# The healing potential of architectural design

Anne Kathrine Frandsen
Architect, PhD.
Researcher
SBi/AAU The Danish Building Research Institute, Aalborg University, Denmark
akf@sbi.dk

Camilla Ryhl, Architect, PhD, Senior researcher
SBi/AAU The Danish Building Research Institute, Aalborg University, Denmark
car@sbi.dk

## 1. Summary
Within the last twenty years a growing body of scientific documentation has developed suggesting that the physical environment on hospitals have an impact on patients' and staffs' experience of well-being, stress and the general outcome. Denmark is in the midst of investing and planning hospital facilities replacing the facilities designed and built in the sixties and seventies.
The research project 'Healing architecture' compiled and reviewed research linking the physical environment on hospitals with patient and staff outcomes. It addressed the question whether architectural design has a healing potential. The objective was to develop a tool that could give an overview of this research for the building clients and decision-makers responsible for the huge investments in future hospitals and healthcare facilities in the coming decade. Drawing upon phenomenological architectural theory a categorical model was developed that facilitated sorting and communicating the research findings. The project concluded that the research findings can be used to inform the decision-making in the briefing and design process. Especially well documented was the impact of light, sound, views to green outdoor areas on the experience of pain, stress and days of admission as well as on the general well-being of patients and it was therefore concluded that architecture can support the healing process of the individual.

**Keywords: Healing architecture, evidence based design, architectural design, and healthcare environment**

## 2. Introduction
In the coming decade huge sums are going to be invested in new hospital or refurbishment of existing hospital facilities in Denmark. In these many building projects there will be a focus on the patient and his or hers sense of cohesion in the treatment and care, wellbeing and safety, a focus that will have a big impact the on requirements for these facilities. This focus on the patient is among other things due to research findings within the two last decades suggesting that reduced levels of stress in patients increases their overall well-being and improves their immune system and healing process, leading to better patient outcome and shorter admission time. Within the same period of time research findings have suggested that the physical environment on hospitals is an important impact factor when it comes to patients' stress, well-being and safety.
This paper describes a research project undertaken by Architecture & Design and the Danish Building Research Institute, Aalborg University finished in the late spring of 2009. The project developed a tool on healing environment to support clients and decision-makers in the briefing and specification process for new or refurbished hospital facilities, based on a review of research literature linking the physical environment on hospitals with patient and staff outcome.

## 3. Theoretical background
Within the last decades the impact of hospital's physical environment on healing and health care outcomes have been subject to much research and the documentation linking the design of the

hospitals physical environment with patient and staff outcomes is growing. In a review of around 600 research studies [1] four main outcome areas that are affected by the design of the hospital's environment has been identified:
Reduction of staff stress and fatigue and increased effectiveness in delivering care,
Improvement of patient safety,
Reduction of stress and improvement of outcomes,
Improvement of overall healthcare quality
This base of scientific knowledge is increasingly being applied in the design of new hospitals in the US.
A central concept in this field is 'Evidence based design'. Basically this concept implies to base design decisions on the best available documentation from research in order to improve the outcome of patients and staff. But the concept is also used about design processes that in addition adapt research methodologies to the design process. This includes defining a hypothesis for how the design will influence the outcome, obtain baseline data and then after the completion, assess the design/innovations impact on the outcome in scientific designed evaluations and disseminate these results to the healthcare community.
In order to expand the base of evidence and widen the areas of study the Center for Health Design in California US launched the Pebble Project in 2000, a joint research effort between the Center for Health Design and healthcare providers. The objective with the Pebble Project is to engage healthcare providers building new or renovating healthcare facilities in an Evidence Based Design process. Another initiative promoting the application of the results from this field of research is Jane Malkin's book 'A Visual Reference for Evidence Based Design' [2] that presents and discuss hospital facilities where insights gained from research on hospital's physical environment and healthcare outcomes have been applied.
In a Danish context the interest for health care environments influence on healing and wellbeing of patients and staff was evoked in 2008 by 'Sansernes hospital' [3] (The hospital of the senses) that presents documentation from evidence based design in combination with a short history of Danish hospital building.

In architectural theoretical research based on a phenomenological tradition it has been stressed that the experience of architecture is a multisensory experience [4] [5] [6]. The whole body and its senses are engaged in the meeting with architecture even if not all senses are addressed with intend by the design. Eiler Rassmussen describes how the different senses encounter architecture including seeing, hearing, touching as well as whole-body experiences of masses, scale and movement [4].
Pallasma further this inclusion of the whole-body sense based on the psychologist James J. Gibson categorisation of senses in five sensory systems: The visual, the auditory, the taste-smell, the basic orienting and the haptic system. Furthermore, Pallasma stresses the multi-sensorial character of perception [6]. Through the multi-sensory perception we encounter and interact with our surroundings and the social context this includes.
Based on this phenomenological understanding of the multisensory experiences of architecture it was possible to differentiate between the documentation of the various ways the physical environment on hospitals had an impact on the outcome of patients and staff, distinguishing between the impact it had on the body and its senses, the relational aspects of hospitalisation and the safety.

## 4. Research objective

The presumption in the project was that architecture has a healing potential in the sense that architecture can influence human wellbeing and therefore can strengthen or support a healing process of the individual.
The objective was to develop a tool that could give an overview of this research for the building clients and decision-makers in Denmark responsible for the huge investments in future hospitals and healthcare environments in the decade to come.
The question to be addressed in the project was whether architecture has a healing potential?
The findings were communicated in a categorical model distinguishing between physical environment (e.g. location, outline, layout), physical factors (the body, relations and safety) and impact factors (e.g. mortality, stress, length of admission, turnover rate).

## 5. Research design

The study was conducted as a literature study and review, only research findings published in peer reviewed journals was included and only primary sources.

The objective was only to study and communicate research findings that had a relation or impact on the spatial design. E.g. if the findings suggested that hand hygiene improved with disinfection with alcohol it would not be included because it does not have particular spatial implications. But if the findings suggested that an alcohol dispenser by each bed improved the hand hygiene, it would be included because the findings had implications for the spatial layout.

Likewise, a distinction was made between

– findings that had implications for the spatial outline, layout or design and therefore could have an impact on architectural decisions,
– findings that had an impact on the engineerical and technical solutions such as principles for and dimensioning of ventilation and
– findings that had an impact on design decisions e.g. suggesting improved outcome with design inventions such as potable drips.

Only finding from the first group was included in the review.

*Table 1 Model of factors*

| Environmental factors | Physical factors | Impact factors |
|---|---|---|
| Location | **Body** | **Physiological** |
| Outline | Light | Healing |
| Lay-out | Colour and art | Pain |
| Interior | Sound | Infection |
| Materials | Air | Sleep |
| Equipment | Movement | Circadian rhythm |
| | | Appetite |
| | **Relations** | Exercise |
| | Personal space | Admission time |
| | Social space | Readmission |
| | External space | Mortality |
| | | **Psychological** |
| | **Safety** | Stress |
| | Hygiene | Angst |
| | Errors and injuries | Distraction |
| | | Confidence |
| | | Safety |
| | | Depression |
| | | Privacy |
| | | Grief |
| | | Control |
| | | Social contact |
| | | Satisfaction |
| | | Communication |
| | | Information |
| | | Motivation |
| | | Joy |
| | | Orientation |
| | | **Economical** |
| | | Sickness absence |
| | | Economy |
| | | Work injury |
| | | Turnover rate |

Based on phenomenological architectural theory and its understanding of the multisensory experience of architecture and its reading of Gibson's five sensory system [7] (the visual, the auditory, the taste-smell, the basic orienting and the haptic system), a model was developed. A model that enables a distinction between the various physical factors that the findings suggested had an impact on well-being and outcome of patients and staff. The model of physical factors had three entries; findings related directly to the body and its senses, findings related to space and human interaction, and findings related to the safety of patients and staff (table 1).
With the objective to establish an overview of the physical factors and the impact that the research findings suggested these physical factors had physiologically, psychologically or economically, a column of impact factor was included in the model.
Likewise a column with environmental factors that are considered and designed in every building process was included in the categorical model, enabling the communication of what decision levels and environmental factors that would have to be addressed if the research findings were to be applied.

# 6. Findings

After sorting the findings in the categorical model differentiating between the body and its senses, the relational aspects of space and safety for patients and staff, the review of the literature showed that there was evidence linking the all three categorical areas to stress, well-being and improved outcomes.

## 6.1 Bodily factors

The review showed that there is documentation that links the sense of seeing (light and art/colour), hearing, smelling and movement to stress reduction, well-being or improved outcomes. Especially the impact of light and sound were well documented, whereas the impact of art was not documented and nor colour, interesting since these last two environmental properties are those most frequently mentioned in connection with healing environments. Movement was also an area with surprisingly small amounts of research and documentation. In the review there was not found any documentation on the impact of the sense of touch. The sense of taste was excluded from the review due to the lack of spatial impact from taste. Some research relating taste and appetite to social relations was included under relational aspects of space (social space).

The factor light includes research that addresses the impact light, both natural daylight and lighting, can have on patients psychologically and physiologically. The review showed that access to daylight is important for everyone that spends their time on a hospital, whether it is as patient, relative or staff. When asked what is important for their personal well-being and job satisfaction, daylight and access to windows is the elements or properties of the physical environment that a majority mentions [8, 9 10, 11, 12].
Light and especially daylight has en effect on our circadian rhythm. For elderly there seems to be a relation between the measure of time spent in daylight or in light with a high intensity at day and the quality of their sleep at night. [13, 14]. The same pattern can be observed on premature babies. When the lighting level differs significantly between day and night, the premature babies' level of activity increase and the difference between their levels of activity at night and day increase, they put on more weight, develop quicker and are discharged earlier compared to those who spent all their time in even semi -dark light [15,16].
Light with high intensity has been a recognised treatment of winter depression (seasonal affective disorder) for quite some time. Now findings suggest that daylight with high intensity can have a positive impact on other types of depression, both patients with severe depression and bipolar depression were hospitalised for a shorter time when they were lying on sunny wards [17,18].
Sunny rooms have also a beneficial effect on patients with no psychiatric diagnose a study suggests. The patients on sunny wards had fewer complications and were admitted for a shorter time when compared to those lying on the darker wards [19]. Also on the experience of pain and stress light has a positive impact. Patient who had undergone a spinal surgery lying on sunny wards used 22 % less analgesic medicine and rated their level of stress lower than the same type of patients lying on darker wards [20].

As mentioned above the research team did not find many studies on the impact of art that met the defined criteria for inclusion in the review (primary source, peer reviewed). One study suggests that the wall colours in combination with mural paintings have a calming effect on aggressive children and adolescents [21]. The literature suggests art (such as video of landscape) as a distraction has a positive impact on pain [22,23].

The factor sound included research on the acoustic environment on hospitals and its impact on patients, relative and staff, either as noise that can interrupt sleep or otherwise disturb or as sound that can ease e.g. the experiences of pain.
Generally the sound level on hospital wards is too high either due to the technical equipment and alarms or the communication and activities of the staff. The more patient there are in a room, the higher is the sound level [24, 25, 26, 27].
These high sound levels have a negative impact on the patients' sleep with disruptions and general reduction of the sleep quality. As sleep is essential in all healing processes such reductions in sleep quality results in negative physiological consequences for the patients [28, 29, 30, 31].
The literature indicated a connection between noise and stress. When the noise level is minimised a significant positive improvement of the patients can be recognised [31,32]. On intensive care units improvements of the sound level and minimisation of the impact from the noise sources can be registered directly in better healing and survival [29]. Besides these impacts, sounds and high sound level have a negative impact on patients' anxiety, worry, nervousness and their feeling of lacking control [33]. Overhearing others conversation involuntarily has similarly negative impacts on patients. The lack of acoustical privacy can increase the experiences of lacking confidentiality and can result in the patient withholding information relevant for the diagnosis or treatment. Furthermore, the sound level has an impact on the work environment. Reduction of the reverberation time in patient rooms, staff rooms and work stations improve the staffs' job satisfaction and their experience of positive improvement of the work environment with fewer conflicts and stress.

There was found very little research on the impact of smell and air on hospitals if the hygienic aspect is not included. Some bedbound patients are particularly sensitive to wrong temperatures or offensive smells because of their illness or their medication. This stresses the importance of good ventilation systems and application of surfaces that does not emit smell [34]. One study with essential oils smelling of oranges suggests that smells can have a calming and stress reducing impact [35].

Likewise the impact of movement and way-finding on the users of hospitals was an area the research team found nearly uncovered by research.

### 6.2 Relational factors

The group of relational factors covered personal space, social space and outdoor space. The review showed that there is documentation that links personal space, social space and outdoor space to patient well-being and stress and improved outcomes for both patients and staff.
The factor 'personal space' included research that dealt with the experience of privacy the individual patient, relative or staff can have or miss having. The reviewed literature documented the importance of the individuals' possibility for privacy and control for their experiences of well-being. This does not necessarily mean that the patients have to lie in a single room, though surveys suggest that quite many would prefer that [36, 37]. The privacy can also be achieved with other means such as clear indication of the area 'belonging' to a bed, a place to keep one's things, control of light and other factors that have impact on the indoor climate and possibility to go to the toilette alone [38].

Privacy is not only important for the patients and their satisfaction, it has also an impact on how much the relatives participates in the care and the intimacy of the care they give [39,40,41]. An impact of more privacy either as more and shielded space around the bed on a multi bed ward or as single room could be recognised in parent's behaviour towards their babies (both premature and normal). After an alteration with securing more privacy around the bed, the parents had their baby considerably more in their arms or close to their body (kangaroo method) than before the alteration [42]. Generally, if it is physically possible and the there is space and privacy for talk and

care the frequency of relatives visits increase and the visits are longer [43]. Single rooms increase the patients and the relatives' experience of privacy [40, 44] and the relatives do not prefer open wards for care of terminal ill persons because it lacks confidentiality and tranquillity for care and private talks [45].
In relation to the staffs' examination and treatment of the patient privacy plays an important role. The confidentiality needed is at stake if the privacy is not established e.g. because others can see the examination or overhear the conversation and this can lead to the patient withholding important information [44,46,47,48,49].

'Social space' included research that dealt with what the various kinds of social interaction on hospitals require from the spaces that house them. The reviewed literature documented that the possibility for patients to talk and establish relations to other patients with the same diagnose and treatment reduces the patient's anxiety, nervousness, fear and stress [40]. Such interaction can be established with common kitchens or rooms for common activities such as cooking, eating together or other relaxed/causal activities. E.g. moving the intake of meals out of the ward and into a common kitchen on a children cancer department and making the meals a social event led to an increase in the children's intake of food from 50 % of their need to 70 % and optimised thereby the potential healing [50,51]. The interaction with the staff is of course crucial in the care and treatment, and the presence of the staff physically or visually and the social support such presence gives, reduces patient anxiety and fear [40]. Visual and physically open spatial lay-out seems to be requisite to make patients and relatives consider the staff accessible and experience social interaction with the staff [12].

External space included research that addressed the impact visual or physical access to the surroundings of the hospital can have on patients, relatives and staff. The reviewed literature documented that having the possibility to view trees and other vegetation or having access to a garden with vegetation and trees have a positive impact on both the physical and psychological well-being. Generally both patients and staff prefer spaces that allow you get a bearing of the exterior surroundings and the course of the day [37,52,11]. Access to gardens is experienced by all users of hospitals patients, staff and relatives as an important oasis that can help to reduce stress and facilitate both social interaction and privacy of the individual [53,54]. Experimental studies indicate that viewing green surroundings have a relaxing and calming effect compared with town environment of various kinds. Both assessments of physiological indicators such as brain waves, heart rhythm and self reported psychological condition suggest a calming impact [55,56,57]. This positive effect of viewing nature and vegetation includes also the ability to recover stressful situations and resistance to stress [58,59]. Being able to view green surroundings seems to be a good distraction that reduces the experiences of pain and increase the threshold of pain [22, 23]. Patients with a view to trees and vegetation used significantly less strong analgesics, had fewer notes in the journals about anxiety and excited behaviour and were discharged from the hospital faster compared with the same type of patients with a view to a brick wall.

### 6.3 Safety

The group of safety factors covered research on the impact of 'Hygiene' and 'Errors and injuries' on the outcome of both patient and staff, when it had spatial implications.
Hygiene included studies on spatial implication of how to prevent transmission of infections by contact, by water and by air.
Transmissions of infections on hospitals are primarily contact transmissions and the staff is the prime carrier. Hand hygiene is an efficient way of prevent this spread and therefore is a high level of hand hygiene among the staff important in order to reduce transmissions. Studies of the impact of the amount and accessibility of wash basins are equivocal, some results suggests that the number and accessibility increases the frequency of hand washing [60] other results suggest that is has no impact at all [61]
Another carrier of contagion are the surfaces and the contagiousness of various materials differ (how long time the bacteria can survive and how well the surface can be disinfected).
Studies of single rooms versus multi bed wards in relation to airborne transmission of infection are contradictory. Some indicate a positive effect of single rooms on the mortality and a strong correlation between multi-bed-wards and the spread of staphylococcal bacteria MSRA [62,63], whereas others found no difference between multi-bed wards and single rooms [64].

The documentation compiled under 'Errors and injuries' included studies of how to prevent patient falls, work damages and errors. The majority of damages is a result of patient's fall from the bed or around it and happens typically where there is lees surveillance and contact with the caretakers. The location of nurses work station and the system for summon help is therefore of importance [65,66].
A important way to reduce the staffs' work injuries is mechanical lifts either portable or ceiling lifts, a device that has to included in the overall lay-out [67,68,69, 70]

## 7. Conclusion and discussion

The review of the literature showed that architectural design has a healing potential. Both in a sense that the literature documented that the physical environment has an impact on the well-being of patients and staff, and in the sense that spatial features and properties such as daylight, acoustic climate, organisation and lay-out, all basic and fundamental elements in an architectural design, have an impact on patients' well-being, safety and their experience of stress.
The documentation fell in two groups of different character. The first group linked the impact of a feature or spatial property directly to improved outcome, such as shortened admission time, decreased mortality, reduced intake of drugs and so on. The second group linked the impact of the physical environment indirectly to improved outcome. This documentation linked features or spatial properties to experiences or assessments of stress, anxiety, nervousness, sleep, pain or hours of relatives present. These findings were of indirect character since they rely on research linking e.g. reduced stress or better sleep quality to better outcomes.
The research on the impact of the bodily and sensorial experience and the aspects of safety primarily were of the first type, whereas the impacts of the relational features were of the second indirect type.
Especially the impact of day light with a high intensity, a good acoustic climate that support private conversations and good sleep quality, views and access to green outdoor surroundings on pain, stress and improved outcomes were well documented in the findings.
The research findings showed that the physical environment has an impact on the experience of well-being and stress. The general picture the findings drew stressed the importance of architectural and aesthetic quality as an important factor in the creation of health care facilities and not just as a luxury of secondary priority. The findings were relevant in relation to architecture in general and were an input to an ongoing discourse on architecture and architectural quality. The implications of the findings were particularly important in relation to hospital design and other health-care facilities, where people are weak and sensitive.

## 8. References


[1] ULRICH, R S ET AL., A review of the research literature on evidence-based healthcare design. *HERD, 1*(3), 61. 2008.
[2] MALKIN J, *A visual reference to evidence-based design.* Concord, California: The Center for Health Design, 2007.
[3] HESLET, L., & DIRCKINCK-HOLMFELDT K, *Sansernes hospital*, Arkitektens Forlag; København, Denmark, 2007
[4] EILIER RASMUSSEN S, *Om at opleve arkitektur*, Arkitektskolen i Aarhus, Denmark 1997
[5] Holl, Perez-Gomez and Pallasma 1994
[6] PALLASMAA J, *The eye of the skin*, Wiley & son, West Sussex, England, 2005
[7] BLOOMER K C, MOORE, C W, *Body, memory and architecture*, Yale University Press, New Haven and London, 1977
[8] LAWSON B & PHIRI M, *The architectural healthcare environment and its effect on patient health outcomes,* NHS Estates, 2003
[9] LEATHER P ET AL.,Outcomes of environmental appraisal of different hospital waiting areas. *Environment & Behavior, 35*(6), 842, 2003
[10] MACNAUGHTON J ET AL., *Designing for health: Architecture, art and design at the james cook university hospital.* No. R & D Project B(01)13)Department of Health, 2005
[11] MROCZEK J ET AL., Hospital design and staff perceptions. *The Health Care Manager, 24*(3), 233, 2005;
[12] SHEPLEY M M, Predesign and postoccupancy analysis of staff behavior in a neonatal intensive care unit. *Children's Health Care, 31*(3), 237, 2002
[13] WALLACE-GUY G. ET AL., Evening light exposure: Implications for sleep and

depression. *Journal of the American Geriatrics Society, 50*(4), 738, 2002
[14] WAKAMURA T & TOKURA H, Influence of bright light during daytime on sleep parameters in hospitalized elderly patients. *Journal of Physiological Anthropology and Applied Human Science, 20*(6), 345, 2001
[15] RIVKEES S. ET AL., Rest-activity patterns of premature infants are regulated by cycled lighting. *Pediatrics, 113*(4 part 1), 833, 2004
[16] ALTIMIER ET AL., Developmental care: Changing the NICUphysically and behaviorally to promote patient outcomes and contain costs. *Neonatal Intensive Care, 18*(4), 12, 2005
[17] BEAUCHEMIN K M & HAYS P, Sunny hospital rooms expedite recovery from severe and refractory depressions. *Journal of Affective Disorders, 40*(1-2), 49,1996
[18] BENEDETTI F ET AL., Morning sunlight reduces length of hospitalization in bipolar depression. *Journal of Affective Disorders, 62*(3), 221, 2001
[19] BEAUCHEMIN K M, & HAYS P, Dying in the dark: Sunshine, gender and outcomes in myocardial infarction. *Journal of the Royal Society of Medicine, 91*, 352, 1998
[20] WALCH J M ET AL., The effect of sunlight on post-operative analgesic medication usage: Aprospective study of spinal surgery patients. *Psychosomatic Medicine, 67*, 156, 2005
[21] GLOD C A ET AL., Modifying quiet room design enhances calming of children and adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 33*(4), 558, 1994
[22] TSE M M Y, The effect of visual stimuli on pain threshold and tolerance. *Journal of Clinical Nursing, 11*(4), 462, 2002
[23] DIETTE G B ET AL., Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: A complementary approach to routine analgesia. *Chest, 123*(3), 941, 2003
[24] BUSCH-VISHNIAC I ET AL., Noise levels in Johns Hopkins Hospital. *Journal of the Acoustical Society of America, 118*(6), 3629, 2005
[25] FALK S A & WOODS N F, Hospital noise: Levels and potential health hazards. *New England Journal of Medicine, 289*(15), 774, 1973
[26] HILTON B A , Noise in acute patient care areas. *Research in Nursing & Health, 8*(3), 283, 1985
[27] MEYER T J ET AL., Adverse environmental conditions in the respiratory and medical ICU settings. *Chest, 105*(4), 1211, 1994
[28] SCHWAB R J, Disturbances of sleep in the intensive care unit. *Critical Care Clinics, 10*(4), 681, 1994;
[29] HAGERMAN I ET AL., Influence of coronary intensive care acoustics on the physiological states and quality of care of patients. *International Journal of Cardiology, 98*(2), 267, 2005
[30] ZAHR L. K & DE TRAVERSAY J, Premature infant responses to noise reduction by earmuffs: Effects on behavioral and physiologic measures. *Journal of Perinatology, 15*(6), 448, 1995
[31] SLEVIN M ET AL., Altering the NICUand measuring infants' responses. *Acta Paediatrica, 89*(5), 577, 2000
[32] HODGE B & THOPSON J F, Noise pollution in the operation theatre. *Lancet, 14*(335(8694)), 891, 1990
[33] SHUMAKER S A & REIZENSTEIN J E, Environmental factors affecting inpatient stress in acute care hospitals. In G. W. Evans (Ed.), *Environmental stress* (pp. 179). New York: Cambridge University Press, 1982
[34] LEHNER J ET AL., Ambient odor of orange in a dental office reduces anxiety and improves mood in female patients. *Physiology & Behavior, 71*(1-2), 83, 2000
[35] NHS ESTATES, *Ward layouts with single rooms and space for flexibility,* NHS Estates. 2005
[36] SYMON A ET AL., *The effects of the interior environment design on service users and staff in maternity facilities* No. R&DProjekt B(02)11)Department of Health, 2007
[37] HIGNETT S & EVANS D, Spatial requirements in hospital shower and toilet rooms. *Nursing Standard (Royal College of Nursing (Great Britain): 1987), 21*(3), 43, 2006
[38] LAITINEN P & ISOLA A., Promoting participation of informal caregivers in the hospital care of the elderly patient: Informal car-givers' perceptions. *Journal of Advanced Nursing, 23*(5), 942, 1996

[39] KOIVULA M ET AL., Social support and its relation to fear and anxiety in patients awaiting coronary artery bypass grafting. *Journal of Clinical Nursing, 11*(5), 622, 2002
[40] PRODROMIDIS M ET AL., Mothers touching newborns: A comparison of rooming-in versus minimal contact. *Birth, 22*(4), 196-201,1995
[41] TARKKA M T ET AL., In-hospital social support for families of heart patients. *Journal of Clinical Nursing, 12*(5), 736, 2003
[42] CHAUDHURY H ET AL., *The use of single patient rooms versus mutiple occupancy rooms in acute care environments*CHEResearch.org. 2004
[43] SALLSTROM C, Relatives' experience of the terminal care of longterm geriatric patients in open-plan rooms. *Scandinavian Journal of Caring Sciences, 1*(4), 133, 1987
[44] BARLAS D, Comparison of the auditory and visual privacy of emergency department treatment areas with curtains versus those with solid walls. *Annals of Emergency Medicine, 38*(2), 135, 2001
[45] KARRO J, Patient perceptions of privacy infringements in an emergency department. *Emergency Medicine Australasia: EMA, 17*(2), 117, 2005
[46] MLINEK E J & PIERCE J Confidentiality and privacy breaches in a university hospital emergency department. *Academy of Emergency Medicine, 4*(12), 1142, 1997
[47] OLSEN J C & SABIN B R, Emergency department patient perceptions of privacy and confidentiality. *Journal of Emergency Medicine, 25*(3), 329, 2003
[48] HOLM L, Madens betydning for patienterne. *Mad, mennesker og måltider* (pp. 279-294). København: Munksgaard Danmark, 2003
[49] SMIDT S, The socio-psychological significance of hospital meals: The impact on introduction of a new catering system in a children's cancer ward. *Scandinavian Journal of Nutrition, 40*(1), 1996
[50] VERDERBER S, Dimensions of person-window transactions in the hospital environment. *Environment & Behavior, 18*(4), 450,1996
[51] MARCUS C C & BARNES M, *Gardens in healthcare facilities: Uses, therapeutic benefits, and design recommendations.* Martinez, CA: Center for Health Design, 1995
[52] WHITEHOUSE S ET AL., Evaluating a children's hospital garden environment: Utilization and consumer satisfaction. *Journal of Environmental Psychology, 21*(3), 301, 2001
[53] HARTIG T ET AL., Environmental influences on psychological restoration. *Scandinavian Journal of Psychology, 37*, 378, 1995
[54] HEERWAGEN J, The psychological aspects of windows and window design. In K. H. Anthony, J. Choi & B. Orland (Eds.), *Proceedings of the twenty-first annual conference of the environmental design research association.*1990
[55] ULRICH R S, Natural versus urban scenes: Some psycho physiological effects. *Environment & Behaviour, 13*, 523, 1981
[56] PARSONS R ET AL., The view from the road: Implications for stress recovery and immunization. *Journal of Environmental Psychology, 18*, 113, 1998
[57] VAN DEN BERG ET AL., Environmental preference and restoration: How are they related? *Journal of Environmental Psychology, 23*, 135, 2003
[58] KAPLAN L M & MCGUCKIN M, Increasing handwashing compliance with more accessible sinks. *Infection Control, 7*(8), 408, 1986
[59] LANKFORD M G ET AL., Impact of hospital design on the handwashing compliance among healthcare workers. [Abstract]. *Clinical Infectious Diseases, 31*(1) 215, 2000
[60] MCMANUS A T ET AL., A decade of reduced gram-negative infections and mortality associated with improved isolation of burned patients. *Archives of Surgery, 129*(12), 1306, 1994
[61] BORG M A, Bed occupancy and overcrowding as determinant factors in the incidence of MRSA infections within general ward settings. *Journal of Hospital Infection, 54*, 316, 2003
[62] CEPEDA J A, Isolation of patients in single rooms or cohorts to reduce spread of MRSA in intensive-care units: Prospective two-centre study. *Lancet, 365*, 295, 2005
[63] HANGER H C ET AL., An analysis of falls in the hospital: Can we do without bedrails? *Journal of the American Geriatrics Society, 47*(5), 529, 1999
[64] VAN LEEUWEN M ET AL., Patient falls from bed and the role of bedrails in the acute care setting. *Australian Journal of Advanced Nursing, 19*(2), 8, 2001
[65] ENGST C ET AL, Effectiveness of overhead lifting devices in reducing the risk of injury to care staff in extended care facilities. *Ergonomics, 48*(2), 187, 2005

[66] CHHOKAR R ET AL., The three-year economic benefits of a ceiling lift intervention aimed to reduce healthcare worker injuries. *Applied Ergonomics, 36*(2), 223, 2005
[67] MILLER A ET AL., Evaluation of the effectiveness of portable ceiling lifts in a new long-term care facility. *Applied Ergonomics, 37*(3), 377, 2006
[68] RONALD L. A. ET AL., Effectiveness of installing overhead ceiling lifts: Reducing musculoskeletal injuries in an extended care hospital unit. *American Association of Occupational Health Nurses Journal, 50*, 120, 2002