The healing potential of architectural design

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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
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*

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<tr>
<th>Environmental factors</th>
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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 an 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 less surveillance and contact with the caretakers. The location of nurses work station and the system for summon help is therefore of importance [65,66].

An important way to reduce the staffs' work injuries is mechanical lifts either portable or ceiling lifts, a device that has to be 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

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