høj intensitet ikke kun en positiv effekt på depressive, også patienter uden en psykiatrisk diagnose har gavn af at opholde sig i lyse rum. En retrospektiv undersøgelse af patienter indlagt på en intensiv hjertemedicinsk afdeling viste, at patienter indlagt på de sydvendte stuer var indlagt signifikant kortere tid end patienterne indlagt på de nordvendte og markant mørkere stuer. Navnlige for kvinder var forskellen markant. Også dødeligheden var lavere blandt patienter, der lå på de sydvendte lyse stuer, end blandt patienterne på de nordvendte mørke stuer (K. M. Beauchemin & Hays, 1998).

Smerte og stress

Dagslys og sollys har også en positiv effekt på smerte og oplevelsen af stress, tyder en prospektiv undersøgelse af patienter, der havde gennemgået en rygoperation, på. Patienter, der lå på lyse (vestvendte) stuer, fik 46 % mere lys end patienterne på mørke (østvendte) stuer. Patienterne på de lyse stuer forbrugte 22 % mindre smertestillende medicin og havde ved udskrivningen signifikant lavere scoringer ved selvrappede målinger af oplevet stress (Walch et al., 2005).

Fejl

Lys niveauet spiller en vigtig rolle, når fejl med medicinering eller journalisering skal undgås. Det angiver plejepersonalet selv i en stort anlagt spørgeskemaundersøgelse, der belyser sammenhængen mellem de fysiske rammer og pleje- og mediciningsfejl. Godt lys ved arbejdsstationen blev vurderet som den tredje vigtigste faktor for at undgå journaliseringsfejl, og godt lys niveau i medicinrummet blev vurderet som den femte vigtigste faktor for at undgå mediciningsfejl. I den statistiske behandling af besvarelsener hvor hyppigheden af mediciningsfejl og faktorerne, der kan føre til dem, blev korreleret, viste sammenhængen mellem lys og fejl sig signifikant (Chaudhury & Mahmood, 2007). En eksperimentel undersøgelse af doseringen af medicin på et hospitals apotek viste, at når belysningsniveauet øgedes markant (fra ca. 450 lux til 1450 lux) reduceredes fejlprocenten fra 3,8 % til 2,6 % (Buchanan, Barker, Gibson, Jiang, & Pearson, 1991). Lys spiller også en indirekte rolle i forhold til mediciningsfejl viser en retrospektiv undersøgelse af mediciningsfejl i Alaska. Det fremgår af undersøgelsen, at tæt ved 60 % af de fejl, der blev begået igennem de fem år undersøgelsen dækker, blev begået i løbet af de første tre måneder af året (Booker & Roseman, 1995). Alle disse resultater peger på vigtigheden af dagslys og den rigtige kunstige belysning både for patienter og for personale. Men ingen af undersøgelserne angiver, hvilke kvaliteter lyset skal have bortset fra høj intensitet angivet i lux. Kun en enkelt undersøgelse kommer ind på placeringen af vinduer og viser, at det ikke er lige meget, hvor vinduet sidder i rummet. Blandt personale og patienter vurderes rum, hvor vinduet sidder meget højt eller rum, hvor vinduet vender ud til en væg og således hverken giver udsigt eller nævneværdigt meget lys, ligeså uattraktive som rum helt uden vinduer (Verderber, 1986).

Litteraturgennemgang

I det følgende listes de publikationer, som projektgruppen har vurderet som de vigtigste referencer med evidenspåvisning i internationale projekter om hospitalsbelysning. Alle artikler er samlet i en database (Mendeley reference manager). Artiklerne er sat op i alfabetisk rækkefølge efter (første-) forfatterens efternavn, og er således ikke systematiseret efter emne. Overskrift og abstract giver i de fleste tilfælde et godt indblik i artiklen, ligesom der gives et link for at få den fulde adgang.

Daylight exposure and the other predictors of burnout among nurses in a University Hospital

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Abstract

The purpose of the study was to investigate if daylight exposure in work setting could be placed among the predictors of job burnout.

The sample was composed of 141 nurses who work in Akdeniz University Hospital in Antalya, Turkey. All participants were asked to complete a personal data collection form, the Maslach Burnout Inventory, the Work Related Strain Inventory and the Work Satisfaction Questionnaire to collect data about their burnout, work-related stress (WRS) and job satisfaction (JS) levels in addition to personal characteristics. Descriptive statistics, parametric and non-parametric tests and correlation analysis were used in statistical analyses.

Daylight exposure showed no direct effect on burnout but it was indirectly effective via WRS and JS. Exposure to daylight at least 3 h a day was found to cause less stress and higher satisfaction at work. Suffering from sleep disorders, younger age, job-related health problems and educational level were found to have total or partial direct effects on burnout. Night shifts may lead to burnout via work related strain and working in inpatient services and dissatisfaction with annual income may be effective via job dissatisfaction.

This study confirmed some established predictors of burnout and provided data on an unexplored area. Daylight exposure may be effective on job burnout.

1. Introduction

Burnout is a term that was first used in the medical arena by Herbert Freudenberger (1974). It is known to be a prolonged psychological response to chronic emotional and interpersonal stressors on the job, and is defined by the three dimensions of emotional exhaustion (EE), depersonalisation (D), and low personal accomplishment (PA). The EE component represents the basic individual stress dimension of burnout. It refers to feelings of being overextended and depleted of one's emotional and physical resources. There has been much discussion whether EE is the essential feature of burnout. The D component represents the interpersonal context dimension of burnout. It refers to a negative, callous or excessively detached response to various aspects of the job. The component of reduced efficacy or PA represents the self-evaluation dimension of burnout. It refers to feelings of incompetence and a lack of achievement and productivity at work (Freudenberger, 1974; Maslach et al., 2001). Burnout is a common problem especially in caregiving and service occupations, in which the core of the job is the relationship between provider and recipient (Maslach et al., 2001). Health care providers, especially nurses, are generally being considered as an above risk group regarding work stress and burnout (Tummers et al., 2001). Previous studies have reported low-to-moderate or moderate-to-high burnout levels among nurses working in different areas of nursing (Chen and McMurray, 2001; Stordeur et al., 1999; Barrett and Yates, 2002). Job-related psychological problems, like burnout, affect both quality of care delivered to patients and professional and personal lives of the caregiver. Burnout has also been shown as a major contributor to shortage of experienced nurses (Stundin-Huard and Fahy, 1999).

Socio-demographic factors such as age, job experience, marital status, having children, educational level or income, and job-related factors such as excessive work load, absence of job resources, lack of autonomy have been found related to burnout (Maslach et al., 2001; Stundin-Huard and Fahy, 1999; Aries and Ritter, 1999; Tyler and Ellison, 1994). Health problems that may be attributed to work conditions and sleeping disorders are also contributing factors to higher burnout levels (Chen and McMurray, 2001; Melamed et al., 1999; Goldberg et al., 1996; Perski et al., 2002).

Daylight exposure has curative effects on mood disorders like depression (Beauchemin and Hays, 1996; Benedetti et al., 2001; Lam et al., 1992; Painter, 1999; Wirz-Justice et al., 1996). Human retina receives only visible light (400–700 nm wavelength). This photic energy is then transduced and delivered to the visual cortex and, by an alternative pathway, to the suprachiasmatic nucleus, the hypothalamic region that directs circadian rhythm. Visible light exposure also modulates the pituitary and pineal glands, leading to neuroendocrine changes. Melatonin, norepinephrine and acetylcholine decrease with light activation, whereas cortisol, serotonin, GABA and dopamine levels increase. These induced neuroendocrine changes can lead to alterations in mood (Roberts, 2000). Oren et al. (2001) have shown that antidepressant source of visible light is capable of inducing the production of reactive oxygen species in skin. They have suggested that such species may participate in signal transduction pathways leading to mood changes. Burnout is described as a kind of depression, which can only be seen in the work setting (Maslach et al., 2001; Penson et al., 2000).

The purpose of this study was to investigate if daylight exposure could be placed among known predictors of burnout.

Energy Efficient Lighting System Design for Hospitals Diagnostic and Treatment Room - A Case Study

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Abstract

Lighting plays an important role in the Hospital Diagnostic and Treatment Room. It shall be environmentally and functionally suitable for three groups of people: patients, hospital professionals and visitors. On the other hand lighting is considered a major consumer of electrical energy and therefore, hospital lighting design should consider the visual performance, visual comfort and energy efficiency. This article discusses the performance of different types of lighting installations used for hospital lighting system design applications: first the visual comfort and second to save energy consumptions in such applications. DIALux 4.8 simulation software is used to study and evaluate the efficient lighting scheme for the hospitals through the use of different types of lamps. Also, visual environment lighting system design procedure is explained. Economics of different lighting scenarios are highlighted.

KEYWORDS: Compact Fluorescent Lamp (CFL), Light Emitting Diode (LED), Light Fitting Cost (LFC), visual performance, visual environment

Introduction

In multi-function and diverse habitant environment such as hospital treatment rooms, lighting system design plays a major role. Lighting must be suitable for three different categories of people: it should consider the comfort of the patients, the critical visual requirements for hospital staff, the comfort and visual need of the visitors. In addition to these goals, lighting systems can achieve considerable energy cost savings through the careful design of lighting schemes used in such applications. In this article, how the visual comfort and energy efficient lighting system can be designed for hospital lighting applications are highlighted.

The distributions of light within a space substantially influence the perception of the space as well as people within it. Hospital lighting system has two main functions: one is to meet the task requirements in each area of the hospital and the second is to create an environment that is visually satisfying the patients as a good lighting system design can influence human emotions and feelings of well-being.

The works of Patricia Rizzo, Mark Rea and Robert White¹⁾, Hilary Dalke, Jenny Little, Elga Niemann, Nilgun Camgoz, Guillaume Steadman, Sarah Hill, Laura Stott²⁾³⁾, Flynn J. E, Spencer T. J, Martyniuk O, Hendrick C⁴⁾ are the important studies concerning hospital lighting design. Their findings focus only on the visual aspect and human perception of lighting in the hospital lighting design applications.

This article explains the hospital lighting system design procedure using DIALUX 4.8 simulation software as per the international standards. Also, the most appropriate selection of lighting type which is visually and financially viable is highlighted.

A framework for predicting the non-visual effects of daylight – Part I: photobiology-based model

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<http://lrt.sagepub.com/content/44/1/37.abstract>

Abstract

This paper investigates the formulation of a modelling framework for the nonvisual effects of daylight, such as entrainment of the circadian system and maintenance of alertness. The body of empirical data from photobiology studies is now sufficient to start developing preliminary non-visual lighting evaluation methods for lighting design. Eventually, these non-visual effects have the potential to become a relevant quantity to consider when assessing the overall daylighting performance of a space. This paper describes the assumptions and general approach that were developed to propose a modeling framework for occupant exposure to non-visual effects of light, and presents a novel means of visualising the 'circadian potential' of a point in space. The proposed approach uses current outcomes of photobiology research to define – at this point static – threshold values for illumination in terms of spectrum, intensity and timing of light at the human eye. These values are then translated into goals for lighting simulation, based on vertical illuminance at the eye, that – ultimately – could become goals for building design. A new climate-based simulation model has been developed to apply these concepts to a residential environment. This will be described in Part 2 of this paper.

Introduction

The primary concern in the daylighting of buildings has generally been to provide illumination for tasks, for example to ensure that 500 lx falls on the horizontal work plane. Although climate-based daylight modelling is over a decade old,^{1,2} building guidelines and recommendations worldwide are still founded on idealised, static sky conditions such as the CIE standard overcast sky (i.e. to predict daylight factors). It is only recently that daylight metrics founded on climate-based simulations have begun to be considered as the basis for the next generation of building guidelines,³ thereby enabling a more realistic and location-specific evaluation of daylighting potential. In the last decade, there has also been a gradual increase in awareness of the non-visual effects of daylight (or more generally light) received by the eye.⁴ It is well known that building occupants almost without exception will prefer a workstation with a view of the outdoor environment to a windowless office.⁵ A view to the outside of course indicates the presence of daylight, although the relation between view and daylight provision is not straightforward, as it is dependent on many factors. In addition to subjective preferences for daylight spaces, it is now also firmly established that light has measurable neuroendocrine and neurobehavioural effects on the human body, in particular with respect to ensuring a healthy sleep – wake cycle and maintaining alertness. Could the quality and nature of the internal daylight environment have a significant effect on human health? Evidence is indeed suggestive of links between daylight exposure and both health and productivity.⁶ The daily cycle of day and night plays a major role in regulating and maintaining 24-hour rhythms in many aspects of our physiology, metabolism and behaviour.

These daily rhythms can be termed circadian rhythms – the term 'circadian' is derived from the Latin *circa*, 'around', and *diem* or *dies*, 'day', meaning literally 'approximately one day' – and the circadian system is commonly referred to as the 'body clock'. Circadian rhythms occur in almost all organisms from bacteria to mammals and are endogenous, meaning that they are spontaneously generated from within the organism even in the absence of external or environmental time cues. These internal rhythms do not usually have a period of exactly 24 hours, and therefore the cycles need to be adjusted or entrained to environment time by external cues, the primary one of which is the daily light–dark cycle. The primary circadian 'clock' in mammals is located in the suprachiasmatic nuclei (SCN), a pair of hypothalamic nuclei containing about 50 000 cells. The SCN receives light information exclusively via the eyes. The retina of the eye contains not only the well-known photoreceptors which are used to detect light for vision (i.e. rod and cones) but also contain a subset of specialised retinal ganglion cells that are intrinsically photosensitive and project directly to the SCN and other brain areas mediating 'non-visual' responses to light. The SCN also conveys signals to other parts of the brain to control the timing of numerous circadian rhythms, including the sleep-wake cycle, performance and alertness patterns, hormones such as melatonin and cortisol and the core body temperature (CBT) rhythm. Light also has several acute effects in addition to synchronising the circadian clock. First, pineal melatonin, which is considered the biochemical correlate of darkness, is acutely suppressed by light exposure at night via the same retina–SCN–pineal pathway that generates melatonin and synchronises its rhythms.^{7,8} Second, light is a stimulant and has direct alerting effects in the brain including measurable effects on subjective sleepiness ratings, reaction time and cognitive performance and brain activity.⁹ The failure to maintain normal entrainment of the circadian system to the natural 24-hours cycle of daylight results in many negative health outcomes for humans, though not all are fully understood. Jet lag and shift work disorders are examples of clinical circadian rhythm sleep disorders in which the internal circadian clock is not synchronised to the external light–dark cycle. For example, when travelling across a number of time zones, the circadian system cannot immediately reset to the new light–dark cycle (it takes about a day per time zone to adjust) and consequently will be 'desynchronised' from environmental time.⁹ Similarly, shift-workers induce a circadian disorder by choosing to work during the night and sleep during the day, in opposition of the natural circadian cycle,^{9–11} inducing both short-term risks for sleepiness-related accidents and injuries, and longer-term risks to health^{12–15} and worker productivity.^{16,17}

Sunny hospital rooms expedite recovery from severe and refractory depressions

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Abstract

Bright light therapy is an effective treatment for seasonal affective disorder, an uncommon condition marked by mild winter depression. Bright lights have been used as adjuncts in the pharmacological treatment of other types of depressive illness. The rooms in our psychiatric inpatient unit are so placed that half are bright and sunny and the rest are not. Reasoning that some patients were getting light therapy inadvertently, we compared the lengths of stay of depressed patients in sunny rooms with those of patients in dull rooms. Those in sunny rooms had an average stay of 16.9 days compared to 19.5 days for those in dull rooms, a difference of 2.6 days (15%); $P < 0.05$.

Keywords: Depression; Phototherapy; Cost

Introduction

Seasonal Affective Disorder (SAD) consists of a winter depression with atypical symptoms and a period of elevated mood in the spring. It affects females more commonly than males. The efficacy of light therapy for SAD is established (Rosenthal et al., 1984); and it is also reported to ameliorate nonseasonal depressions (Peter et al., 1986; Yerevanian et al., 1986; Volz et al., 1990; Kripke et al., 1987, both bipolar and unipolar (Kripke et al., 1992). Bright light is presumed to exert its effects neurohormonally, by suppressing melatonin which is involved in the entrainment of circadian rhythm (Lam et al., 1989) and hence the sleep-wake cycle. However, the precise mode of action is unknown.

Criteria for the admission of depressed patients to our wards are stringent because our bed numbers have been reduced for economy's sake, and with few exceptions those admitted have severe, often suicidal, depressions, or depressions which are refractory to conventional remedies or dosages. Policies are consistent, six out of the seven admitting psychiatrists having trained at this centre, while all seven have worked together in teams. Patients admitted receive a variety of medications and other treatments, including electroconvulsive therapy in some cases.

Criteria for the admission of depressed patients to our wards are stringent because our bed numbers have been reduced for economy's sake, and with few exceptions those admitted have severe, often suicidal, depressions, or depressions which are refractory to conventional remedies or dosages. Policies are consistent, six out of the seven admitting psychiatrists having trained at this centre, while all seven have worked together in teams. Patients admitted receive a variety of medications and other treatments, including electroconvulsive therapy in some cases.

In Edmonton, Alberta, the sun shines year round for a total of 2,300 h, the winter sunlight being intensified over a 4-month period by reflection from the snow. Our hospital is constructed so that each inpatient room has a large window with a view. Some rooms overlook an airy glass-roofed courtyard, and others have an outdoor view. Of those with an outdoor aspect, rooms containing 17 beds face due east and, because the terrain is flat and the horizon low, get full unimpeded morning sunlight: these are the brighter rooms. Turning to the remaining rooms, 2 single rooms face north; rooms containing the remaining 15 beds either face the indoor courtyard, or face west and receive no direct sunshine because a large structure intervenes: these are the dull rooms. By chance, then, the orientation of the inpatient units is such that the level of illumination in all rooms is either bright and sunny, or sunless and relatively dim. On a cloudy February day between 09:00 and 10:00, a bright room measured at 500 lux, and a dull room at 200 lux; on a day with light cloud the figures were 1700 and 300, respectively; on a bright day, when the outside temperature was -24°C . the measurements were 5000 and 300. Artificial light treatments usually range between 2,500 and 10,000 lux.

Our two psychiatric wards 4F3 and 4G2 are symmetrical about their north to south long axes, with the nursing stations in their geometrical centres, and the two rows of rooms on each ward are almost identical to each other. None of the admitting doctors has patients mainly in one or other side of the ward, and new patients are allocated randomly according to what bed is empty. The ease with which patients can be observed in a room depends on the closeness of the room to the nursing station, but not on which side they are placed. There is no apparent grouping of patients according to diagnosis. Patients admitted to the unit are treated diligently until they improve, but although there are various activities during the day the patients spend the first part of the day in their rooms, in daylight, before these scheduled activities start and while the psychiatrists and their juniors make their daily rounds. In keeping with our status as a teaching hospital, we aim to offer exemplary care, and under the Canadian system there is no financial burden on the patient if the stay is prolonged. Transfer to any other unit is rare. At the same time, over the period in question, no inpatient committed suicide. It follows that in the great majority of instances a patient's date of discharge marked the time an adequate improvement had taken place; but no rating scales of mood are used routinely, so that data which would be available in the usual experimental setting were lacking. Patients admitted to our unit are of course given a final diagnosis, and their admission and discharge dates are recorded. These circumstances together made up a *natural experiment*, enabling us to test the hypothesis which (since we are currently conducting a trial of light therapy of different intensities) naturally arose, that depressed patients in sunny rooms would have stayed in hospital for a shorter term than those in rooms without direct sunshine. Although we did not include this in our hypothesis, we anticipated that the effect of brightness, if any, would be more marked in the females.

Dying in the dark: sunshine, gender and outcomes in myocardial infarction

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Journal of the royal society of medicine, Volume 91 July 1998

Abstract

We report a natural experiment that took place in a cardiac intensive care unit (CICU). We had been alerted to the possibility that sunny rooms would be conducive to better outcomes by our findings in the psychiatric unit, and by reports that depressed cardiac patients did less well than those in normal mood. The 628 subjects were patients admitted directly to the CICU with a first attack of myocardial infarction (MI). Outcomes of those treated in sunny rooms and those treated in dull rooms were retrospectively compared for fatal outcomes and for length of stay in the CICU. Patients stayed a shorter time in the sunny rooms, but the significant difference was confined to women (2.3 days in sunny rooms, 3.3 days in dull rooms). Mortality in both sexes was consistently higher in dull rooms (39/335 dull, 21/293 sunny). We conclude that illumination may be relevant to outcome in MI, and that this natural experiment merits replication.

Introduction

When conducting a trial of light therapy in depression¹ we noticed that the natural sunlight in some rooms was so bright as to overpower the effects of the artificial light boxes in use. On inspection, the rooms in our symmetrical psychiatric unit turned out to be sunny in half the instances and, because of their opposite orientation, sunless and dull in the rest. Reasoning that the patients in the sunny rooms were inadvertently getting phototherapy, we looked at the lengths of stay of depressed patients in sunny rooms compared with the lengths of stay of depressed patients in sunless rooms, these data being available from the hospital records. We found that depressed patients in sunny rooms stayed an average of 2.6 days (15%) less than the others ($P < 0.05$).

Of course, we soon wondered whether there were other conditions of similar dangerousness which might be affected by levels of illumination and which had been managed in the same ward over a period of years. In the course of reorganization of our local health system, divisions and clinical departments had been moved around a lot in our hospital. The CICU had not been moved.

Patients with MI and depression do less well than euthymic cardiac victims, as regards both their cardiac² and their affective states³. Women with MI but normal mood also do less well than might be expected. At some centres women seem, or did once seem, to be less vigorously treated than men^{4 7}. We were to find no indicator among our statistics of any sex bias. Still, it is usually the case that, even when appropriate allowances are made for their greater average age and other risk factors, females with MI do less well than we would expect⁸. Our range of choice was limited when it came to looking at the cumulative records of outcomes of different illnesses according to the sunniness of rooms, because most units cannot be clearly demarcated into sunny and dark, and few units have a single condition which dominates their intake.

The CICU had not only stayed in the same place, but fulfilled our hopes in various other ways. It is symmetrical, with 4 beds in rooms facing north, 4 facing south and 2 facing due east. For economy's sake, only 8 of these 10 beds are now open. The nurses avoid using the east-facing rooms because they are close to the busy nursing station. That proviso aside, patients are admitted to whichever of the beds is empty. The north-facing beds are sunless, of course. In Edmonton, Alberta, the sun shines year round for a total of 2300 hours, the winter sunlight being intensified over a four-month period by reflection from the snow, and the south-facing rooms are distinctly bright. On 26 June 1996 at 0945, the north-facing rooms registered 200-400 lux, the south-facing rooms 1200-1300 lux, and the east-facing rooms 2000 lux; on 21 November 1996, when the outside temperature was -25°C the readings at 1245 were north 200 lux, south 2500 lux (vertical blinds half drawn), and east 400 lux.

Some patients are admitted to the CICU postoperatively for example, after bypasses or transplants. Most, however, have suffered a MI. We wanted to compare samples which were as near homogeneous as possible, and settled on abstracting data from patients with a first attack of MI who had been admitted directly to the CICU. Because patients are transferred from the CICU as soon as their condition permits it, we made the assumption that length of stay in the CICU would be a measure of the rapidity with which the patients had improved.

Morning sunlight reduces length of hospitalization in bipolar depression (Brief report)

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Journal of Affective Disorders 62 (2001) 221–223, www.elsevier.com/locate/jad

Abstract

Background: Bright artificial light improves non-seasonal depression. Preliminary observations suggest that sunlight could share this effect. *Methods:* Length of hospitalization was recorded for a sample of 415 unipolar and 187 bipolar depressed inpatients, assigned to rooms with eastern (E) or western (W) windows.

Results: Bipolar inpatients in E rooms (exposed to direct sunlight in the morning) had a mean 3.67-day shorter hospital stay than patients in W rooms. No effect was found in unipolar inpatients.

Conclusions: Natural sunlight can be an underestimated and uncontrolled light therapy for bipolar depression. *Limitations:* This is a naturalistic retrospective observation, which needs to be confirmed by prospective studies. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Sunlight; Bipolar depression; Hospitalization

Morning light treatment hastens the antidepressant effect of citalopram: a placebo-controlled trial

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J Clin Psychiatry. 2003 Jun;64(6):648-53. <http://www.ncbi.nlm.nih.gov/pubmed/12823078>

Abstract

BACKGROUND

Selective serotonin reuptake inhibitors are effective in approximately 70% of patients with a major depressive episode, but therapeutic changes usually require 2 weeks of administration to become clinically relevant. Adjunct light therapy has been proposed to hasten the effects of drug treatment. The purpose of the present study was to evaluate the effect of morning light therapy or placebo combined with citalopram in the treatment of patients affected by a major depressive episode without psychotic features.

METHOD

Thirty inpatients (DSM-IV major depressive disorder [N = 21] and bipolar disorder [N = 9]) were treated with citalopram, 40 mg, and randomized in a 3:2 manner to receive 30 minutes of 400 lux green light treatment in the morning or placebo (exposure to a deactivated negative ion generator) during the first 2 weeks of drug treatment. Timing of light therapy was individually defined to obtain a 2-hour phase advance to morning light. Outcome was measured with the Hamilton Rating Scale for Depression and the Zung Self-Rating Depression Scale every week, and with a Visual Analogue Scale 3 times a day during the first week.

RESULTS

All outcome measures showed significantly ($p < .05$) better mood improvement in light-treated patients, resulting in faster responses to antidepressant treatment.

CONCLUSION

The combination of citalopram and light treatment was more effective than citalopram and placebo in the treatment of major depression. With an optimized timing of administration, low-intensity light treatment significantly hastened and potentiated the effect of citalopram, thus providing the clinical psychiatrists with an augmenting strategy that was found effective and devoid of side effects.

Evidence that abnormally large seasonal declines in vitamin D status may trigger SLE flare in non-African Americans

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Cross-sectional studies have shown that low vitamin D (25-hydroxyvitamin D (25(OH)D)) is associated with increased systemic lupus erythematosus (SLE) activity. This study is the first to assess the temporal relationship between 25(OH)D levels and onset of SLE flare. This assessment was made possible because of the specimen bank and database of the Ohio SLE Study (OSS), a longitudinal study of frequently relapsing SLE that involved regular bimonthly patient follow-up. We identified for this study 82 flares from 46 patients that were separated by at least 8 months from previous flares. Serum 25(OH)D levels were measured at 4 and 2 months before flare, and at the time of flare (a flare interval). We found that for flares occurring during low daylight months (LDM, Oct-Mar), 25(OH)D levels were decreased at the time of flare, but only in non-African American (non-AA) patients (32% decrease at flare, compared to 4 months prior, $p < 0.001$). To control for seasonal effects, we also measured 25(OH)D levels in the LDM “no-flare” intervals, which were intervals that matched to the same calendar months of the patients’ LDM flare intervals, but that didn’t end in flare ($n = 24$). For these matches, a significant decrease occurred in 25(OH)D levels during the flare intervals (18.1% decrease, $p < 0.001$), but not during the matching no-flare intervals (6.2% decrease, $p = 0.411$). For flares occurring during high daylight months (HDM), 25(OH)D levels changed only in non-AA patients, increasing slightly (5.6%, $p = 0.010$). Analysis of flare rates for the entire OSS cohort ($n = 201$ flares) revealed a tendency for higher flare rates during LDM compared to HDM, but again only in non-AA patients ($p = 0.060$). Flare rates were lower during HDM for non-AA patients compared to AA patients ($p = 0.028$). In conclusion, in non-AA SLE patients, unusually large declines in 25(OH)D during LDM may be mechanistically related to SLE flare, whereas relatively high 25(OH)D levels during HDM may protect against flare. *Lupus* (2012) 21, 855–864.

Key words: Vitamin D; systemic lupus erythematosus; disease flare

Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor

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The Journal of Neuroscience, August 15, 2001, 21(16):6405–6412

<http://www.jneurosci.org/content/21/16/6405.abstract>

The photopigment in the human eye that transduces light for circadian and neuroendocrine regulation, is unknown. The aim of this study was to establish an action spectrum for light-induced melatonin suppression that could help elucidate the ocular photoreceptor system for regulating the human pineal gland. Subjects (37 females, 35 males, mean age of 24.5 ± 0.3 years) were healthy and had normal color vision. Full-field, monochromatic light exposures took place between 2:00 and 3:30 A.M. while subjects' pupils were dilated. Blood samples collected before and after light exposures were quantified for melatonin. Each subject was tested with at least seven different irradiances of one wavelength with a minimum of 1 week between each nighttime exposure. Nighttime melatonin suppression tests ($n = 627$) were completed with wavelengths from 420 to 600 nm. The data were fit to eight univariant, sigmoidal fluence-response curves ($R^2 = 0.81-0.95$). The action spectrum constructed from these data fit an opsin template ($R^2 = 0.91$), which identifies 446 - 477 nm as the most potent wavelength region providing circadian input for regulating melatonin secretion. The results suggest that, in humans, a single photopigment may be primarily responsible for melatonin suppression, and its peak absorbance appears to be distinct from that of rod and cone cell photopigments for vision. The data also suggest that this new photopigment is retinaldehyde based. These findings suggest that there is a novel opsin photopigment in the human eye that mediates circadian photoreception.

Key words: melatonin; action spectrum; circadian; wavelength; light; pineal gland; neuroendocrine; photoreception; photopigment; human

Seasonality of UV-radiation and vitamin D status at 69 degrees north

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Photochemical & Photobiological Sciences, www.rsc.org/pps

Abstract

The main purpose with this study was to assess the seasonal variation in measured UV-radiation and its impact on vitamin D status throughout one year in subjects living at high latitude. Blood samples drawn from 60 volunteers (44 women, 16 men) living at Andenes (69° N), Norway, were collected throughout one year, at two-month intervals. The blood samples were analysed for 25-hydroxy vitamin D [25(OH)D]. Data on dietary intakes of vitamin D, time spent in daylight, use of sun beds and sun seeking holidays were collected by using questionnaires. The ambient vitamin D effective UV-radiation was measured at a site near by Andenes, and the number of hours spent outdoors with sufficient radiation for cutaneous vitamin D production (UV-hours) was estimated for each day. The mean 25(OH)D values were significantly higher at the end of the summer and in December, 2004 and varied from 42.0 nmol L⁻¹ in October, 2004 and April, 2005 to around 47 nmol L⁻¹ in December, 2004 and September, 2005. For the whole group, a positive relationship between UV-hours and 25(OH)D was found at UV-hours ≥ 3.5. However, for subjects with lower 25(OH)D levels *i.e.* at least one blood measurement with 25(OH)D < 37.5 nmol L⁻¹, the positive relationship were found at around 1.5 UV-hours and more, whereas for the group of subjects that had all their vitamin D values above 37.5 nmol L⁻¹, positive relationship was found at UV-hours ≥ 4.0, when adjusting for vitamin D intake, sun bed use and sun seeking holidays. The generally high dietary intakes of vitamin D, especially in winter, mask largely the effect of seasonal variation in UV-exposure, causing an atypical seasonal variation in vitamin D status. The UV-hour variable significantly predicted 25(OH)D levels in blood when adjusted for intakes and artificial UV-radiation exposure and sun holidays abroad.

The Pittsburgh Sleep Quality Index: A New Instrument for Psychiatric Practice and Research

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*Psychiatry Research, 28, 193-2 13. 1989 Elsevier Scientific Publishers Ireland Ltd.
<http://www.sciencedirect.com/science/article/pii/0165178189900474>*

Abstract. Despite the prevalence of sleep complaints among psychiatric patients, few questionnaires have been specifically designed to measure sleep quality in clinical populations. The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire which assesses sleep quality and disturbances over a 1-month time interval. Nineteen individual items generate seven "component" scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The sum of scores for these seven components yields one global score. Clinical and clinimetric properties of the PSQI were assessed over an 18-month period with "good" sleepers (healthy subjects, $n = 52$) and "poor" sleepers (depressed patients, $n = 54$; sleep-disorder patients, $n = 62$). Acceptable measures of internal homogeneity, consistency (test-retest reliability), and validity were obtained. A global PSQI score > 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% ($\kappa = 0.75$, $p < 0.001$) in distinguishing good and poor sleepers. The clinimetric and clinical properties of the PSQI suggest its utility both in psychiatric clinical practice and research activities.
Key Words. Sleep, sleep quality, depression, sleep disorders.

Introduction

"Sleep quality" is an important clinical construct for two major reasons. First complaints about sleep quality are common; epidemiological surveys indicate that 15 - 35 % of the adult population complain of frequent sleep quality disturbance, such as difficulty falling asleep or difficulty maintaining sleep (Karacan et al., 1976, 1983; Bixler et al., 1979; Lugaresi et al., 1983; Welstein et al., 1983; Mellinger et al., 1985). Second, poor sleep quality can be an important symptom of many sleep and medical disorders. One frequently measured component of sleep quality, sleep duration, may even have a direct association with mortality (Kripke et al., 1979).

The Pittsburgh Sleep Quality Index was developed with several goals: (1) to provide a reliable, valid, and standardized measure of sleep quality; (2) to discriminate between "good" and "poor" sleepers; (3) to provide an index that is easy for subjects to use and for clinicians and researchers to interpret; and (4) to provide a brief, clinically useful assessment of a variety of sleep disturbances that might affect sleep quality. This article describes the instrument and its clinimetric properties, including internal homogeneity, performance consistency, and validity.

Psychometric evaluation of the Pittsburgh sleep quality index

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Journal of Psychosomatic Research, Vol. 45, No. 1, pp. 5–13, 1998. 1998 Elsevier Science Inc.
<http://www.sciencedirect.com/science/article/pii/S0022399997002985>

Abstract The Pittsburgh Sleep Quality Index (PSQI) measures sleep quality and disturbance retrospectively over a 1-month period using self-reports. Although the PSQI has been used in a variety of populations, published psychometric data are limited. The goal of this study was to examine psychometric properties of the PSQI among four populations: bone marrow transplant patients ($n=155$); renal transplant patients ($n=56$); women with breast cancer ($n=102$); and women with benign breast problems ($n=159$). Results supported PSQI internal consistency reliability and construct validity. Cronbach's alphas were 0.80 across groups and correlations between global and component scores were moderate to high. PSQI scores were moderately to highly correlated with measures of sleep quality and sleep problems, and poorly correlated with unrelated constructs. Individuals with sleep problems, poor sleep quality, and sleep restlessness had significantly higher PSQI scores in comparison to individuals without such problems. 1998 Elsevier Science Inc.

Keywords: Pittsburgh Sleep Quality Index; Psychometrics; Sleep disturbance; Sleep measures; Sleep quality.

INTRODUCTION

Subjective assessment of sleep quality and disturbance is important to a variety of researchers and clinicians because diminished sleep quality and the presence of sleep disturbance can profoundly impact quality of life and may be associated with physical and/or emotional illness [1, 2]. Sleep disturbance and poor sleep quality may result from physical discomfort, side effects of medications, and other aspects of physical illness, and can be related to psychiatric disorders such as depression, anxiety, and schizophrenia.

Although various methods are available to study subjective sleep quality, many do not provide a comprehensive assessment of sleep quality and sleep disturbance. Methods such as single item scales [3], simple visual analog scales [4, 5], temporal sleep logs for recording time of sleep onset and awakening [6], or sleep diaries [7, 8] tend to assess only one or two components of sleep quality. Although standardized questionnaires provide a more comprehensive assessment of sleep quality, relatively few such questionnaires exist. Of three standardized measures of sleep quality found in the literature, the Karolinska Sleep Diary [9], the Verran and Snyder-Halpern Sleep Scale [10], and the Pittsburgh Sleep Quality Index (PSQI) [1], the PSQI is the most widely used [2, 11–20].

Given the limitations of the available psychometric data and the fact that the PSQI is appropriate for use in a variety of clinical populations, additional psychometric data from larger and more diverse populations would be useful. The goal of this study was to examine psychometric properties of the PSQI within four clinical populations: bone marrow transplant (BMT) patients; renal transplant patients; women with breast cancer (BC); and women with benign breast problems (BBP). Data from these populations were available to us because we had used the PSQI in previous quality-of-life research. The purpose of this study was to examine internal consistency reliability and construct validity (convergent, discriminant, and known groups validity) of the PSQI within each of the aforementioned populations. Comparisons between groups were not made due to wide variability in demographic, disease, and treatment variables across groups.

Colour and lighting in hospital design

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Optics & Laser Technology, Volume 38, Issues 4–6, June–September 2006, Pages 343–365

<http://www.sciencedirect.com/science/article/pii/S0030399205001283>

Abstract

Little information or guidance has been available to assist the development of a hospital's visual environment. A report on lighting and colour design schemes, accessible to non-professionals with responsibility for refurbishment strategies, was required by NHS Estates. Firstly, 20 hospitals were audited to establish a picture of current practice and to identify key issues where colour design could broadly enhance the environment for patients, staff and visitors. Critical areas were outlined in this report, where colour design can be utilised and applied, for the benefit of all users, from ambience to essential legal requirements such as colour contrast for the visually impaired.

Provision of staff relaxation rooms that are different in terms of colour and lux levels from immediate work spaces, or thoughtfully designed areas for patients awaiting intensive treatment, have been shown to have some beneficial effects on a sense of well-being. Colour and design have not been established as a definite cure for sickness and ill health, but certainly monotony and poor conditions in premises that have not been refurbished with any care, have had a detrimental effect on recovery rates and staff morale. The realisation that a well-balanced and attractive environment is of major importance to patients' health is, in no way new; Florence Nightingale observed that 'a variety of form and brilliance of colour in the objects presented to patients are an actual means of recovery'.

Keywords: Colour design; Colour contrast; Hospital

Introduction

Much has been written on the different effects of colour on people's sense of well-being and lighting and colour design is of vital importance in the creation of a pleasant, ambient environment. The NHS Estates Research and Development department funded the research into the use of colour design and lighting in hospitals. It was a 12-month study of current practice in general hospitals throughout England with two centres: the Colour Design Research Centre at London South Bank University and the Building Research Establishment.

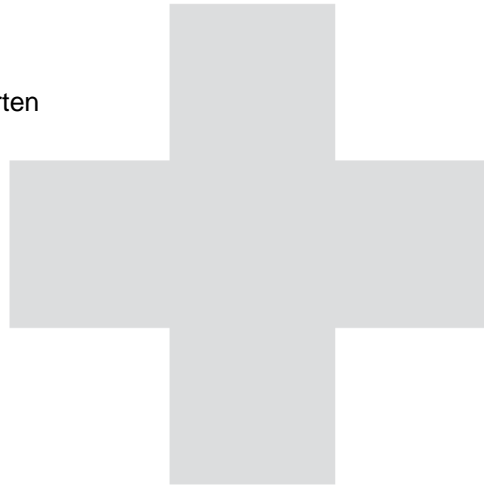
The study to establish current colour application in the design of hospitals, revealed a wide range of literature presenting mixed evidence on this aspect of colour as well as a diversity of strategies for colour usage in interior design. The project stance on colour design was that colour is an inherent property of all materials and surfaces including everything from light and paint to art, from aesthetics to functionality and is an inseparable element of design.

Helende arkitektur

Helende arkitektur er et designkoncept, der repræsenterer visionen om, at arkitekturen påvirker både menneskeligt velvære, og at arkitekturen derfor kan medvirke til at styrke eller fremme en helingsproces hos det enkelte menneske. Den grundlæggende tanke er ikke, at arkitekturen alene kan helbrede, men at den arkitektoniske udformning udtrykt i dagslysets kvalitet, rummets stemning, farver, lyd og muligheden for at være privat og tryk kan understøtte den heling, der finder sted både fysisk og psykologisk. Arkitekturen spiller i denne begrebsramme en central rolle som understøttende faktor i den menneskelige helingsproces. I udgangspunktet har designkonceptet taget afsæt i patientens oplevelse af rum og arkitektur, men også personalets og de pårørendes oplevelse af arkitekturens påvirkning er inkluderet i konceptets vision. Designkonceptet kan i princippet anvendes i alle typer byggeri, men har primært fokus på byggeri relateret til helsesektoren, herunder plejefaciliteter, rehabilitering, hospices og hospitalsbyggerier.

Et hospital er et meget komplekst byggeri, der bl.a. inkluderer mange brugergrupper, funktioner, sikkerhedsforanstaltninger og infrastrukturer. I forskningsprocessen har det derfor været nødvendigt at foretage en skarp afgrænsning af fagområdet, og forskningsprocessen har krævet en differentiering af tre indbyrdes relaterede fagområder, der i dette arbejde defineres som hhv. *helende arkitektur*, *helende teknik* og *helende design*. Med *helende arkitektur* forstås de faktorer, som berører arkitektur og rum som fx sengeafsnittets planløsning eller vinduernes placering, med *helende teknik* forstås ingeniørspecifikke faktorer som fx ventilationsfiltre, og med *helende design* forstås industriel design som fx hjælpemidler og elektroniske apparater.

Klik for at åbne rapporten



HELENDE ARKITEKTUR

Anne Kathrine Frandsen,
Camilla Ryhl,
Mette Blicher Folmer,
Lars Brorson Fich,
Turid Borgstrand Øien,
Nils Lykke Sørensen og
Michael Mullins

Associations between seasonal variations in day length (photoperiod), sleep timing, sleep quality and mood: a comparison between Ghana (5°N) and Norway (69°N)

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<http://www.ncbi.nlm.nih.gov/pubmed/22074234>

Keywords: circadian rhythm, negative mood, seasonality, sleep patterns, sleep problems

SUMMARY

The hypothesis of whether day length (photoperiod) is an important zeitgeber (time-giver) for keeping the circadian rhythm entrained to a 24-hour cycle was examined, as was its association with sleep patterns and mood problems. Data were collected prospectively from a site with very large differences in daylight duration across seasons (Tromsø in Norway, 69° 39' N) and a site with very small seasonal differences in daylight duration (Ghana in Accra, 5° 32' N). Two hundred subjects were recruited from both sites in January. At the follow-up in August, 180 and 150 subjects in Ghana and Norway participated, respectively. Use of a weekly sleep diary indicated low to moderately strong seasonal changes in rise- and bedtime, sleep efficiency and sleep onset latency only in the northern latitude. No seasonal changes in sleep duration or night awakenings were observed. The self-report measures indicated moderate to strong seasonal differences in insomnia and fatigue, and weaker differences in depressed mood in Norway, but small to non-existing seasonal differences in Ghana. Lack of daylight was related to phasedelayed rise- and bedtimes, increased problems falling asleep, daytime fatigue and depressive mood. However, total sleep duration and sleep quality appeared unaffected.

INTRODUCTION

Sleep is a behaviour regulated by two independent factors: a sleep-dependent homeostatic factor and a sleep-independent circadian factor (Borbely et al., 1989). The homeostatic drive factor is a function of prior wakefulness that declines exponentially during sleep and increases linearly during wakefulness. The circadian factor is governed by the suprachiasmatic nuclei (SCN) in the hypothalamus and has an endogenous rhythm that is somewhat longer than 24 hour. It is entrained by external stimuli (zeitgebers: timegivers) to adhere to a 24-hour rhythm (Duffy and Wright, 2005). Its contribution to wakefulness is at its minimum in the early morning and at its maximum in the evening, when the core body temperature is usually lowest (nadir) and highest, respectively (Dijk and Czeisler, 1995). Daylight is the most important zeitgeber, but the entrainment effect of light depends upon when the light exposure takes place.

In order to increase the power of detecting differences in seasonal influences on sleep and mood, we collected data prospectively from two parts of the world with large seasonal variations in daylight. In Tromsø in Norway the average duration of visible sunlight is 4.4 h and 16.1 h in January and in August, respectively, while the corresponding numbers for Accra in Ghana are about 11.9 and 12.2 h, respectively.

Ambient bright light in dementia: effects on behaviour and circadian rhythmicity

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<http://www.sciencedirect.com/science/article/pii/S0360132308000279>

Abstract

Behavioural and psychological symptoms, such as nocturnal restlessness and wandering, are seen in 90% of patients with dementia at some point in their course. Non-pharmacologic interventions, such as high-intensity lighting, can play an important role in managing these behavioural and psychological symptoms by impacting both the visual and the circadian system. In order to assess the effects of prolonged exposure to high-intensity light (about 1800 lx horizontal on table level) on behaviour and circadian rhythmicity of institutionalised older adults with dementia, ceiling-mounted luminaires emitting bluish (6500 K) and yellowish (2700 K) light were installed in an intervention group that was compared to a control group of traditional dim lighting equipment. The study was performed from May to August 2006. Effects of the lighting intervention were assessed by the Dutch Behaviour Observation Scale for Intramural Psychogeriatrics (GIP), and tympanic temperature measurements. In the bluish light scenario, a significant improvement in restless behaviour was observed in the intervention group, as well as a significant increase in the range of tympanic temperature. These effects were not found in the yellowish light scenario. Further evidence is found that high-intensity bluish light may play a role in managing restless behaviour and improving circadian rhythmicity in institutionalised older adults with dementia.

Keywords: Ambient bright light; Correlated colour temperature (CCT); Dementia; Older adults; Behaviour; Circadian rhythmicity; Tympanic temperature

The Impact of Light on outcomes in Healthcare Settings

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This paper was funded by a grant from the Robert Wood Johnson Foundation.

https://www.healthdesign.org/sites/default/files/CHD_Issue_Paper2.pdf

Abstract

Objective: To identify the mechanisms by which light impacts human health and performance and review the literature linking light (daylight and artificial light) with health outcomes in healthcare settings.

Methods: Literature review of peer-reviewed journal articles and research reports published in medicine, psychology, architecture, ergonomics, and lighting design periodicals and books. Keywords used to search for articles included light, lighting, daylight, sunlight, healthcare, hospitals, depression, circadian rhythm, health, patients and nurses.

Key findings: Light impacts human health and performance by enabling performance of visual tasks, controlling the body's circadian system, affecting mood and perception, and by enabling critical chemical reactions in the body. Studies show that higher light levels are linked with better performance of complex visual tasks and light requirements increase with age. By controlling the body's circadian system, light impacts outcomes in healthcare settings by reducing depression among patients, decreasing length of stay in hospitals, improving sleep and circadian rhythm, lessening agitation among dementia patients, easing pain, and improving adjustment to night-shift work among staff. The presence of windows in the workplace and access to daylight have been linked with increased satisfaction with the work environment. Further, exposure to light is critical for vitamin D metabolism in the human body. Light exposure also is used as a treatment for neonatal hyperbilirubinaemia.

Conclusions: Adequate and appropriate exposure to light is critical for health and well-being of patients as well as staff in healthcare settings. A combination of daylight and electric light can meet these needs. Natural light should be incorporated into lighting design in healthcare settings, not only because it is beneficial to patients and staff, but also because it is light delivered at no cost and in a form that most people prefer.

Impact of daylight illumination on reducing patient length of stay in hospitals after coronary artery bypass graft surgery

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Lighting Research and Technology published online 7 August 2012

<http://lrt.sagepub.com/content/45/4/435.short>

Abstract

In this research, a field investigation was done with 263 coronary artery bypass graft (CABG) surgery patients to identify the impact of daylight exposure on patient length of stay (LoS) in hospital. Lighting data were collected by installing sensors inside in-patient rooms, and were used to develop a multiple linear regression (MLR) model to explore the relationship between daylight intensity and patient LoS in the presence of other environmental (i.e. provision of outdoor view and room status) and clinical (i.e. mean arterial pressure, heart rate and diabetes mellitus) variables. The coefficient estimates of the developed MLR model suggest that while holding the other explanatory variables constant, the patient LoS reduced by 7.3 hours per 100 lx increase of daylight inside in-patient rooms.

Introduction

Human health in the built environment is one of the most critically needed research subjects, requiring both extensive experimental and field research efforts. Apart from controlled laboratory experiments, real world field investigations in the presence of multiple factors need to be carried out to establish the correlations between daylight and health-related concerns,¹ e.g. acceleration in patients' clinical recovery process. Researchers and designers are not yet very specific about the many physiological impacts and impressions daylight can have on individuals' performance.² It is important to investigate the healing effects of daylight in healthcare buildings carefully and scientifically, rather than them being the subject of anecdote, personal opinion and unsupported conjecture.^{3,4}

Evidence of patients' physiological and clinical improvement, measured objectively, needs to be linked with daylight availability inside in-patient rooms. Therefore, the primary goal of this research is to establish strong evidence of a quantitative relationship between daylight intensities and patient stay time in hospitals. Most of the research related to the impact of daylight on occupants has been oriented toward offices and schools rather than focusing on healthcare facilities; however, patient's physiological conditions are expected to be influenced with the change of environmental conditions i.e. daylighting. Various effects of daylight with measurable components have not yet been successfully identified by quantitative and reliable analysis.⁵

Walking on sunshine: effect of weather conditions on physical activity in older people

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<http://www.ncbi.nlm.nih.gov/pubmed/21325149>

ABSTRACT

Background It is unclear which weather parameters effect the motion-sensor-based measurement of physical activity in terms of walking duration in older people.

Methods Between March 2009 and April 2010, the physical activity of 1324 German community-dwelling older people (≥ 65 years, 56.4% men) was recorded over 5 days using accelerometers. Multilevel linear regression analysis was used to estimate the effect of local daily weather parameters (daylight, maximum temperature, total global radiation, average precipitation, average wind speed and average humidity) on walking duration.

Result Mean daily walking duration was comparable for men and women, with 104.46 ± 50.7 min and 102.96 ± 47.8 min, respectively. A linear relationship with walking duration was seen for all considered weather parameters. The strongest effect was found for global radiation, which involved an increase in walking duration of 16.1 min in men and 19.2 min in women between an average winter day (with about 0.8 kWh/m^2 radiation) and an average summer day (with about 6 kWh/m^2 radiation); similar patterns were found for daily maximum temperature and daylight. Furthermore, physical activity decreased significantly with increasing wind speed, precipitation and humidity.

Conclusions Studies on physical activity in community dwelling older people should consider weather conditions.

INTRODUCTION

There has been an increase in the number of studies using objective measures from sensor devices to quantify physical activity. Studies published in the literature suggest that weather conditions can considerably influence study results. Yet, mostly the effect of season on physical activity has been analysed. Studies considering the effect of specific meteorological factors on physical activity are rare, and have reported only activity counts, which are not very intuitive to interpret compared with walking duration. Therefore, the aim of this study was to analyse the effect of various weather parameters on objectively assessed daily walking duration in older people.

Choosing Surgical Lighting in the LED Era

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Surgical Innovation 16(4) 317- 323

<http://www.ncbi.nlm.nih.gov/pubmed/20031945>

Abstract

Background. The aim of this study is to evaluate the illumination characteristics of LED lights objectively to ease the selection of surgical lighting.

Methods. The illuminance distributions of 5 main and 4 auxiliary lights were measured in 8 clinically relevant scenarios. For each light and scenario, the maximum illuminance E_c (klux) and the size of the light field d_{10} (mm) were computed.

Results. The results showed: that large variations for both E_c (25-160 klux) and d_{10} (109-300 mm) existed; that using auxiliary lights reduced both E_c and d_{10} by up to 80% and 30%; that with segmented lights, uneven light distributions occurred; and that with colored LED lights shadow edges on the surgical field became colored.

Conclusions. Objective illuminance measurements show a wide variation between lights and a superiority of main over auxiliary lights. Uneven light distributions and colored shadows indicate that LED lights still need to converge to an optimal design.

Keywords: surgical lighting, LED luminaires, evaluation

Introduction

For many years, choosing surgical lighting has been a challenging process for both surgeons and hospitals. The challenge of choosing surgical lighting has further been increased since the recent introduction of the expensive LED operating room (OR) light in the OR as an emerging lighting technology. Several studies, as reviewed in,¹ have pointed at the surgical OR light as a source of laminar air flow disturbances. Increased sizes and heat loads of OR lights have been associated with the introduction of more undesirable effects to the laminar air flow as compared with smaller sizes and heat loads. Although clinical evidence is still lacking, these effects might compromise the sterility of the wound by bringing more contaminating airborne particles to the surgical site. Therefore, hospitals tend to choose small-sized auxiliary-lights-only lighting systems instead of large-sized main lights in an attempt to minimize air flow distortion and to save money. To assist hospitals in the purchase processes of OR lights, surgeons' requirements for surgical lighting have been described by several authors.²⁻¹⁰ Several important aspects of surgical lighting have been reported—for example, light quantity, shadow reduction, light beam directionality, heat production, and light color.

The aim of this study is to compare extensively the lighting quality of main and auxiliary surgical OR lights that use state-of-the-art LED technology. In addition to the tests described by the standard, which only requires the measurement of the maximum light quantity in different situations, the current study also measures the light field sizes and distribution of light across the illuminated field in all the above-mentioned situations. The light field sizes are expressed in a comparable, clinically relevant way to enable comparison between OR lights. The study further highlights some phenomena that can be introduced to the surgical field by the use of the new LED lighting technology.

Outcomes of Environmental Appraisal of Different Hospital Waiting Areas

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Environment and Behavior. Vol. 35 No. 6, November 2003 842-869
<http://eab.sagepub.com/content/35/6/842.extract>

ABSTRACT

This article evaluates the intuitively informed interior design changes made to a United Kingdom neurology outpatient waiting area following relocation to an alternative building. This *nouveau* environment is compared with the more *traditional* waiting area used before the relocation. The two waiting areas are compared in terms of their effects on the environmental appraisals, self-reported stress and arousal, satisfaction ratings, and pulse readings of 145 outpatients. The equivalence of the outpatient samples attending each clinic is demonstrated in terms of their common demographic characteristics and their similar health profiles. The results provide convergent evidence that the *nouveau* waiting area is associated with more positive environmental appraisals, improved mood, altered physiological state, and greater reported satisfaction. These findings provide support for the concept of a therapeutic hospital environment.

Keywords: *hospitals; environmental appraisal; stress; arousal*

Verification of electrical energy savings for lighting retrofits using short- and long-term monitoring

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Energy Conversion & Management 41 (2000) 1999-2000. Elsevier Science Ltd.
<http://www.sciencedirect.com/science/article/pii/S0196890400000376>

Abstract

This paper presents the verification of the annual electrical energy savings associated with lighting retrofits using short- and long-term monitoring. The effort was part of a US utility-sponsored energy efficiency program to reduce energy consumption in commercial and industrial facilities. Although this paper describes the verification procedures in three facilities, the recommended methods have broad application. In this study, we first conducted lighting energy audits to identify lighting efficiency measures at three facilities, namely an office building, an industrial manufacturing plant, and a city hospital. Then, we estimated the lighting energy savings for the facilities and sought to present the results in a meaningful form. Actual energy savings were measured using short- and long-term monitoring. In all cases, the energy savings measured were within 30% of the projected energy savings.

Introduction

Although energy savings due to lighting retrofits are relatively commonplace in the US, the approach may be new to those in other countries where energy-savings contracts are only now appearing. The results presented in this study are part of a US utility-sponsored energy efficiency program to reduce energy consumption in commercial and industrial facilities. The objective of this project was to verify the annual electrical energy savings associated with lighting retrofits using short- and long-term monitoring.

The calculation procedures for estimating the energy savings for lighting retrofits are fairly simple, consisting of factors for the connected loads before and after the retrofits, the number of operating hours, and a demand diversity factor [1,2]. The pre- and post-retrofit connected loads can be determined with great reliability, but the demand diversity factors and run hours are often inaccurate, resulting in over-prediction of savings. Taylor and Pratt [4], as well as Stoops and Pratt [3], addressed the above issue by conducting a study to evaluate a large utility DSM project in the Northwest.

In this study, short-term monitoring of the energy savings involved the measurements of fixture kW before and after the retrofit. Instantaneous demand metering was conducted on 10% of the fixtures, in accordance with the utility's measurement and verification protocol. For long-term monitoring, run time loggers were installed on 10% of the fixtures of each type after installation and were read quarterly for one year. As the utility-sponsored energy efficiency program was to reduce energy consumption, no effort was made to measure the demand diversity, which is the probability that the participating measures will be online during the utility's peak demand period. As such, load profiles were not measured for the buildings. The heating and cooling interactive effects due to the lighting efficiency measures were also omitted because the utility did not allow additional credit for energy savings due to such interactive effects. In any case, the above measurement and verification procedures are similar to the standard performance measurement and verification protocols established by the US Department of Energy [5].

Effect of simulated dawn on quality of sleep – a community-based trial

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BMC Psychiatry 2003, 3:14

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC270037/>

Abstract

Background: Morning light exposure administered as simulated dawn looks a promising method to treat Seasonal Affective Disorder, but it may moreover help with resetting the inaccurate organisation of body clock functions relative to sleep occurring in winter among people in general. Disturbances in sleep patterns are common and may compromise wellbeing even in the short term. Our hypothesis was that simulated dawn could improve the subjective quality of sleep during winter.

Methods: A community-based trial with 100 volunteer subjects provided with dawn simulators. Study period lasted for eight weeks, and subjects used the dawn simulators for two weeks at a time, each subject acting as his own control (ABAB-design). Main outcome measure was subjective quality of sleep recorded each morning with Groningen Sleep Quality Scale.

Results: 77 subjects completed the trial. Quality of sleep improved while subjects were using dawn simulator-devices ($p = 0.001$). The treatment became beneficial after six days' use of dawn simulator, but the effect did not last after the use was ceased.

Conclusion: Dawn simulation may help to improve the subjective quality of sleep, but the benefits are modest. Further research is needed to verify these findings and to elucidate the mechanism by which dawn simulation acts on the sleep-wake pattern.

Effect of bright light treatment on agitated behavior in institutionalized elderly subjects

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Psychiatry Research 57 (1995) 7-12. Elsevier Science Ireland Ltd.
<http://www.ncbi.nlm.nih.gov/pubmed/7568561>

Introduction

Agitated behavior is very common in dementia and is one of the hallmarks of the demented patient (Jackson et al., 1987; Wild et al., 1987; Cohen-Mansfield et al., 1990; Jeste and Krull, 1991; Pollack and Perlick, 1991; Aronson et al., 1992). Until recently, studies on agitation in institutionalized elderly subjects were sparse and primarily anecdotal, but data suggest a connection between dementia and/or brain damage and agitation (Chesrow et al., 1965; Granacher, 1982; Fisher et al., 1983).

Agitation is not a diagnostic term; rather it is used to describe a group of symptoms. Cohen-Mansfield and colleagues defined symptoms of agitation as aggressive, nonaggressive, or verbal behaviors that are manifested as increased confusion, wandering, attempts to escape restraints, calling out, or screaming (Cohen-Mansfield, 1986; Cohen-Mansfield and Billig, 1986; Cohen-Mansfield et al., 1989a, 1989b, 1990). Agitation is extremely common in nursing home patients and poses a challenge for nursing staff who must care for the agitated patient while simultaneously attempting to calm other patients disturbed by the noise or activity. Currently, problems of agitation are managed by using medications, restraints, or environmental design changes or by increasing the staff-to-resident ratio (Cohen-Mansfield et al. 1989a).

In summary, agitation is a prevalent and important problem. To date, no treatments have been totally satisfactory in effectively managing the disturbances. Medications are limited by side effects, restraints do not adequately solve the problem, psychotherapy is only partially effective and often unavailable, and environmental changes frequently cannot be made. Controlled studies looking at the relationship between dementia, agitation, and bright light in the skilled nursing home population are still needed. Thus, the objective of the present study was to examine whether agitated behavior in the institutionalized elderly could be effectively treated with bright light treatment

R&D Project B(01)13: Designing for health: Architecture, art and design at the James Cook University Hospital

Macnaughton, R. J. and Collins, P. J. and White, M. and Elliott, K. and Soukas, A. and Purves, G. and Kellett, P. and Coleman, S. M. (2007). Project Report. NHS Estates, London.

Findes på DRO (Durham Research Online): <http://dro.dur.ac.uk/5280/>

Summary of the research

This report details the research carried out over a two- year period in two hospitals, Middlesbrough General Hospital and the James Cook University Hospital, both serving the town of Middlesbrough in the UK. The research compared hospital accommodation before and after the move into a new building (the JCUH). The JCUH was developed from a pre-existing building, South Cleveland Hospital (SCH), and partly encapsulates this old hospital. The study was carried out by a multidisciplinary team using a mixed qualitative and quantitative methodological approach.

The study team addressed three main questions:

1. How was the design brief for the new JCUH developed, and what were the main principles encapsulated in the brief?
2. Were those principles realised and valued in any noticeable way by patients, visitors and staff of the new hospital, and did they think the new accommodation was a better environment for patient care than the old?
3. What was the impact on patients, visitors and staff of the artwork commissioned for and placed within the new hospital?

Although this study did employ quantitative methods in the survey, our main focus was qualitative. As a result of our open research approach, the study allowed additional themes and questions to be uncovered such as “what are the features of hospital design that users most value?” These additional questions have also been addressed in the report.

Nurses' perceptions of how physical environment affects medication errors in acute care settings

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Applied Nursing Research 24 (2011) 229 – 237. Elsevier Inc.
<http://www.ncbi.nlm.nih.gov/pubmed/22099470>

Abstract

The work that nurses perform in hospital environments is physically and psychologically intense, with the potential for burnout and stress. This issue is compounded by crowded and poorly designed work spaces in nursing units that can contribute to medical mistakes, including medication errors. This article is based on a study that examined the nurses' perception of how the physical environment in hospitals affects medication errors. Literature suggests that reduction of staff stress can be achieved through physical environmental considerations, such as improved air quality, acoustics, and lighting. However, there is no empirical study specifically exploring the relationship between aspects of the physical environment and medication errors. In this study, a cross-sectional survey was conducted with nursing staff ($N = 84$) in four hospitals in the Pacific Northwest region of the United States. The survey included questions on nursing unit design, medication room configurations, perceived incidence of errors, and adverse events. Respondents noted several physical environmental factors that are potentially problematic in the nursing station area and can lead to medication, documentation, and other types of nursing errors. These factors include inadequate space in charting and documentation area, lengthy walking distances to patient rooms, insufficient patient surveillance opportunity/lack of visibility to all parts of the nursing unit, small size of the medication room, inappropriate organization of medical supplies, high noise levels in nursing unit, poor lighting, and lack of privacy in the nursing stations. As administrators in acute care facilities consider strategies for organizational and staff interventions to reduce medication errors, it is important to consider physical environmental factors to have a comprehensive understanding of the issue.

Morning vs. Evening Light Treatment of Patients With Winter Depression

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Arch Gen Psychiatry. 1998 Oct;55(10):890-6
<http://www.ncbi.nlm.nih.gov/pubmed/9783559>

Abstract

Background: According to the phase-shift hypothesis for winter depression, morning light (which causes a circadian phase advance) should be more antidepressant than evening light (which causes a delay). Although no studies have shown evening light to be more antidepressant than morning light, investigations have shown either no difference or morning light to be superior. The present study assesses these light-exposure schedules in both crossover and parallel-group comparisons.

Methods: Fifty-one patients and 49 matched controls were studied for 6 weeks. After a prebaseline assessment and a light/dark and sleep/wake adaptation baseline week, subjects were exposed to bright light at either 6 to 8 AM or 7 to 9 PM for 2 weeks. After a week of withdrawal from light treatment, they were crossed over to the other light schedule. Dim-light melatonin onsets were obtained 7 times during the study to assess circadian phase position.

Results: Morning light phase-advanced the dim-light melatonin onset and was more antidepressant than evening light, which phase-delayed it. These findings were statistically significant for both crossover and parallel-group comparisons. Dim-light melatonin onsets were generally delayed in the patients compared with the controls.

Conclusions: These results should help establish the importance of circadian (morning or evening) time of light exposure in the treatment of winter depression. We recommend that bright-light exposure be scheduled immediately on awakening in the treatment of most patients with seasonal affective disorder.

Hospital Design and Staff Perceptions

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Health Care Manag (Frederick). 2005 Jul-Sep;24(3):233-44

<http://www.ncbi.nlm.nih.gov/pubmed/16131934>

Abstract

The movement in the health care design field to focus on "patient-centered care" and "healing environments" is often reflected in the health care facilities' incorporation of features meant to mitigate the stressful nature of serious illness. These features may range from a resource center (to allow patients and families to properly educate themselves about their illness) to providing space in rooms so family members can remain with patients, to more ambient features such as soft lighting, water features, or healing gardens. Research has shown that such features can in fact have positive effects for patients and may reduce stress and speed physical healing. What is not as well understood is how (if at all) the medical staff uses these types of features. Good health care cannot be administered without health care professionals, but factors such as job stress and burnout can impair both the physical and psychological health of the staff. A supportive organizational environment is imperative, but this article will set out to show that a supportive physical environment can be just as necessary in influencing how the staff views their workplace as well as how they might fare with regard to their own health. This article will examine a subset of results from a recent employee satisfaction survey given at a medical center. Exploratory analysis and interpretation will begin to shed light on whether or not building design can have an impact (positive or negative) on staff satisfaction. This can potentially act as a springboard to guide future empirical research in the area of health care design and its impact on staff satisfaction and well-being. By analyzing findings from a recent employee satisfaction survey, we can begin to understand how the hospital staff perceives the design of their building and begin to determine if these perceptions might impact health outcomes among the employees.

Effects on subjective and objective alertness and sleep in response to evening light exposure in older subjects

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Behavioural Brain Research 224 (2011) 272–278. Elsevier B.V.
<http://www.sciencedirect.com/science/article/pii/S0166432811004347>

Abstract

Evening bright light exposure is reported to ameliorate daytime sleepiness and age-related sleep complaints, and also delays the timing of circadian rhythms. We tested whether evening light exposure given to older adults with sleep-wake complaints would delay the timing of their circadian rhythms with respect to their sleep timing, thereby reducing evening sleepiness and improving subsequent sleep quality. We examined the impact of evening light exposure from two different light sources on subjective alertness, EEG activity during wakefulness, and sleep stages.

Ten healthy older adults with sleep complaints (mean age = 63.3 years; 6F) participated in a 13-day study. After three baseline days, circadian phase was assessed. On the evening of days 5–8 the subjects were exposed for 2 h to either polychromatic blue-enriched white light or standard white fluorescent light, and on the following day circadian phase was re-assessed. Subjects were allowed to leave the laboratory during all but the two days when the circadian phase assessment took place. Evening assessments of subjective alertness, and wake and sleep EEG data were analyzed.

Subjective alertness and wake EEG activity in the alpha range (9.75–11.25 Hz) were significantly higher during light exposures when compared to the pre-light exposure evening ($p < 0.05$). The light exposures produced circadian phase shifts and significantly prolonged latency to rapid eye-movement (REM) sleep for both light groups ($p < 0.05$). The increase in wake EEG alpha activity during the light exposures was negatively correlated with REM sleep duration ($p < 0.05$).

Evening light exposure could benefit older adults with early evening sleepiness, without negatively impacting the subsequent sleep episode.

Average sunrise time predicts depression prevalence

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Journal of Psychosomatic Research 55 (2003) 99 – 105

<http://www.sciencedirect.com/science/article/pii/S0022399902004798>

Abstract

Objective: Folk wisdom has it that early rising is associated with being “healthy, wealthy and wise.” A physiologic explanation may be Wiegand’s “Depressiogenic Theory of Sleep,” which posits that excessive REM sleep causes depression. Sleeping late increases REM sleep, and thus may increase depression risk. Published depression prevalence research does not use arising time, but average sunrise time (AST) for cities might serve as an analogue for arising time. Two studies of depression prevalence in urban populations, the EURODEP Programme, which measured geriatric depression in nine European cities, and the Epidemiologic Catchment Area (ECA) study of five US centres, have so far lacked satisfactory explanations for the striking differences in depression prevalence between cities. It was hypothesized that differences in rising times between cities, as determined by AST, could explain the variability in depression prevalences.

Methods: Correlations were calculated for published depression prevalences from the EURODEP and ECA studies, and AST for each site.

Results: For both studies, depression prevalences are significantly correlated with AST, with later sunrise (corresponding to earlier arising times in relation to sunrise) associated with lower depression prevalence.

Conclusions: The hypothesis that later rising from sleep is associated with increased depression was supported. The findings also suggest that a city’s depression prevalence could be reduced by simple public health measures to manipulate AST, such as going to Daylight Saving Time (DST) year-round or shifting time-zone boundaries. For individuals, getting up earlier from sleep may be helpful in depression.

A Review of the Empirical Literature on the Relationships Between Indoor Environment and Stress in Health Care and Office Settings

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Environment and Behavior 2008 40: 151

<http://eab.sagepub.com/content/40/2/151.abstract>

Abstract

A conceptual framework linking indoor environment and stress is provided. The framework suggests that, in many cases, indoor environments may set forth a process leading to stress by affecting individual and/or workplace needs. The framework also suggests that because any direct causal relation between indoor environment and stress may be difficult to establish, researchers should focus more on the evidence that links indoor environment to individual and/or workplace needs. This review focuses primarily on the evidence that relates indoor environment to individual and/or workplace needs in health care and office settings. It shows a growing body of literature addressing these relationships in both settings. However, because the available evidence is uneven, there is a great need for the sharing of knowledge among researchers of these settings. In this regard, differences in organizational factors, user and workplace needs, and physical settings are some issues that need to be carefully considered.

Keywords: *indoor environment of health care and office settings; stress; noise; lighting; ambient temperature; air quality*

Effect of Bright Light and Melatonin on Cognitive and Noncognitive Function in Elderly Residents of Group Care Facilities

A randomized controlled trial

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2008 American Medical Association. *JAMA*, June 11, 2008—Vol 299, No. 22
<http://www.ncbi.nlm.nih.gov/pubmed/18544724>

Abstract

Context Cognitive decline, mood, behavioral and sleep disturbances, and limitations of activities of daily living commonly burden elderly patients with dementia and their caregivers. Circadian rhythm disturbances have been associated with these symptoms.

Objective To determine whether the progression of cognitive and noncognitive symptoms may be ameliorated by individual or combined long-term application of the 2 major synchronizers of the circadian timing system: bright light and melatonin.

Design, Setting, and Participants A long-term, double-blind, placebo-controlled, 2 X 2 factorial randomized trial performed from 1999 to 2004 with 189 residents of 12 group care facilities in the Netherlands; mean (SD) age, 85.8 (5.5) years; 90% were female and 87% had dementia.

Interventions Random assignment by facility to long-term daily treatment with whole-day bright (\pm 1000 lux) or dim (\pm 300 lux) light and by participant to evening melatonin (2.5 mg) or placebo for a mean (SD) of 15 (12) months (maximum period of 3.5 years).

Main Outcome Measures Standardized scales for cognitive and noncognitive symptoms, limitations of activities of daily living, and adverse effects assessed every 6 months.

Results Light attenuated cognitive deterioration by a mean of 0.9 points (95% confidence interval [CI], 0.04-1.71) on the Mini-Mental State Examination or a relative 5%. Light also ameliorated depressive symptoms by 1.5 points (95% CI, 0.24-2.70) on the Cornell Scale for Depression in Dementia or a relative 19%, and attenuated the increase in functional limitations over time by 1.8 points per year (95% CI, 0.61-2.92) on the nurse-informant activities of daily living scale or a relative 53% difference. Melatonin shortened sleep onset latency by 8.2 minutes (95% CI, 1.08-15.38) or 19% and increased sleep duration by 27 minutes (95% CI, 9-46) or 6%. However, melatonin adversely affected scores on the Philadelphia Geriatric Centre Affect Rating Scale, both for positive affect (-0.5 points; 95% CI, -0.10 to -1.00) and negative affect (0.8 points; 95% CI, 0.20-1.44). Melatonin also increased withdrawn behavior by 1.02 points (95% CI, 0.18-1.86) on the Multi Observational Scale for Elderly Subjects scale, although this effect was not seen if given in combination with light. Combined treatment also attenuated aggressive behavior by 3.9 points (95% CI, 0.88-6.92) on the Cohen-Mansfield Agitation Index or 9%, increased sleep efficiency by 3.5% (95% CI, 0.8%-6.1%), and improved nocturnal restlessness by 1.00 minute per hour each year (95% CI, 0.26-1.78) or 9% (treatment x time effect).

Conclusions Light has a modest benefit in improving some cognitive and noncognitive symptoms of dementia. To counteract the adverse effect of melatonin on mood, it is recommended only in combination with light.

Sleep and Circadian Misalignment for the Hospitalist: A Review

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Abstract

Shift work is necessary for hospitalists to provide on-site 24-hour patient care. Like all shift workers, hospitalists working beyond daylight hours are subject to a misalignment between work obligations and the endogenous circadian system, which regulates sleep and alertness patterns. With chronic misalignment, sleep loss accumulates and can lead to shift work disorder or other chronic medical conditions. Hospitalists suffering from sleep deprivation also risk increased rates of medical errors. By realigning work and circadian schedules, a process called circadian adaptation, hospitalists can limit fatigue and potentially improve safety. Adaptation strategies include improving sleep hygiene before work, caffeine use at the start of the night shift, bright light exposure and planned naps during the shift, and short-term use of a mild hypnotic after night work. If these attempts fail and chronic fatigue persists, then a diagnosis of shift work disorder should be considered, which can be treated with stronger pharmacotherapy. Night float scheduling strategies may also help to limit chronic sleep loss. More research is urgently needed regarding the sleep patterns and job performance of hospitalists working at night to improve scheduling decisions and patient safety.

Therapeutic lighting design for the elderly: A review

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<http://rsh.sagepub.com/content/early/2011/10/19/1757913911422288>

Abstract

Aims: Research suggests that specialised lighting design is essential to cater for the elderly users of a building because of reduced visual performance with increased age. This review aims to document what is known of the physical and psychological aspects of lighting and their role in promoting a healthy and safe environment for the elderly.

Methods: A methodical review was carried out of published literature on the physical and psychological impacts of light on the elderly. Design standards and guides from professional organizations were evaluated to identify synergies and gaps between the evidence base and current practice.

Results: Lighting has been identified as a significant environmental attribute responsible for promoting physical and mental health of the elderly. The evidence related to visual performance was found to be robust. However, guides and standards appeared to have focused mostly on illumination requirements for specific tasks and have lacked detailed guidelines on vertical lighting and luminance design. This review has identified a growing body of evidence on the therapeutic benefits of lighting and its use in treating psychological disorders among the elderly. The experiments using light as a therapy have improved our understanding of the underlying principles, but the integration of therapeutic aspects of lighting in design practice and guidelines is lacking.

Conclusions: While design guidelines discuss the physical needs of lighting for the elderly fairly well, they lack incorporation of photobiological impacts. Despite positive outcomes from research, the implementation of therapeutic aspects of lighting in buildings is still debatable due to insufficient relevant investigations and robustness of their findings. Collaborations between designers and physicians can contribute in delivering customised lighting solutions by considering disease types and needs. Further investigation needs to be carried out for translating therapeutic benefits to photometric units to implement them in building lighting design.

Melatonin, environmental light, and breast cancer

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Breast Cancer Res Treat (2008) 108:339–350. Springer Science+Business Media B.V.
<http://www.ncbi.nlm.nih.gov/pubmed/17541739>

Abstract

Although many factors have been suggested as causes for breast cancer, the increased incidence of the disease seen in women working in night shifts led to the hypothesis that the suppression of melatonin by light or melatonin deficiency plays a major role in cancer development. Studies on the 7,12-dimethylbenz[a]anthracene and *N*-methyl-*N*-nitrosourea experimental models of human breast cancer indicate that melatonin is effective in reducing cancer development. In vitro studies in MCF-7 human breast cancer cell line have shown that melatonin exerts its anticarcinogenic actions through a variety of mechanisms, and that it is most effective in estrogen receptor (ER) α -positive breast cancer cells. Melatonin suppresses ER gene, modulates several estrogen dependent regulatory proteins and pro-oncogenes, inhibits cell proliferation, and impairs the metastatic capacity of MCF-7 human breast cancer cells. The anticarcinogenic action on MCF-7 cells has been demonstrated at the physiological concentrations of melatonin attained at night, suggesting thereby that melatonin acts like an endogenous antiestrogen. Melatonin also decreases the formation of estrogens from androgens via aromatase inhibition. Circulating melatonin levels are abnormally low in ER-positive breast cancer patients thereby supporting the melatonin hypothesis for breast cancer in shift working women. It has been postulated that enhanced endogenous melatonin secretion is responsible for the beneficial effects of meditation as a form of psychosocial intervention that helps breast cancer patients.

Keywords: Melatonin · Breast cancer, Estrogen receptor, ·Light at night, · Shift-work, · Melatonin receptors, ·Meditation

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Light in the built environment: potential role of circadian disruption in endocrine disruption and breast cancer

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<http://www.ncbi.nlm.nih.gov/pubmed/11405333>

Key words: *breast cancer, buildings, circadian disruption, endocrine disruption, light.*

Abstract

Life in industrialized societies is primarily life inside buildings. Illumination from electric lighting in the built environment is quite different from solar radiation in intensity, spectral content, and timing during the 24-hour daily period. Humans evolved over millions of years with the day-night pattern of solar radiation as the primary circadian cue. This pattern maintained a 24-hour rhythm of melatonin release, as well as a host of other physiological rhythms including the sleep-wake cycle. Electric lighting in the built environment is generally more than sufficient for visual performance, but may be inappropriate for the maintenance of normal neuroendocrine rhythms in humans; e.g., insufficient during the day and too much at night. Lighting standards and engineering stress visual performance, whereas circadian function is not currently emphasized. The molecular biological research on the circadian clock and on mechanisms of phototransduction makes it clear that light for vision and light for circadian function are not identical systems. In particular, if electric lighting as currently employed contributes to 'circadian disruption' it may be an important cause of 'endocrine disruption' and thereby contribute to a high risk of breast cancer in industrialized societies.

Introduction

The potential for environmental pollutants to alter endocrine function resulting in a variety of adverse health effects has become a high-visibility environmental issue. In particular, there is now a federal framework for research on so-called 'endocrine disruption' with many agencies involved, most heavily involved being the National Institute of Environmental Health Sciences [1]. The focus is on synthetic chemicals with ability to impact the function, especially during developmental stages, of the endocrine system. However, there are other agents in the industrialized world that may also start the chain of events leading to endocrine disruption. One may be indoor electric lighting.

Life in modern societies differs in many ways from life before industrialization. One change has been the exposure to electric lighting. Humans have moved from a terrestrial environment with dark nights and bright, broad-spectrum days to a modern built environment with relatively dim, limited-spectrum days *and* nights.

Indeed, the built environment is where most people spend the major part of their lives. It is surprising how little sunlight people receive (approximately 2 hours, or less) even in locations such as San Diego during the summer [2].

The purpose of this paper is to help draw attention to the possible link between the characteristics of the light environment and pineal response and, thereby, to suggest a strategy for determining whether current lighting practice may contribute to the long-term risk of breast cancer.

Length of Stay Has Minimal Impact on the Cost of Hospital Admission

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Background: Hospital cost containment, cost reduction, and alternative care delivery systems continue to preoccupy health care providers, payers, employers, and policy makers throughout the United States. The universal metric for gauging the success of these efforts is hospital length of stay (LOS). Reducing the LOS purportedly yields large cost savings. The purpose of this study is to assess precisely how much hospitals save by shortening LOS.

Study Design: We reviewed the cost-accounting records of all surviving patients (n = 12,365) discharged from our academic medical center during fiscal year 1998 with LOS of 4 days or more. Actual costs were identified through the University of Michigan cost-accounting system. Individual patient costs were broken out on a daily basis and then decomposed further into variable direct, fixed direct, and indirect categories. The population was analyzed by determining the incremental resource cost of the last full day of stay versus the total cost for the entire stay. The data were also stratified by LOS and by surgical costs. An analysis of all trauma patients was then performed on all patients discharged from the hospital's adult level I trauma center (n = 665). Costs were determined on specific days, including admission day, each ICU day, day of discharge from the ICU, and each of the last 2 days before the discharge day.

Results: The incremental costs incurred by patients on their last full day of hospital stay were \$420 per day on average, or just 2.4% of the \$17,734 mean total cost of stay for all 12,365 patients. Mean end-of-stay costs represented only a slightly higher percentage of total costs when LOS was short (eg, 6.8% for patients with LOS of 4 days). Even when the data were stratified to focus on patients without major operations, the \$432 average last-day variable direct cost was only 3.4% of the \$12,631 average total cost of care. A focus on the trauma center helps to explain this phenomenon. For our trauma center, variable direct costs accounted for 42% of the mean total cost per patient of \$22,067. The remaining 58% was hospital overhead (fixed and indirect costs). The median variable direct cost on the first day of admission is \$1,246, and the median variable direct cost on discharge is \$304. Approximately 40% of the variable costs are incurred during the first 3 days of admission.

Conclusions: For most patients, the costs directly attributable to the last day of a hospital stay are an economically insignificant component of total costs. Reducing LOS by as much as 1 full day reduces the total cost of care on average by 3% or less. Going forward, physicians and administrators must deemphasize LOS and focus instead on process changes that better use capacity and alter care delivery during the early stages of admission, when resource consumption is most intense.

Circadian time of morning light administration and therapeutic response in winter depression

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Arch Gen Psychiatry. 2001 Jan;58(1):69-75
<http://www.ncbi.nlm.nih.gov/pubmed/11146760>

Abstract

BACKGROUND:

We investigated a possible mechanism of action for the antidepressant response to light-phase advances of the circadian clock-by measuring the onset of melatonin secretion before and after light treatment in the morning or evening.

METHODS:

Plasma melatonin was sampled in 42 patients with seasonal affective disorder, in the evening or overnight while depressed and after 10 to 14 days of light therapy (10 000 lux for 30 minutes) when symptoms were reassessed.

RESULTS:

Morning light produced phase advances of the melatonin rhythm, while evening light produced delays, the magnitude depending on the interval between melatonin onset and light exposure, or circadian time (morning, 7.5 to 11 hours; evening, 1.5 to 3 hours). Delays were larger the later the evening light ($r = 0.40$), while advances were larger the earlier the morning light ($r = 0.50$). Although depression ratings were similar with light at either time of day, response to morning light increased with the size of phase advances up to 2.7 hours ($r = 0.44$) regardless of baseline phase position, while there was no such correlation for evening light. In an expanded sample ($N = 80$) with the sleep midpoint used as a reference anchor for circadian time, early morning light exposure was superior to late morning and to evening exposure.

CONCLUSION:

The antidepressant effect of light is potentiated by early-morning administration in circadian time, optimally about 8.5 hours after melatonin onset or 2.5 hours after the sleep midpoint.

Factors associated with objective (actigraphic) and subjective sleep quality in young adult women

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<http://www.ncbi.nlm.nih.gov/pubmed/16126091>

Abstract

Objective: The aim of this study was to describe factors associated with actigraphic and subjective sleep quality in young women. **Methods:** Participants were 73 regularly menstruating women, 20 - 40 years old, who were not taking oral contraceptives, pregnant, or shift workers. Women contributed an average of 7 nights of actigraphy data during the luteal menstrual cycle phase, resulting in a total of 595 nights of data.

Results: One night of actigraphy data was unreliable for measuring total sleep time, sleep onset, and time in bed (intraclass correlation $V.15$) but was acceptable for measuring sleep efficiency and total wake time (intraclass correlation [ICC]=.52). Going to bed late, medication use, employment, increased daylight hours, longer menstrual cycle length, and higher body mass index (BMI) were associated with poorer actigraphic sleep measures. Employment, age, and perceived stress were associated with subjective sleep quality.

Conclusion: Multiple factors were associated with sleep quality in these young women who were sleeping at home. However, the associations differed for subjectively versus actigraphically assessed sleep quality. Actigraphy is feasible for measuring sleep, but multiple recording nights may be needed to obtain reliable estimates.

Introduction

Chronically disturbed sleep is associated with a number of deleterious effects, including reduced memory and learning ability, compromised immune function, and an increased risk of cardiovascular disease. Thus, it is important to understand factors that are associated with poor sleep quality in a natural environment. In assessing such relationships, both subjective and objective assessments of sleep quality should be considered because the two are only modestly correlated, suggesting that each modality assesses different aspects of an individual's sleep experience.

The purpose of this study was to examine objectively assessed sleep patterns across multiple nights (range = 2 -10), using actigraphy, in a large sample of 20- to 40-year-old women. Women were assessed while sleeping at home, where they were unrestricted in their behavior. Specifically, we assessed the within- and between-subject variability and the reliability of actigraphic sleep assessments. We also examined potential risk factors for poor sleep quality for both actigraphic and subjective sleep assessments and determined whether patterns of association differed between the two types of measures. Participants from this study were drawn from an intervention trial examining the effect of magnetic field exposure on hormone levels and sleep patterns; the current study represents a cross-sectional analysis of these data.

The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity

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Report to The Center for Health Design for the Designing the 21st Century Hospital Project.

This project is funded by the Robert Wood Johnson Foundation

https://www.healthdesign.org/sites/default/files/Role_Physical_EnvABSTRACTS_0.pdf

Abstract

In this project, research teams from Texas A&M University and Georgia Tech combed through several thousand scientific articles and identified more than 600 studies - most in top peer-reviewed journals - that establish how hospital design can impact clinical outcomes. The team found scientific studies that document the impact of a range of design characteristics, such as single-rooms versus multi-bed rooms, reduced noise, improved lighting, better ventilation, better ergonomic designs, supportive workplaces and improved layout that can help reduce errors, reduce stress, improve sleep, reduce pain and drugs, and improve other outcomes. The team discovered that, not only is there a very large body of evidence to guide hospital design, but a very strong one. A growing scientific literature is confirming that the conventional ways that hospitals are designed contributes to stress and danger, or more positively, that this level of risk and stress is unnecessary: improved physical settings can be an important tool in making hospitals safer, more healing, and better places to work.

Research process

The research teams searched through scores of databases and in libraries at Texas A&M, Georgia Institute of Technology, University of Michigan, and elsewhere. The team was looking for studies that are:

- Rigorous, in that they use appropriate research methods that allow reasonable comparisons, and discarding of alternative hypotheses. The research studies were assessed on their rigor, quality of research design, sample sizes, and degree of control.
- High impact, in that the outcomes they explore are of importance to healthcare decision-makers, patients, clinicians, and society.

In 1998, Haya Rubin and her colleagues Amanda Owens and Greta Golden found 84 studies produced since 1968 that met similar criteria (Rubin, Owens, & Golden, 1998). Reviewing the research literature six years later, the team estimated that they would find around 125 rigorous studies. We found more than 600.

Results

The research team found rigorous studies that link the physical environment to patient and staff outcomes in four areas:

1. Reduce staff stress and fatigue and increase effectiveness in delivering care
2. Improve patient safety
3. Reduce stress and improve outcomes
4. Improve overall healthcare quality

View through a Window May Influence Recovery from Surgery

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Science 27 April 1984: Vol. 224 no. 4647 pp. 420-421

<https://mdc.mo.gov/sites/default/files/resources/2012/10/ulrich.pdf>

Abstract

Records on recovery after cholecystectomy of patients in a suburban Pennsylvania hospital between 1972 and 1981 were examined to determine whether assignment to a room with a window view of a natural setting might have restorative influences. Twenty-three surgical patients assigned to rooms with windows looking out on a natural scene had shorter postoperative hospital stays, received fewer negative evaluative comments in nurses' notes, and took fewer potent analgesics than 23 matched patients in similar rooms with windows facing a brick building wall.

Assessing Beliefs about Lighting Effects on Health, Performance, Mood, and Social Behavior

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Environment and Behavior 1996 28: 446
<http://eab.sagepub.com/content/28/4/446>

Abstract

Energy conservation through the adoption of new, energy-efficient technologies will succeed only to the extent that the new technologies are not themselves perceived as risk sources. Previous research has found that beliefs about the health effects of fluorescent lighting predict compact fluorescent lamp use in homes. This paper describes the development and validation of a questionnaire to assess beliefs about the effects of common types of interior lighting on human health, work performance, mood, and social behavior. Principal components analysis of the 32-item Lighting Beliefs Questionnaire revealed 6 interpretable components: Lighting Importance, Brightness, Major Health Effects: Fluorescent Lighting, Minor Health Effects: Fluorescent Lighting, Social Setting, and Daylighting. The questionnaire may be used to explore responses to interior lighting and to discover what beliefs are held by end users. This information will assist in allaying unwarranted fears and concerns about new lighting technologies.

Dimensions of Person-Window transactions in the Hospital Environment

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Environment and Behavior, July 1986, Vol. 18 No. 4, July 1986, 450-466
<http://search.proquest.com/openview/190ce71b8107032a459681cf20298b89/1?pq-origsite=gscholar>

Abstract

An empirical investigation focused on person-window transactions in the physical medicine and rehabilitation environment. Attributes of windows, view, daylight, and spaces perceived as insufficient in these respects were studied in six hospitals. Preference, environmental documentation, and behaviors associated with windows and windowless rooms were the subject of a two-part interview and questionnaire. The respondent group numbered 250 persons. Nonmetric multidimensional scaling (MDS) was utilized, yielding an array of 21 cognitive dimensions. From evaluations of 56 photographs that sampled a broad spectrum of spaces ranging from highly windowed to windowless, 8 visual dimensions were identified; and 13 nonvisual dimensions distilled from 89 written response items were identified that addressed degree of satisfaction and associated behaviors. Among the findings, ideal window and view conditions frequently contrasted the actual conditions in one's hospital setting; informative views of urban life and nature beyond the hospital, accessible from one's typical viewing angle and position within the room, were desired; minimally windowed rooms were equated with architecturally windowless spaces, and window-view substitutes in windowless rooms were distinguished from similar rooms without such compensatory measures. Implications for hospital planning and design are discussed.

Actigraphic assessment of the circadian rest-activity rhythm in elderly patients hospitalized in an acute care unit

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<http://www.ncbi.nlm.nih.gov/pubmed/12519455>

Abstract

Hospitalization for acute illness is a major risk factor of rest–activity rhythm disturbance among elderly subjects. The rest–activity rhythm is disturbed by the acute illness, aging and hospital environment. The purpose of this study is to assess the rest–activity rhythm and light exposure (using a wrist worn actigraph) of 10 patients (mean age 81 years, seven females) admitted on an acute care unit, suffering from cardiac, respiratory or renal acute disease. A non-parametric method was used to analyze activity data. With an improvement of the underlying diseases, the mean relative amplitude of rhythm increased from 0.31 ± 0.19 for the first 5-day period after admission to 0.54 ± 0.21 for the second period before discharge ($P < 0.05$). The amount of time at night spent above a lighting threshold of 50 lux decreased from 31.4 to 12.3 min between the two periods. The rhythm of elderly subjects hospitalized in the acute care unit is severely altered during the initial period and is progressively resynchronized following clinical improvement. Under the acute underlying disease and/or aging, environmental conditions (light, noise) should be considered to maintain regular rest–activity rhythm.

Key words: actigraphy, circadian rhythms, intensive care, light.

Introduction

Admission for an acute illness is a major risk factor of rest–activity rhythm disturbance, particularly among elderly subjects. It may be altered by several factors. Usual environmental conditions (e.g. meals, daily physical activity, bed times) are modified by acute illness and/or by hospital environment (e.g. nursing care, continuous monitoring and lighting, ‘medical noise’). These new conditions may induce sleep and psychiatric (delirium) disorders that may contribute to amplify disturbances of the circadian timing system. This situation and its consequences have not been studied yet, except sleep disturbances in intensive care units¹ or in conventional unit but focusing on delirium². The activity rhythm is recorded non-invasively and without discomfort by wearing an actigraph continuously (night and day) for several weeks on the non-dominant wrist. It records movement-induced accelerations on a minute epoch (Fig. 1). Actigraphy has been validated by polygraphic sleep recording in normal subject in whom it accurately estimates rest–activity rhythm^{3–6}. For clinical purposes, it is used to evaluate some sleep disorders⁷ and rest–activity rhythm disturbances in demented patients^{8,9}.

The purpose of the present study is to assess the rest-activity rhythm and light exposure (using a wrist worn actigraph) of 10 patients (mean age 81 years, seven females) admitted on an acute care unit, suffering from cardiac, respiratory or renal acute disease. For the present study we enrolled very dependant and/or severely ill subjects admitted to the acute care unit of Hôpital de Hautepierre, Hôpitaux Universitaires de Strasbourg, France. We used Van Sommeren’s non-parametric parameters¹⁰ instead of cosinor analysis¹¹, complex demodulation¹² and the Lomb-Scargle periodogram¹³, which lack sensitivity for the analysis of rest-activity data that are highly non-sinusoidal and/or too irregular.

Influence of Bright Light during Daytime on Sleep Parameters in Hospitalized Elderly Patients

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J Physiol Anthropol Appl Human Sci. 2001 Nov;20(6):345-51
<http://www.ncbi.nlm.nih.gov/pubmed/11840687>

Abstract

Nurses frequently care for sleepless elderly patients on bed rest in a hospital environment. Our previous study with young adults showed that bright light exposure during the daytime affected the induction of nocturnal deep sleep. The purpose of this study is aimed at finding whether similar research could be observed with hospitalized elderly patients. Seven patients (mean age 67; range 57-77 yrs, males 3; females 4) served as participants and their informed written consent was obtained. A fluorescent lamp fixed in the bed frame near the head of the patient was turned on at 10:00 h and off at 15:00 h each day for 1 week (BL). Moreover, each patient was required to stay near this light during this period. The patients lived in a room facing north, where the ambient light intensities ranged from 50 to 300 lx during the daytime. Their activities were continuously measured using an Actiwatch (model-AWL, Mini-Mitter, USA). Salivary samples were collected at midnight for the measurement of melatonin. The findings were compared between 2 days before BL exposure (baseline) and the last 2 days during BL exposure, respectively. The bright light exposure during the daytime prolonged "Time in Bed" ($p < 0.05$), increased "Immobile Minutes" ($p < 0.05$), and delayed "Get up Time" ($p < 0.01$). The average melatonin secretion at midnight in four patients increased from 7.5 ± 2.6 pg/ml to 13.3 ± 9.2 pg/ml. These findings suggest that diurnal bright light exposure for hospitalized elderly patients lying in bed under dark condition during the daytime may favor clinically the induction of nocturnal deep sleep. Attention should be given to the illumination conditions for elderly patients in hospitals to improve their impaired sleep.

Keywords: bright light, sleep promotion, circadian rhythm, elderly sleep

The Effect of Sunlight on Postoperative Analgesic Medication Use: A Prospective Study of Patients Undergoing Spinal Surgery

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<http://www.ncbi.nlm.nih.gov/pubmed/15673638>

Objective: Exposure to natural sunlight has been associated with improvement in mood, reduced mortality among patients with cancer, and reduced length of hospitalization for patients who have experienced myocardial infarction. Our aim was to evaluate whether the amount of sunlight in a hospital room modifies a patient's psychosocial health, the quantity of analgesic medication used, and the pain medication cost.

Methods: A prospective study of pain medication use was conducted in 89 patients undergoing elective cervical and lumbar spinal surgery where they were housed on either the "bright" or "dim" side of the same hospital unit. Analgesic medication was converted to standard morphine equivalents for interpatient comparison. The intensity of sunlight in each hospital room was measured daily and psychologic questionnaires were administered on the day after surgery and at discharge.

Results: Patients staying on the bright side of the hospital unit were exposed to 46% higher-intensity sunlight on average ($p = .005$). Patients exposed to an increased intensity of sunlight experienced less perceived stress ($p = .035$), marginally less pain ($p = .058$), took 22% less analgesic medication per hour ($p = .047$), and had 21% less pain medication costs ($p = .047$). Age quartile was the only other variable found to be a predictor of analgesic use, with a significant negative correlation ($p < .001$). However, patients housed on the bright side of the hospital consistently used less analgesic medications in all age quartiles.

Conclusion: The exposure postoperatively of patients who have undergone spinal surgery to increased amounts of natural sunlight during their hospital recovery period may result in decreased stress, pain, analgesic medication use, and pain medication costs.

Key words: analgesic medication, sunlight, morphine, stress, opioid.

Introduction

Exposure to artificial high-intensity light (phototherapy) or natural light has been shown to positively affect feelings and emotions (1,2). Phototherapy has been successfully used to treat patients with depression and seasonal affective disorder (SAD) (3,4). Studies examining the effects of natural sunlight on the recovery of patients with refractory, bipolar, and SAD have demonstrated a decreased length of stay (LOS) among patients exposed to increased light intensity (5–7). Exposure to natural sunlight or artificial high-intensity light has been associated with reduced depression for pregnant women (8); reduced mortality from ovarian, breast, and colon cancer (9,10); as well as reduced hospital mortality and LOS in patients experiencing myocardial infarction (11).

A multitude of studies have examined the effect of sunlight and artificial high-intensity light on hospitalized patients (5–11). However, to our knowledge, no prior investigations have studied the effects of exposure to natural sunlight or artificial high-intensity light on the use of analgesic medications by hospitalized patients. In this article, we report the results of the first prospective study to determine the effects of natural sunlight on the use of opioid-equivalent medications among a group of 89 postoperative patients who had undergone spinal surgery.

Evening Light Exposure: Implications for Sleep and Depression

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Objectives: To examine whether dim illumination in the evening is a factor in sleep disturbances of aging, depression, and circadian phase advance.

Design: One-week continuous recordings were made to record illumination exposure and to infer 24-hour sleep patterns from wrist activity.

Setting: Recordings took place during normal home and community activities.

Participants: Complete data of 154 postmenopausal women, mean age 66.7, were selected from a larger study of participants in the Women's Health Initiative.

Measurements: Illumination in lux was averaged for 4 hours before bedtime and over 24 hours. Mood was measured using a brief eight-item screen.

Results: Illumination in the 4 hours before bedtime was quite dim: median 24 lux. Nevertheless, evening light exposure was not significantly related to sleep amount (in bed or out of bed) sleep efficiency, sleep latency, wake within sleep, or mood. In contrast, the overall amount of light throughout the 24 hours was negatively correlated with sleep latency, wake within sleep, and depressed mood.

Conclusions: Low evening lighting does not appear to be a crucial factor in sleep and mood disturbances of aging, but overall lighting may contribute to these disturbances.

Keywords: light; activity; mood; circadian; phase; advance; depression; evening

Bilag 2. Sund hospitalsarkitektur

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