

The Effect of Hospital Building on Patient Recovery

Rotraut Walden



Rotraut Walden, PhD

Dr. Rotraut Walden's major fields of research are Architectural Psychology as well as Work and Organizational Psychology. She works for the Institute for Psychology at the University in Koblenz, Germany where she holds a tenure position, and has been a member of the Environmental Design Research Association (EDRA) since 1989. Her research focuses on Building Performance Evaluation, the development of questionnaires and systems to judge hospitals, schools, office buildings, and universities. Her methods require Post-Occupancy Evaluation and User Needs Analysis. She is the author of the books "Lively Dwelling: Development of Psychological Guidelines for Housing Quality" as well as "Happiness and Unhappiness. Experiences of Happiness and Unhappiness from the Interactionistic Perspective" and the co-author of "Psychology and the Built Environment", "Places for Children" and "Schools of the Future".

Problem: Value and importance of hospital design

Health underpins both work performance and well-being. The built environment affects health to a great extent; Sick Building Syndrome can make us ill. Functional demands have long ceased to be the only concern when constructing hospitals. Patients and visitors should, increasingly, link recovery and well-being with the building itself and therefore should develop a positive image of the hospital. Design is also

used as an effective marketing tool that builds trust with patients and visitors and should convey a sense of reliability; or, in other words: "Quality architecture will give the image of quality care." In *Design That Cares* by Carpan and Grant (1993), a series of guidelines is listed that has also been applied in the course of this study at three clinics in the Kemperhof Hospital in Koblenz.

In our article, we researched a surgical ward, a women and pediatric clinic with regards to the connection of building features with recovery of patients, productivity of the employees and well-being of all users. The methodological approach of this study uses post-occupancy evaluation (POE), knowing fully well that this is just one step of the International Building Performance Evaluation (BPE) which refers to the complete life cycle of a building (Preiser & Schramm, 1997, 2005; Preiser, 2005; Preiser & Vischer, 2005). Despite conducting just a POE in our study, we develop a methodological structure for our questionnaire in the facet approach (Borg & Shye, 1995) and accomplish a system to judge hospital quality (cf. Walden, 2005) on the basis of qualitative and empirical data. In our opinion both steps help to further our progress in the methodology which is connected with BPE.

The Kemperhof Hospital

The Kemperhof Hospital is funded by the town of Koblenz. Kemperhof is an acute hospital for focussed care with nine main fields of expertise and a total of 641 beds, making it the largest hospital in the region with over 1.000 employees.



Figure 1 View of the Kemperhof Hospital in Koblenz/ Germany

Clinics/Departments	number of beds	doctors
1. Surgery	155	20
2. Anaesthesiology	(interdisciplinary)	24
3. Medical clinic I	100	14
4. Medical clinic II	102	20
5. Radiology	5 special beds	12
6. X-Ray		30 (together with Radiology)
7. Women's clinic	64	13
8. Pediatrics	90	19
9. Urology	78	12

Table 1 Kemperhof Hospital – number of beds and doctors on each ward

In close proximity to the main building at Kemperhof there is a helicopter landing pad. The town hospital of Kemperhof in Koblenz is an academic teaching hospital for the University of Mainz.

First hypotheses

- 1) The judge's assessment of aspects which are linked with environmental control of patients and personnel will be reported.
- 2) A preference ranking shows the patient's assessments of the building's quality.
- 3) Personnel and patient's quality assessment differs concerning the hospital's building characteristics.
- 4) Design and environmental control in the building have a measurable correlation with the performance of the personnel and the recovery

of the patient as well as the general well-being of both parties. The assessment of recovery raises when a high judgement of well-being comes along with it.

5) Qualitative and empirical specifications for important design characteristics are the basis of our system to judge a hospital's quality.

Procedure: Facet Approach, Rating Scale, Sample

The structure of the assessment sheet draws itself from the figure 1 of the so-called category groups. These in this structure of so-called facets are the fundamentals for the creation of the questionnaires.



Figure 2 Mapping Sentence to Judge the Subjective Effect of Hospital Design on Recovery, Well-being, and Performance (cf. Walden, 2005)

At the end of each section of questions, space was left available for participant's individual thoughts.

Sample: To begin with, 34 student assessors from the University of Koblenz were questioned "in situ", along with 42 independent assessors using photographs (242 items), 28 patients and 28 staff members using 84 items. Completing the questionnaires took up to 2 hours for all 242 items.

Results

In the first description of our results for student assessors "in situ", we focussed on the evaluation of environmental control and the overall assessments: performance of the staff, recovery of patients and the well-being of both groups. Environmental control means positive or negative design aspects that patients themselves. In the second part of the descriptions of our results, the

feedback for the hospital planners is given from the view point of patients and staff followed by a summary with detailed comparisons of the results from the four groups of assessors.

Student assessors "in situ"

The goals set for health, performance and well-being are fulfilled to a particular degree in the pediatric and maternity departments. Surgery follows with around 1 rating scale value for poor assessment. In particular, there is a need for improvement in the aesthetic appearance of the surgical department and in its functionality.

Correlations in the answers

Aided by Pearson-Product-Moment-Correlations, it should be determined, for example, whether there exists a connection between well-being and the quality of the hospital from the assessor's point of view. Correlative values with a significance level viewed at $p < 0.01$.



Figure 3 Decorations for little patients at a staircase in the pediatrics ward

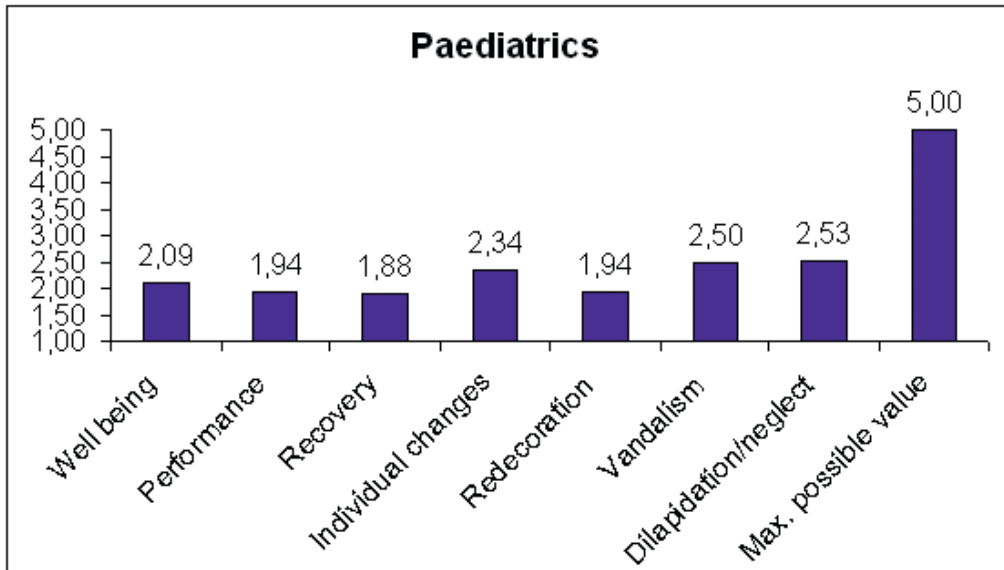


Figure 4 Assessment “in situ” by student assessors (Number of individuals/N=34). The questionnaire includes 242 items. Mean values on a scale reach from 1 = very good to 5 = very poor.

Because of the abundance of these values we have only analysed highly significant correlative values over 0.7.

About hypothesis (4):

The assessors estimate the performance of the staff at a higher rate when the level of well-being is also high ($rx_y=0.78$). From the point of view of the assessors, the greater the subjective opportunities for design and control on the part of the staff and patients (for functional improvements and aesthetic appearance), the higher the level of staff and patient well-being ($rx_y=0.72$).

Personal information from those questioned using the photographic assessment (N=42)

In all, 42 people were questioned as independent assessors. The evaluation is considered in the conclusion. A more exact representation has been left out due to space restraints.

Patients (N=28)

28 patients filled the questionnaires with 84 items out (N=28). They are divided up as follows:

- paediatrics: 8 subjects (four children; four adults)
- Surgery: 9 subjects
- Women’s clinic: 11 subjects

The most positive and most negative items in descending and ascending order of mean value, as well as significant differences in the ratings given by staff.

In the following paragraph the items that were rated in all three departments as (very) good and (very) poor should be viewed. Along with these, the top ten best and ten worst features of the paediatric clinic were considered.

First, the items (features) rated as very good or good in all three departments are described (table 2, table 3, table 4) Altogether, the women’s clinic has the best ratings from patients, followed by the surgical ward, with paediatric clinic

Table 2: Pediatrics		Significantly poorer ratings from staff t-Test ($p < .05$)
Item	Mean	
Lockable cupboards/lockers available for staff	1,00	
Central heating that can be regulated in patients' rooms	1,25	2,80
Natural light in patients' rooms from windows	1,38	2,08
Corridors of the clinic are bright and decorated	1,50	
Through corridors in the clinic are sufficiently wide	1,50	2,83
Staff allowed to brighten up lounge areas	1,50	
Floor covering ensures safe movement	1,63	
Shade from sun available in patients' rooms	1,75	
Sisters' offices located centrally	1,75	
Map of hospital located in main entrance	1,86	
Brightening up or redecoration of exterior and grounds by patients and staff	3,60	
Changes in main entrance made by staff and patients	3,67	
Handrails suitable for children and disabled	3,67	
Patients' rooms not overcrowded	4,00	
Smokers' room/zone available for visitors	4,00	
Telephones available in patients' rooms	4,00	
Sufficient number of public telephones available in the main entrance	4,14	
Privacy facilities available outside	1,17	
Privacy facilities available in main entrance	4,17	
Adjustable seating available in main entrance	4,80	

at the bottom of the scale.

Connections in patients' answers (development of correlations) (hypothesis 4)

From the patients' point of view, we can see that a real connection exists between the well-being of the patients and staff performance ($r_{xy} = 0.91$). In addition, it could be substantiated that well-being and recovery are clearly linked ($r_{xy} = 0.84$), as well as a connection between staff performance and patient recovery ($r_{xy} = 0.94$).

Staff members (N=28)

Questions concerning staff members' personal information

28 questionnaires returned from the following clinics: Pediatrics (N=12), Surgery (N=11), Women's clinic (N=5) Short summary of results obtained. It is striking that in the assessments of clinics by the staff, pediatrics does well, with the most positive values (1.92-2.5). Surgery, on the other hand, is rated as the worst clinic in comparison, with the lowest score of positive values (2.3- 2.5), and also the most negative value of 4.73 (adjustability of seating). Pediatrics was judged completely differently by the staff and patients. However, it must be noted that the positive assessments made by patients overall clearly outweigh the negative ones. Negative

assessments dominate in the staff's responses. The staff assessments and those of the student assessors are therefore very similar, but are based partly on different impressions of individual features.



Figure 3 Two available seats in the main entrance

The following aspects were rated positively by all three clinics:

- The sisters' office being located centrally
- Patient rooms all having access to natural light
- Staff and users being able to make functional changes and can modify the aesthetic appearance

These aspects should be maintained as a result.

The following aspects were rated negatively by all three clinics:

- smoker's room
- few privacy and recreational facilities
- few seating facilities in the main entrance
- sign-posting and direction signs throughout the hospital as a whole were also criticized
- generally, the staff assessed many aspects more critically than the patients (compared with t-Tests).

Connections in the answers (development of correlations) (hypothesis 4)

The same stipulation applies to the examination of correlations that applies to the other studies (that is, only correlations with high significance

are used [$r_{xy} > \pm .60$]).

Clinics (design)

The overall impression of the hospital contributes to good staff performance, which is connected to well-being (0.88). The overall impression of staff performance in clinics shows connections between individual improvements in aesthetic appearance (0.68), the existence of personal items (0.65) and the overall impression of well-being (0.89) – from this it is understood that some redecoration and personal items increase well-being, which undoubtedly also has a subjective influence on the estimations of staff performance.



Figure 4 Decorations by a medical doctor

Conclusions for the construction and alteration of hospitals

In every hospital, the building blocks for success are good staff performance, patient recovery that is as fast as possible (proven by a high quota of success rates), and the well-being of staff, patients and visitors. Since a hospital's architectural design has an effect on staff performance, patient recovery and the well-being of staff, patients and visitors, future hospital construction or renovation projects should give the same amount of consideration to the architecture of the building that is given to its medical equipment and furnishings. This conclusion is based on the subjective assessments of four groups of people, not on objective data. To collect objective data to add to this is a task for future evaluations of this kind. As a result, using a posi-

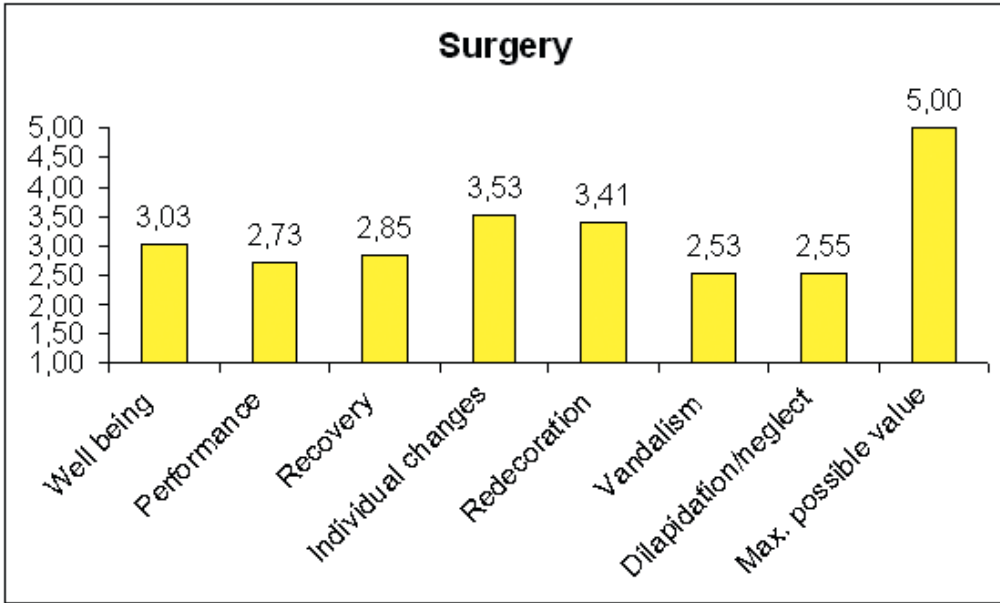


Figure 5 Assessment “in situ” (N=34). Mean values on a scale reach from 1=very good to 5=very poor.

tive architectural design could raise employee performance, record shorter lengths of stay for patients in the hospital’s annual report through its positive influence on recovery times, and in addition, increased levels of well-being in the hospital would leave staff, patients and visitors alike with a more overall positive impression of it, under which certain circumstances could result in a better image of hospitals as a whole being expressed amongst the general public.



Figure 6 Surgery examination room without decorations

There are numerous architectural features that can influence the named aspects of recovery, performance and well-being. These have already been listed in the summary of results. The most important features can be found in the following tables; what significance they have for outsiders, patients or staff is variable.

However, the clues of the varied meaning of the characteristics inform the concrete results of our empirical study. The meaning of the characteristics can, however, appear completely different in other hospitals when the specific problem situation is taken care of. What is more important is the development of a procedure to assess the quality of the hospitals that provides a pool of judgement criteria for hospitals all together. On the basis of such a system, new surveys and tests could always be generated that would then be tailored to the corresponding local situations. The effects of the design features on the

Table 3: Surgery		Significantly poorer ratings from staff
Item	Mean	
Telephone available in patients' rooms	1,56	
Lockable cupboards/lockers available for staff in the clinic	1,60	
Sisters' offices centrally located	1,67	
Staff allowed to brighten up the lounge	1,71	
Patients' rooms are suitable and friendly	1,75	
Main entrance is clean and hygienic	1,78	2,73
Patients' rooms not overcrowded	1,78	
TV and radio available in patients' rooms	1,78	
Plugs, light switches, emergency call buttons available in patients' rooms (ease of use and functionality)	1,78	
Natural light through windows in patients' room	1,78	
Adjustable seating available in main entrance	3,63	4,73

Table 4: Women's clinic		Significantly poorer ratings from staff
Item	Mean	
Natural light in patients' rooms from windows	1,00	2,40
Sisters' offices centrally located	1,25	
Central heating that can be regulated in patients' rooms	1,38	
Shade from sunlight available in patients' rooms	1,55	3,00
Lighting in patients' rooms is suitable for patients	1,55	
Telephone available in patients' rooms	1,55	
TV and radio available in patients' rooms	1,55	
Staff allowed to brighten up the lounge	1,60	3,00
Fittings available in baths for easy use	1,73	
Effect of overall impression of the clinic on staff performance	1,78	
Library available	3,50	
Comfortable seating areas available in main entrance	3,60	
Sufficient number of public telephones available in main entrance	3,73	
Personal items allowed in lounge	3,80	
Privacy facilities available in lounge	4,00	
Adjustable seating facilities available in main entrance	4,33	

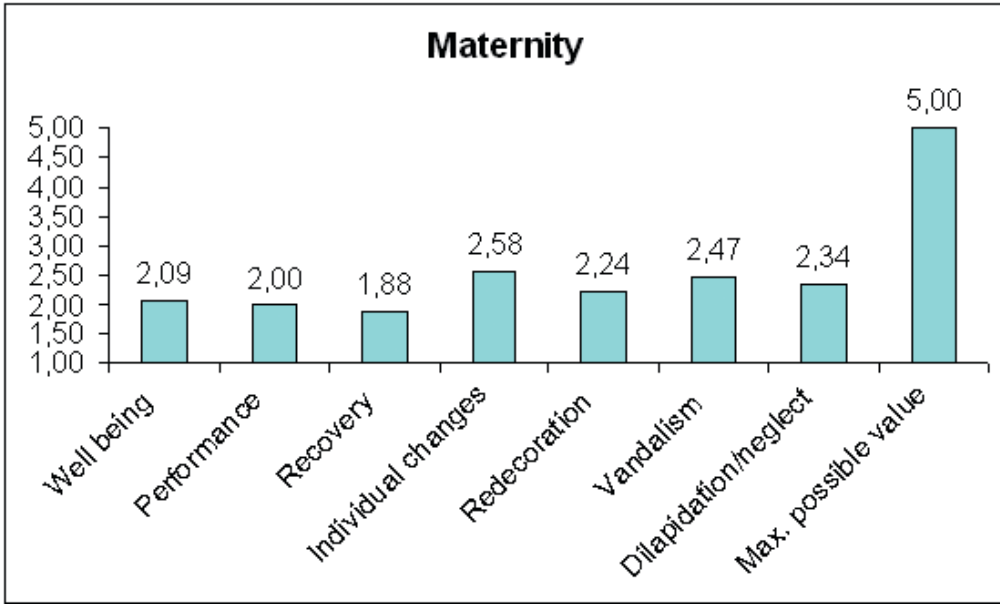


Figure 7 Assessment „in situ“ (N=34). Mean values on a scale reach from 1 = very good to 5 = very poor.

recovery, performance and well-being should be checked with a greater random sampling (N>30 per group) and with the help of calculation through the regression analyses (cf. Walden in preparation).



Figure 8 Sign pointing to the delivery room

System to judge the quality of hospitals

The elements of the system to judge hospital quality were developed based on the important

design features which are mentioned in the literature (Carpman & Grant, 1993; 2002; Dilani, 1999; Reizenstein Carpman, Grant & Simmons, 1985; Monz & Monz, 2001; Shumaker & Reizenstein, 1982; Walden, 2005; Zimring, 1994) and on the results of interviews with experts containing exploratory questions such as: Which mistakes should be avoided;

Which aspects of the building as it stands now can be judged positively;

Which particular aspects do you consider to be most important for future hospital buildings...?

Hospital environments can be assessed using four criteria, namely the functional, aesthetic, social, and ecological. These criteria are developed by applying the basic central themes of architectural trends, such as “form follows function” to architectural psychology. What is meant by this is that functional aspects save time and energy; for example, layout, wayfinding and quality of materials. Aesthetic design results in feelings of beauty or newness. Social-physical aspects can result in conflicts that arise from si-

multaneous use of one setting by multiple parties (for example concentrated work disrupted by someone using a pneumatic drill in the vicinity) or in opportunities through communication. Ecological aspects mean that the consequences of a building's existence are taken into account - from breaking ground and recycling, to health concerns.

The structure in the Mapping Sentence also followed these 4 criteria.

Table 5: System to judge the quality of hospital buildings (cf. Walden, 2005)

However, a hospital's architectural features are not the only things that can affect recovery, performance and well-being. The present study has shown that opportunities for designing and controlling the building and for organization, from the perspective of staff and patients, can also have an effect on staff performance, patient recovery and on the well-being of both groups (cf. Burger, 1992, S. 171; Clements-Croome, 2000; Ehlers, Greisle, Hube, Kelter & Rieck, 2003; Voordt, 2004).

Improvements are desirable for patients with all types of influences in an individual's environment from the opportunity to be able to relax (privacy), to the operation of everyday objects such as lighting, heating, air-conditioning, television, radio, blinds and bed etc., and the influence of personal design touches – for example, displaying or putting up personal things or being able to influence decision-making). The opportunity for staff and patients to design or control elements such as these should be granted to a much greater extent in the future, in order to produce a positive influence on the different aspects of recovery, performance and well-being.

Conclusion: Achieving perceptible changes and effects form part of people's well-being and recovery. Only data from all involved individuals in a multi-method-approach forms a complete overview of the running of a facil-

ity.

Furthermore, the data should be appraised concerning the economic benefit of improvements of the architectural design in the future targeted through BPE's

Gifford (2002, p. 371) reported that an investment in workspace design can result in a productivity improvement of between 10 and 50 per cent; and Brill, Margulis, Konar & BOSTI (1984) calculated a 17 percent improvement. With hospital construction and the realization of such improvement measures, a corresponding benefit is expected in the form of earlier patient recovery and superior personnel work performance.

Environment Criteria	Patients' rooms applicable to all wards	Sisters' offices/treatment rooms/ hallways etc.	Hospital facade and grounds, including main entrance	Environment / Infrastructure
<p>Functional (use value)</p> <ul style="list-style-type: none"> - Layout (size) - Breakdown of space - Connections to bathroom, hallways, sister offices, and other rooms (central location, easy contact) - Easy-to-maintain materials - (childproof) plugs, light switches and emergency call buttons, (accessibility and ease of use), windows, electrical items (TV, radio (individually activated, with headphones), equipment for therapy) - Corridors suitable for patients (space for gurneys, wheelchairs, etc.), accessibility to all daily necessities; surrounding views in relationship to each other - Overnight rooms for parents (children's ward) - Available furnishings / comfort - Quiet room (maternity ward) - Sanitary facilities (washrooms, communal bathrooms, suitable for children) - Beds (compatible with their function, adjustable) - Night stands (accessibility, ease of use, (suitable for children) - Appropriate lighting (bedside and individually regulated 	<ul style="list-style-type: none"> - Size, height, and number of rooms and storage space in near vicinity with respect to - Breakdown of space - easy-to-maintain materials, stairs, corridors, supplied with electrical connections, heating - functional spaces: rooms for heating systems, storage, washing etc - Stairwells (practical, clean) - Equipment of corridors (wash basins, disinfectant dispensers to counter the spread of germs, trolleys with treatment equipment, handrails for patients etc.) - Seating areas/waiting room - available? - recreational facilities, privacy - can be modified? - Access for the disabled - Handrails for patients - Corridors for gurneys, trolleys etc. - Visitor restrooms - Location - Cleanliness, hygiene - Sister offices (centrally located) - Reception/ treatment rooms - Central location - Rooms signposted - Way-finding using signs and colored markers 	<ul style="list-style-type: none"> - Convenient and efficient location of trash cans; child-proof materials - Cost of maintenance - Protection against rain (roof); size of grounds for various functions; parking spaces, helicopter landing pad, pathways, accommodation for emergency medical services, useful plants, facilities for relaxation, storage depots, fleet of vehicles, etc. - Doors (width; automatic or manual) - Elevators (height of control panel, width) - Information boards, colored markers - Floor plan - Telephone booths (location, number) - Shop/snack-bar - Consideration for steps, corridors, lighting and handrails for patients, and entrances suitable for the disabled (using wheelchairs, gurneys, stretchers etc.) 	<p>Distances and links to other medical and social services,shops, etc.</p> <ul style="list-style-type: none"> - Transport links: tramway/subway ; bus - Road network - Signposting - Highway (airport) - Traffic safety, protection from crime - Footpaths - Shop/Kiosk, etc. - Childproof ponds or lakes, safe playgrounds - Sidewalks, ramps for wheelchairs, pushchairs - Pathways, steps, routes and corridors suitable for the disabled - Florists - Bookshops - Grocery store/shop 	

Table 5 System to judge the quality of hospital buildings (cf. Walden, 2005)

Environment Criteria	Patients' rooms applicable to all wards	Sisters' offices/treatment rooms/ hallways etc.	Hospital facade and grounds, including main entrance	Environment / Infrastructure
Functional (use value)	<ul style="list-style-type: none"> - Wardrobes (height, size, lockable) - Telephones - Heating/air-conditioning (that can be regulated) 	<ul style="list-style-type: none"> - Emergency exits; well signposted and marked) / smoke alarms - Fire extinguishers (readily available, signposted) / sprinkler systems - Fire doors / surveillance cameras - Floor coverings (smooth, flat, non-slip) - Lockers for staff/ checkroom - Air conditioning (that can be regulated) 		
Aesthetic (form, geometry etc.)	<ul style="list-style-type: none"> - Colors, forms, surface materials (ceilings, walls, floor coverings, windows, doors) - View from windows - Type of light / direction of light (natural, from the windows, view), protection from the sun (blinds) - Design (suitable for children, friendly) - Friendly, personal things 	<ul style="list-style-type: none"> Colors, forms, surface materials - Stairs, walls, ceilings, floor coverings, (flagstones, PVC, etc.), wallpaper, tiling, window seats and frames - View from the windows and light coming through them, brightness (natural light, windows, view), protection from the sun (blinds) - Decorations, flowers - Traces left by users (dilapidation; destruction of serviceability; signs of individual alterations, e.g. brightening up/improvements made by users/staff) - Friendly, light, personal things Originality of the design. 	<ul style="list-style-type: none"> Colors, forms, surface materials - Roof, facade, balconies, gates, entrances, etc. - Plant arrangements - Blends in with neighborhood - Type of paving (Tarmac, slabs, paved, etc.) - Traces left by users (dilapidation; destruction of serviceability; signs of individual alterations, e.g. brightening up/improvements made by users/staff) 	<ul style="list-style-type: none"> Uniformity, attractiveness, complexity, interest - Suitability for the environment (commercial, industrial and living quarters, nature etc.) - Removal of dirt - Upkeep

Table 5 System to judge the quality of hospital buildings (cf. Walden, 2005)

Environment Criteria	Patients' rooms applicable to all wards	Sisters' offices/treatment rooms/ hallways etc.	Hospital facade and grounds, including main entrance	Environment / Infrastructure
<p>Social (value for communication)</p> <ul style="list-style-type: none"> - Density (dependent on size and use: number of patients per room) - possible conflicts in use between patients - viewing contact /connections between patients and guests - curtains for privacy - Feeling of constriction due to bed layout - Atmosphere (hectic, noise level, quiet) 	<ul style="list-style-type: none"> - Direction (of sun and light intensity) - Clocks for thermostats - Temperature, noise, air, humidity, smells (opportunity to regulate these) - Ecological quality of materials used (effluvium) 	<p>Possible conflicts in the use of communally-used spaces (hallway, ward bathroom, patient and staff restrooms/ kitchen, etc.)</p> <ul style="list-style-type: none"> - Routes, corridors: patients, staff, visitors - recreational facilities; privacy, roller shutters - Visual connections from seat height - Atmosphere (hectic, noise levels, quiet) - Communal room (playroom, library, smokers' room/smoking zone also for visitor use) - Visitor's room - Kitchen with tea-making facilities - Staff room 	<p>Division and links to neighboring houses (fences, gates, walls, alcoves (cut off from view))</p> <ul style="list-style-type: none"> - Benches in the park for patients and visitors to meet on - Design of park area (table tennis, chess, checkers) - Recreational facilities, privacy - Central/ information/ registration (central location) - Information board - Cafeteria - Opportunities to sit down in main entrance area (availability, adjustable seating, recreational facilities, privacy) 	<p>Availability of playgrounds, benches, pedestrian areas, churches, etc.</p> <ul style="list-style-type: none"> - Frequency - Density - Courtilike layout vs. anonymity - Positive insights and perspectives; positive controls (helpful attitude, protection from crime)
<p>Ecological value</p>			<ul style="list-style-type: none"> - Flora and fauna - Natural paths (pavements) directions/ - signposting - Insulation from noise made by neighbors and traffic (helicopter, traffic, railways, etc.) - Water games for children and for relaxation in the park - Thermal insulation 	<p>Trees, parks, lakes, streams/rivers;</p> <ul style="list-style-type: none"> - toxic emissions, wind, thermodynamics, formation of gases from rivers and roads; residential streets - Security on footpaths (lighting) - Waste management and its utilization - Sporting facilities - High-voltage power lines

Table 5 System to judge the quality of hospital buildings (cf. Walden, 2005)

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