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Evidence-Based Design in Dutch Hospitals

Spatial qualities that can influence the health and well-being of patients

The healing environment has become a generally accepted concept within the world of hospital design. The term is frequently used by healthcare professionals and advisors (including architects). However, in the Netherlands, there is no generally accepted definition of what a healing environment is. Rather, it has become a catch-all term, and everyone seems to have their own interpretation of what it entails (e.g. colour, nature, treatment, hospitality, etc.).

Healing environment is defined on Wikipedia as a physical setting that supports patients and family through the stresses imposed by illness, hospitalization, medical visits and the process of healing. The concept assumes that the physical environment can have an impact on the amount of time it takes for a patient to recover or adapt to specific acute and chronic conditions. Thus, the term “healing environment” indicates what the ambitions are, but what makes the healing environment so “healing” is still not clear.

The healing environment owes its credibility to the scientific foundation laid by Evidence-Based Design (EBD). This study is focused solely on the aspects of the healing environment that have had a proven effect. EBD research considers whether the hospital environment can have a positive effect on the health and well-being of patients. In this study, the healing environment is approached exclusively from the EBD perspective. This means that only concrete spatial qualities that have had a proven positive effect on patient health and well-being have been selected from the scientific literature on EBD.

For centuries, hospitals were founded from different perspectives and with various interests in mind, but generally not with the goal of curing patients. In the Middle Ages, caring for the sick was considered a duty of faith, and in the 17th-18th century, hospitals were primarily used to care for the poor, who posed a threat to social security. Hospitals have been built to serve wounded soldiers (e.g. Les Invalides in Paris) or to quarantine the sick for fear of infection. In the Renaissance, doctors and students studied the human body in the anatomical theatres at universities, but not with the aim of using the knowledge they acquired to treat the sick. It was not until the mid-19th century, when surgery and medical research improved by leaps and bounds (with e.g. the discovery of bacteria, anaesthesia, antiseptic, sterilisation, penicillin and X-rays), that the hospital as we know it today began to develop. For a long time, however, hospitals neglected to consider the positive influence that environmental factors can have on patients. In the 1960s and 1970s, that began to change as the concept of "patient-centred care" emerged. Research fields such as neuroscience, psychology and psych-immunology developed into sciences and linked the physiological effects of stress to the individual's ability to recover. From then on, health was seen as a state of complete physiological, mental and social well-being and not just as the absence of illness.

Evidence-Based Design
In the 1990s, the term Evidence-Based Design was first used to describe design solutions in healthcare that were based on published research. Since then, the influence of the physical hospital environment on patient health has received academic attention, and a growing body of EBD knowledge is now available. Drawing from Evidence-Based Medicine, EBD attempts to analyse the health effects of the built environment in a similar way. It involves complex and detailed research that aims to establish the relationship between one isolated measure (with all other factors excluded) and the health and well-being of the patient. In this thesis, we will focus solely on physical spatial qualities that have been validated by EBD expert groups and are thus effective regardless of their context.

The literature review is approached from the following three categories:

Health
Medical errors and hospital bacteria have become serious threats in hospitals. Improving patient health is one of the most important angles of EBD research on the hospital environment. The main focus is patient safety: the patient should not become sicker in hospital due to conditions he or she did not have at the time of admission. This category is also important for the health care sector; after all, the risk of additional medical care and longer hospital stays can lead to higher costs.

Well-being
There is a relationship between increased patient well-being and physical recovery. Studies show that as patient stress is reduced, well-being is improved. Stress has a negative influence on the patient's physical recovery. If this influence can be positively reversed, it can have a positive effect on the patient's health: blood pressure and heart rate go down, medication use (pain and sleep medication) can be reduced, and hospital stays can be shortened. Increased well-being also has a positive influence on patient satisfaction.

Patient care
This study considers environments that have been scientifically proven to improve staff efficiency. When staff are able to carry out their work efficiently and effectively, they can provide better, more direct care to patients. And given that patients who receive more direct care recover more quickly, this has a positive impact on patient health. This category is particularly important because, if the environment is able to increase staff satisfaction, the hospital can become a more attractive employer and potentially reduce the absence of staff due to illness or burnout.

For this thesis, a new, specific layout and structure of the literature was needed to obtain a thorough overview of the various themes and topics. The structure is as follows:

1. Problem - 2. Explanation - 3. Architecture - 4. Interior - 5. Miscellaneous

For example:
1. Patient is sleeping badly, usually only a few hours a night.
2. Sleeping promotes the healing process; however, patients are often awakened by noise from fellow patients or staff. Thus, patients ask for sleep medication; patients become less satisfied.
3. Day and night rhythms are stimulated by windows with daylight, as well as by single rooms.
4. A soft acoustic environment with sound-absorbing materials.
5. Avoid squeaky curtain rails and trolley wheels.

In practice, this set-up is a very effective way to engage hospital professionals in a conversation, because it makes the connection between what they know (1 and 2) and the language of the architect (3, 4 and 5).

Some topics come up in all categories because one aspect can have different effects; sometimes the meas-

Single bed rooms at the Tergooi Hospital in Hilversum

ures are the same but not always. Because the literature review considers the patient its starting point, the spatial qualities assessed all have to do with patient-related spaces (e.g. waiting room/consultation room at outpatient clinics, nursing wards, patient rooms, day treatment rooms) and not with the integration of the building into the landscape, the layout of the building as a whole, etc.

1. Improving patient health

In EBD literature, the emphasis is often on patient safety and physical recovery, for which treatment is, of course, paramount. Yet in all cases, the goal is to make sure that the patient does not become any sicker while staying in hospital than he or she was at the time of admission.

In this regard, there are three points of focus: reducing hospital-acquired infections, reducing medical errors, and reducing falls.

1.1 Reducing hospital-acquired infections

There are three routes of infection in the hospital:

- Airborne contamination: Many of the measures to fight airborne contamination are related to air quality. These include requirements for air filtration, air ventilation and air flows. The single-patient room is one of the most significant architectural measures we can take to reduce airborne contamination.
- Contact contamination: This occurs via contaminated hands and surfaces. The hands of staff seem to be the most significant source of contact contamination. Thus, the presence of easily accessible and logically placed washbasins and hand sanitizer dispensers can promote frequent hand washing. When it comes to preventing contact contamination, single-patient rooms with private bathrooms seem to be the better choice as well. In terms of materials, hard floor finishes seem preferable, but material choices are directly related to the manner and frequency of cleaning procedures, which are outside of the architect's control.
- Water contamination: Most measures involve the proper installation and maintenance of the hospital's water supply system (W-installations). The presence of clean plastic glove dispensers is a measure that can be taken in this respect.

1.2 Reducing medical errors

Medical errors are defined as the failure to perform a planned action or the application of a wrong plan to achieve a goal. The four environmental factors mentioned in relation to medical errors are:

- **Acoustics**: Noise affects concentration; noise can cause distraction. All mental activities are sensitive to noise. Thus, it is important that the working environment not be noisy.
- **Light**: The quality of the execution of visual tasks increases when light levels are improved. The number of lux, the CRI (colour rescue index) and CCT (correlated colour temperature) are standards that have to be carefully determined with the E-consultant.
- **Acuity adaptable single rooms**: The application of this measure is gaining ground. The greatest risk of medical errors is caused by transfers, and acuity adaptable

Sense of safety: Het Gasthuis reception area at the Antoni van Leeuwenhoek Hospital in Amsterdam

rooms reduce this risk. It is estimated that acuity adaptable rooms reduce medical errors by 67%. The design of the room must meet a number of requirements.
- **Department layout**: Having a standardised layout for treatment rooms, patient rooms, and departments reduces the risk of errors, as does having decentralised nursing posts and sufficient working space where staff can work undisturbed in a non-chaotic environment.

1.3 Reducing fall incidents

According to the literature, the percentage of patients who fall during their hospital stay with the risk of serious consequences is 4 to 17%. The two rooms with the highest incidence of falls are:
- The patient's room: Fewer falls are reported in single rooms where there is good nurse supervision (thanks to decentralised nursing posts) and where the presence of the patient's family in the room is encouraged.
- The bathroom: A spacious bathroom with a wide door opening, good use of materials, support handles and proper application of sanitation height guidelines can help to prevent falls.
  The use of bed gates seems to increase the risk of serious falls, and the use of handrails also seems to compel patients to try walking on their own when they should seek help.

2. Promoting patient well-being

Our knowledge of the extent to which the physical spatial environment influences our lives and behaviour is still fairly limited. The less competent an individual is, the greater impact environmental factors can have on that individual. When a person is sick, his or her adaptive capacity is reduced. This implies that patients can benefit from a reassuring, calming and positive environment.

Almost all measures examined from an EBD perspective serve to reduce stress in patients and thus contribute to positive health outcomes. There are five aspects that have an impact on reducing stress and promoting well-being:
- Basic physiological needs
- Privacy & control
- Social support
- Positive distraction (nature, windows and views, aesthetically pleasing environment)
- Reduction of negative emotions (crowding, orientation & wayfinding, noise).

2.1 Basic physiological needs

Being sick makes people very vulnerable. When sick, people are often unable to meet their most basic needs by themselves. This can cause stress, which can in turn lead to other negative outcomes. For this reason, hospital buildings should be designed to promote the following:

Social support: Oncology department at the Tergooi Hospital in Hilversum

- Sense of safety: In terms of physical safety, the building should be designed in such a way that patients (including those with a physical disability or impaired vision/hearing) can use it safely. In terms of psychological safety, the building should give the feeling of protection and make people feel confident that help will come if needed. This is one of the reasons why patients appreciate having a clear view of the nursing station. Other important factors include safe access routes with sufficient light and social control.
- Sleep: People who have been admitted into hospital have an increased need for sleep. In the hospital environment, however, they often experience a reduced day-night rhythm and thus sleep poorly. This can lead to increased stress, which can hamper the healing process. Design solutions include using single rooms, separating front-back office areas, providing sufficient daylight and creating an acoustically soft environment.
- Light: Studies show that patients housed in sunny rooms have shorter hospital stays. The presence of ample daylight in rooms where patients stay for an extended period of time and the presence of accessible outdoor areas can have a positive influence on patient well-being. The use of artificial light and even light therapy are also included in this category of measures.

2.2 Privacy & control

Control over one's own environment is a starting point for patient-centred care. This means that the patient has choice, a fundamental aspect of environmental psychology. Privacy is the right to keep personal matters to oneself and the process of setting interpersonal boundaries by which one can regulate communication with others.

- Spatial qualities that increase the sense of control are those that offer spatial complexity, more options, and variations in the design. In terms of design, this means avoiding the appearance of a large-scale, sterile environment, uniformity in colours, materials and furniture, and an institutional character.
- It is also possible to provide freedom in the choice of daily rituals, for example by offering a pantry where patients can grab something to eat or drink for themselves. Other measures mentioned in EBD research in clude providing information and installing bulletin boards that patients can personalise.
- A lack of privacy can be experienced both audibly (e.g. information that is unintentionally shared with others because there are only bed curtains or no privacy at a reception desk) and visually (e.g. patients do not feel safe during an examination). Single rooms with private bathrooms contribute to the feeling of privacy. In day treatment clinics, a feeling of privacy can also be created through half walls and cubicles.

Social support: Lounge at the Slingeland Ziekenhuis in Doetinchem

2.3 Social support

Social support is the emotional, informative and tangible/practical support that a patient can receive from family and friends during a period of severe stress. Recently, this has been referred to as family-centred care. A growing body of evidence shows that healthcare workers are most effective when they work in well-functioning teams, with the active participation of patients and family. Social support is important for patients throughout the hospital. Important questions include:

- Is there room for family (in the waiting room, patient rooms, and multi-person spaces)? Do these spaces offer comfortable furniture and sufficient privacy for family members to stay with the patient?

2.4 Positive distraction

Distractions can awaken the senses, calm the mind and reduce stress. The physical environment should have a certain degree of stimulation but not too many stimuli (e.g. too much sound, light, bright colours). On the other hand, the level of stimulation shouldn't be so low that patients become bored or depressed. Factors to consider include:

- Nature: The presence of visually and physically accessible gardens can reduce stress. The use of a soft col our palette, harmonious colour schemes, naturally warm and cool colours, wood and wood tones, and natural materials can serve to mimic nature. The presence of plants indoors can have a positive effect, and EBD research has yet to find any evidence that bacterial organisms in potting soil can cause infection. Alternatives to plants include images of nature or alternative ways of imitating nature.
- Windows and views: Large windows with an attractive view of a sunny, natural spot provide patients with a visual connection to the outside world. The positioning of the window in relation to the patient's line of sight should be carefully considered. For internal spaces, fake windows can be created as an alternative.
- Aesthetic appeal: Providing distraction and activity can help patients continue their daily activities as much as possible and spend less time thinking about their illness. The architectural environment can contribute to the treatment of patients and significantly influence their health outcomes. Patients are sensitive to and outspoken about their architectural environment. A hospital can offer facilities such as a lounge, shop, meditation room or restaurant. It is recommended that hospitals provide a comfortable, aesthetically appealing environment that makes use of well-orchestrated colour components, light finishes, and texture in an effective combination to create a cohesive visual whole. EBD talks about the creation of a hotel-like environment, one that is nicely decorated and does not have the sterility and uniformity of a large institutional environment. Spaces should be

Positive distraction: Child-friendly dressing change room at the Maasstad Hospital Burn Centre in Rotterdam

clean and tidy, and medical equipment should be kept out of the patients' sight as much as possible. Artificial light should be adaptable to the room's function and used to create the desired effect. Incorporating art, smell or music into the design can also contribute to the creation of an aesthetically pleasing environment.
- Suppress negative emotions: Patients prefer rooms that are large enough that they do not have to be close to strangers and that allow them to choose how they want to use the space (e.g. together or alone, open or closed). EBD lists various measures at the building level that can help with orientation. One of them is differentiation and variation in the building. Finally, stress is a negative emotion that can be caused by noise. Again, the use of single rooms and sound-absorbing materials are good solutions for reducing stress.

3. Improving the effectiveness of staff

The literature shows that the sufficient presence of nursing staff and the amount of time that nursing staff are able to devote to direct patient care are two factors that can improve patient outcomes. There are four areas of focus:
- Reducing injuries and illness
- Reducing stress
- Improving effectiveness and efficiency
- Improving satisfaction

3.1 Reducing injuries and illness

When staff become injured or ill, this results in a lower care-to-patient ratio and/or a more exhausted and stressed workforce. This can affect the quality of patient care. Therefore, the following should be avoided:
- Infections: The same measures that are adequate for the prevention of infections in patients appear to be adequate for staff as well.
- Back problems: Special attention should be paid to the establishment of good health and safety practices in the workplace, the provision of spacious bathrooms with wide doorways, the use of patient lifts, and measures to help restore the biological clock for staff on night duty.

3.2 Reducing stress

Environmental measures that can help reduce staff stress include the use of single rooms and the provision of sufficient workspaces (with different types of spaces for different activities and with the front and back office zones separated from each other). Using smaller units with visual accessibility and avoiding long corridors are additional measures mentioned in EBD research. The prevention of noise nuisance and the provision of sufficient daylight and good levels of artificial light are also important elements of a good working environment.

Reducing stress: Central break room in the UMCU Intensive Care Unit where staff can meet and relax during their long shifts

3.3 Improving effectiveness and efficiency

Nurses spend less than half of their time providing care. Measures to promote staff effectiveness include:

- Nursing unit layout: The nursing unit layout (radial, single- or double-aisle structure) affects the amount of time spent walking. When nurses spend less time walking, they can spend more time on patient care activities and interaction with family members.
- Standardization: Staff can work more efficiently in departments and rooms with standardized floor plans.
- View of the patient: The positioning of the bathroom or patient bed can allow for good visual contact between the nurse in the corridor and the patient; this can also shorten walking distances.
- Decentralised nursing posts: The decentralisation of nursing stations reduces walking distances and significantly increases time for observation and patient care. However, it also requires separate central break rooms and consultation rooms.
- Decentralised supply storage: By decentralizing supply storage and bringing supplies closer to patients, less time is wasted, which means less fatigue and a quicker distribution and replenishment of medical supplies.

3.4 Improving satisfaction

A dissatisfied staff is much less likely to provide excellent care. A lack of support from the physical environment can make already stressful working conditions even worse. Therefore, the following factors should be taken into consideration:

- Nature: Accessible gardens offer a brief escape from the stressful work environment. Staff can use the garden to interact with colleagues, find privacy and recover from stressful situations at work.
- Daylight: Staff are sensitive to whether or not they have a window with a view of nature.
- Break room: There should be a separate break room with a dining area where staff can sit and relax (preferably with a window).
- Design: A pleasant and attractively designed work environment can have a positive effect on staff.

Field research

The literature review provides insight into problems the patient may face (e.g. lack of sleep) that could be improved by physical spatial interventions. These elements are gathered in a checklist, which provides a total overview of the validated spatial qualities. The list makes clear which positive effects can be attributed to which spatial qualities.

Some interventions, such as the single-patient room, are significant because they help solve a number of problems, while others occur only once and help solve one specific problem. The checklist is used in each of the case studies to consider how EBD has been applied in recently built Dutch hospitals. Nine hospitals were

View of the patient: Department of Intensive Care Amphia in Breda

visited in the field study (Orbis Medisch Centrum Sittard, Isala Clinics Zwolle, Meander Medisch Centrum Amersfoort, Jeroen Bosch Hospital Den Bosch, Flevo Hospital Almere, Maas Hospital Pantein Boxmeer, Deventer Hospital, Bright Sites VUMC Amsterdam and Alexander Monroe Clinic Bilthoven). The aim of the case studies was to gain insight into:

- The extent to which and the way in which the selected measures have been applied.
- The consequences that these measures have on architectural quality.

The case studies provide answers to the following questions:

- Does the frequent use of terms such as “healing environment” indicate that effective design measures are actually being applied?
- If certain aspects of EBD have been applied, how has this been carried out?

In addition, five hospitals were analysed during the design and construction phase (Erasmus Medisch Centrum Rotterdam, Medisch Spectrum Twente, Zaans Medisch Centrum Zaandam, Tergooi Ziekenhuis Hilversum and Medisch Centrum Alkmaar).

Architectural quality

From the architect’s perspective, the demand for architectural quality is particularly relevant. EBD literature provides limited guidance on architectural quality. Most starting points relate to the interior (such as variation and differentiation). There are a number of EBD articles that describe an aesthetically pleasing environment, hotel-like interiors and well-decorated spaces, thereby acknowledging the importance of design quality. This study considers architectural quality separately and makes use of standard architectural vocabulary and common architectural analysis methods, such as programme, spatial structure and specific coherence (clarity and legibility).

The space (e.g. the waiting room, consultation room, nursing ward, patient room and day treatment room) is analysed, and then the analysis is compared with observations from the field study. When it comes to architectural quality, consensus tends to shift over time depending on the current trends and culture. This can be seen in architecture prizes, awards and (international) trade publications. Compared to the aesthetic and spatial quality see in national trade publications, many interiors of recently built hospitals have a familiar appearance and a level of design that has been considered characteristic of hospitals for many years. In this sense, when it comes to interior design, hospitals seem to limit themselves, both in terms of functionality and architectural quality.

Conclusion and recommendations
Evidence-Based Design provides functional requirements that can be incorporated into a Programme of Requirements. This knowledge is relevant for healthcare managers and their external advisors, particularly architects. With knowledge of EBD measures, the architect can achieve the desired positive effects in the care environment. In a functional programmatic sense, conflicts between architecture and EBD have been regularly observed in field research. The field research carried out for this study has led to the conclusion that many spatial qualities of EBD are not being applied, namely:

- **Daylight and views**: It was found that most hospitals surveyed still have many internal rooms with no natural daylight. It is also not unusual for the patient's view of the outdoors to be obstructed by furnishings or layout.
- **Nature**: Almost none of the hospitals surveyed had an easily accessible (indoor) garden that patients and staff can use.
- **Patient rooms**: More than half of the hospitals surveyed have multi-person patient rooms with shared sanitary facilities. In almost all cases, there was no solution to offer the patient any form of privacy, control, positive distraction or social support.
- **Interior design**: The majority of hospitals surveyed have rooms with an institutional character that patients and staff spend a lot of time in. In many cases, equipment and supplies did not to have a fixed place in rooms, making the rooms appear messy and unattractive.

The research shows that EBD can go hand in hand with architectural quality. The spatial qualities inspired by EBD do not inhibit architectural quality in any way. Many of the hospitals from the field study have a large, impressive entrance or atrium, decorated with beautiful materials and special fixtures. However, if one goes deeper into the building and enters the rooms where patients stay for longer periods of time, a clear institutional character emerges.

The functional and programmatic guidelines from Evidence-Based Design provide the architect with a lot of direction for designing better hospitals. The EBD guidelines that relate specifically to architecture are valuable for the architect as well. Field research has shown that many EBD guidelines are still not being applied in hospitals. It is recommended that both the care industry and architects alike embrace the solutions proposed by EBD, so that positive effects for patients can be achieved.

TU Delft Architecture and the Built Environment
2016 dr. ir. Milee Herweijer-van Gelder
ISBN 978-94-6186-632-5

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